WAPCOS LIMITED
(भारत सरकार का उपक्रम)
जल शक्ति मंत्रालय
(A Government of India Undertaking)
Ministry of Jal Shakti

TENDER DOCUMENT FOR

Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.

Tender No.: WAP/CMU-II/2023-24/IIT(ISM)/Centenary Building/35

Date: 15-12-2023

WAPCOS LIMITED (A GOVT. OF INDIA UNDERTAKING)
76-C, Institutional Area, Sector-18, Gurugram,
Haryana-122015

December, 2023

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DISCLAIMER

WAPCOS Limited has prepared this document as Project Management Consultant to give information on the Project to the interested Bidder. The information is provided to Bidders on the terms and conditions set out in this document and any other terms and conditions subject to which such information is provided.

The purpose of this document is to provide Bidders with information to assist the formulation of their Bid. The information is not intended to be exhaustive. Bidders are required to make their own inquiries and respondents will be required to confirm in writing that they have done so and they do not rely solely on the information in the document.

The information is provided on the basis that it is non-binding on WAPCOS Limited, any of its authorities or agencies or subsidiaries or any of their respective officers, employees, agents or advisors.

WAPCOS reserves the right not to proceed with the Project or to change the configuration of the Project, to alter the timetable reflected in this document or to change the process or procedure to be applied. It also reserves the right to decline to discuss the Project further with any party submitting the Bid.

While WAPCOS Limited have taken due care in the preparation of the information contained herein and believe it to be accurate WAPCOS Limited, any of its authorities or agencies nor any of their respective officers, employees, agents or advisors gives any warranty or make any representations, express or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it.

NOTICE INVITING TENDER (NIT)

NOTICE INVITING TENDER (NIT)

NIT No. WAP/CMU-II/2023-24/IIT(ISM)/Centenary Building/35 **Dated 15-12-2023**

WAPCOS Limited (A Govt. of India Undertaking), for and behalf of Indian Institute of Technology (Indian School of Mines), Dhanbad, invites **"Online Electronic Tenders"** on **"Percentage Rate Engineering Procurement and Construction (EPC) mode - I"** from experienced, competent and eligible bidders in a two-envelope system as per below:

1.	**Work/ Project**	Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.
2.	Site / Location	Indian Institute of Technology (Indian School of Mines), Dhanbad Main Campus and Nirsa Campus.
3.	Website for viewing tender, Corrigendum/ Addendum, if any.	www.wapcos.co.in & www.etenders.gov.in/eprocure
4.	Website for Registration/ uploading of Tender	www.etenders.gov.in/eprocure
5.	Estimated Cost of Work / NIT Cost	Rs. 131,67,54,019/- including GST (One Hundred Thirty One Crore Sixty Seven Lakhs Fifty Four Thousand and Nineteen Rupees Only)
6.	Cost of Tender Document	NIL
7.	Earnest Money Deposit (EMD) / Bid Security	Rs. 1,41,67,540/- (One Crore Forty One Lakh Sixty Seven Thousand Five Hundred and Forty Rupees Only) (Refundable) in the form of Insurance Surety Bonds/ Account Payee Demand Draft/ Fixed Deposit Receipt/ Banker's Cheque or Payment through RTGS/ NEFT in favor of 'WAPCOS Limited' payable at Gurugram, Haryana. OR A part of EMD is acceptable in the form of Bank Guarantee including e- Bank Guarantee also. In this cases Rs. 20 lakhs EMD to be deposited in shape prescribed above and balance Rs. 1,21,67,540/- (One Crore Twenty One Lakhs Sixty Seven Thousand Five Hundred and Forty Rupees Only) will be accepted in form of Bank Guarantee issued by Nationalized/ Scheduled Commercial Bank approved by Reserve Bank of India (RBI). The bank account as per details:

		Name of Bank: Indian Overseas Bank Bank Account Number: 193502000000290 IFSC Code: IOBA0001935 Branch Name: National Horticulture Board (NHB) Building, G-85, Industrial Area, Sector-18, Gurugram-122015, Haryana **Note: Bid Security shall remain valid for a period of 45 days beyond final bid validity period**.
8.	Solvency Certificate - **specific to this Bid submission only and mentioning the name of the work/project**	Rs. 52,67,01,608 (Fifty Two Crore Sixty Seven Lakhs One Thousand Six Hundred and Eight Rupees Only) in original from a Nationalized/ Scheduled Commercial Bank approved by Reserve Bank of India (RBI). The Certificate should be issued between the publishing of NIT & last date of submission of Bids, including extensions if any and shall be addressed to WAPCOS Limited, 76-C, Institutional Area, Sector-18, Gurugram, Haryana quoting the name of the work. The certificate should carry name, designation of the bank official, who has the authority to issue Solvency Certificate. **Note:** This Certificates will be verified from the issuing authority by WAPCOS.
9.	Project Completion Period	24 Months (3 Months for Planning & Designing and Obtaining Approvals and 21 Months for Execution of Original works) from the Date of Award
10.	Bid Validity Period	180 days from the date of opening of Technical bid
11.	Site Visit	Bidders are advised/encouraged to visit the site for actual assessment of the project site location and its consequences during execution of work
12.	Pre Bid Meeting	21/12/2023 at 17:00 hours to be held in the office of Addl. Chief Engineer, WAPCOS Limited Office at CMU Building, IIT (ISM) Dhanbad Campus
13.	Last date & time for online submission of Technical & Financial Bid	29/12/2023 up to 17:00 hours
14.	Offline Submission of Technical document, Tender Fees, EMD and Solvency etc. as detail in Tender for bidders**.**	29/12/2023 up to 17:00 hours in the office of Addl. Chief Engineer, WAPCOS Limited Office at CMU Building, IIT (ISM) Dhanbad Campus
15.	Online opening of Technical Bid	01/01/2024 at 17:30 hours
16.	Online opening of Financial Bid	Intimated to Technical Qualified Bidders.
17.	Tender Inviting Authority & Communication address during Tendering and Execution of Works	Addl. Chief Engineer WAPCOS Limited Office at CMU Building, IIT (ISM) Dhanbad Campus, Dhanbad, Jharkhand-826004 **Email:** rd@wapcos.co.in; ssm@wapcos.co.in **Contact No**. +91-124-2399830
18.	The Bid Security/ EMD / Solvency Certificate / BG against Performance Security/ BG against	WAPCOS Limited 76-C, Institution Area Sector-18, Gurugram, Haryana-122015

	Mobilization Advance/ shall be addressed to WAPCOS Corporate Office	

- The tender document has to be viewed/ downloaded from above specified websites. Bidders are advised to visit above specified websites regularly for updates /Amendments/ Corrigendum, if any and not be published elsewhere. The Updates/Corrigendum/Addendum shall be followed up to submission of tender and it will be the part of tender.
- The purpose of this NIT is to provide interested parties with information to assist the preparation of their bid. While WAPCOS Limited has taken due care in the preparation of the information contained herein, and believe it to be complete and accurate, neither it nor any of its authorities or agencies nor any of its respective officers, employees, agents or advisors give any warranty or make any representations, expressed or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it. The Bidders must read all the terms and conditions of bidding document carefully and only submit the bid, if eligible and in possession of all the documents required. Corrigendum while all efforts have been made to avoid errors in the drafting of the tender documents, the Bidder is advised to check the same carefully. No claim on account of any errors detected in the tender documents shall be entertained.
- Further, WAPCOS Limited does not claim that the information is exhaustive. Respondents to this NIT are required to make their own inquiries/ surveys and will be required to confirm, in writing, that they have done so and they did not rely solely on the information in NIT. WAPCOS Limited is not responsible if no due diligence is performed by the bidders.
- If the office of WAPCOS Limited happens to be closed on the last date and time mentioned for any of the event, the said event will take place on the next working day at the same time and venue.
- WAPCOS Ltd. reserves the right to accept or reject any or all bids without assigning any reasons. No Bidder shall have any cause of action or claim against the WAPCOS Ltd. For rejection of his Bid and will not be bound to accept the lowest or any other tender.
- No reimbursement of cost of any type or on any account will be paid to persons or entities submitting their Bid.
- All information submitted in response to this NIT shall be the property of WAPCOS Limited and it shall be free to use the concept of the same at its will.
- It is hereby declared that WAPCOS is committed to follow the principle of transparency, equity and competitiveness in public procurement. The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the Bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer/bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected. This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the WAPCOS.

For and on behalf of WAPCOS LIMITED
Additional Chief Engineer

SECTION– I

INSTRUCTIONS TO BIDDER

SECTION– I
INSTRUCTIONS TO BIDDER

1.0 SPECIAL INSTRUCTIONS TO BIDDERS FOR E-TENDERING

1.1 GENERAL

Submission of Online Bids is mandatory for this Tender. E-Tendering is a methodology for conducting Public Procurement in a transparent and secured manner. For conducting electronic tendering, bidders shall use the portal www.etenders.gov.in/eprocure. Tender is invited in Single Stage -Two Envelope system, one Technical Bid and second as financial bid. Accordingly, bidder is directed to make all formalities and registration on www.etenders.gov.in/eprocure website and submit the Technical Bid and Financial bid.

The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.

More information useful for submitting online bids on the CPP Portal may be obtained from website: https://etenders.gov.in/eprocure/app**.**

1.2 REGISTRATION

a) Bidders are required to enroll on the e-Procurement module of the Central Public Procurement Portal (URL: https://etenders.gov.in/eprocure/app) by clicking on the link "Online bidder Enrollment" on the CPP Portal which is free of charge.
b) As part of the enrolment process, the bidders will be required to choose a unique username and assign a password for their accounts.
c) Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
d) Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.
e) Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC's to others which may lead to misuse.
f) Bidder then logs in to the site through the secured log-in by entering their user ID /password and the password of the DSC / e-Token.

1.3 SEARCHING FOR TENDER DOCUMENTS

a) There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.
b) Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective 'My Tenders' folder. This would enable the CPP Portal to intimate the bidders through SMS / e- mail in case there is any corrigendum issued to the tender document.
c) The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

1.4 PREPARATION OF BIDS

a) Bidder should take into account any corrigendum, Addendum published on the web portal along with tender document before submitting their bids.

b) Bidder should read the tender document, corrigendum, Addendum and any other related correspondence, carefully to understand the documents required to be submitted as part of the bid.
c) Bidder, in advance, should get ready the bid documents to be submitted as indicated in the tender document / schedule and generally, they can be in PDF / XLS / RAR / DWF/JPG formats. Bid documents may be scanned with 100 dpi with black and white option which helps in reducing size of the scanned document.

1.5 SUBMISSION OF BIDS

a) Please uninstall any Java version if installed already. Then go to this link https://eprocure.gov.in/cppp/jre-windows-i586.exe and download this prescribed version of java for this portal.
b) Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.
c) Bidder should log into the site well in advance for bid submission so that they can upload the bid in time i.e. on or before the bid submission time. Bidder will be responsible for any delay due to other issues.
d) The bidder has to digitally sign and upload the required bid documents one by one as indicated in the tender document.
e) Bidder has to select the payment option as "offline" to pay the tender fee / EMD as applicable and enter details of the instrument.
f) Bidder should prepare the EMD as per the instructions specified in the tender document. The original should be posted/couriered/given in person to the concerned official, latest by the last date of bid submission or as specified in the tender documents. The details of the DD/any other accepted instrument, physically sent, should tally with the details available in the scanned copy and the data entered during bid submission time. Otherwise the uploaded bid will be rejected.
g) Bidders are requested to note that they should necessarily submit their financial bids in the format provided and no other format is acceptable. If the price bid has been given as a standard BoQ format with the tender document, then the same is to be downloaded and to be filled by all the bidders. Bidders are required to download the BoQ file, open it and complete the white coloured (unprotected) cells with their respective financial quotes and other details (such as name of the bidder). No other cells should be changed. Once the details have been completed, the bidder should save it and submit it online, without changing the filename. If the BoQ file is found to be modified by the bidder, the bid will be rejected.
h) The server time (which is displayed on the bidders' dashboard) will be considered as the standard time for referencing the deadlines for submission of the bids by the bidders, opening of bids etc. The bidders should follow this time during bid submission.
i) All the documents being submitted by the bidders would be encrypted using PKI encryption techniques to ensure the secrecy of the data. The data entered cannot be viewed by unauthorized persons until the time of bid opening. The confidentiality of the bids is maintained using the secured Socket Layer 128 bit encryption technology. Data storage encryption of sensitive fields is done. Any bid document that is uploaded to the server is subjected to symmetric encryption using a system generated symmetric key. Further this key is subjected to asymmetric encryption using buyers/bid opener's public keys. Overall, the uploaded tender documents become readable only after the tender opening by the authorized bid openers.
j) The uploaded tender documents become readable only after the tender opening by the authorized bid openers.
k) Upon the successful and timely submission of bids (i.e. after Clicking "Freeze Bid Submission" in the portal), the portal will give a successful bid submission message & a bid summary will be displayed with the bid no. and the date & time of submission of the bid with all other relevant details.

l) The bid summary has to be printed and kept as an acknowledgement of the submission of the bid. This acknowledgement may be used as an entry pass for any bid opening meetings.

1.6 ASSISTANCE TO BIDDERS

a) Any queries relating to the tender document and the terms and conditions contained therein should be addressed to the Tender Inviting Authority for a tender or the relevant contact person indicated in the tender.
b) Any queries relating to the process of online bid submission or queries relating to CPP Portal in general may be directed to the 24x7 CPP Portal Helpdesk.
c) In case of any discrepancy, the online version of the bids uploaded on CPP Portal shall be considered as final. The clarifications, if sought from the bidder, and submitted by bidder through email / hard copy through courier shall be considered.
d) The financial bid is not to be submitted in sealed cover physically. However, the same is to be uploaded online only.
e) The contents of the Technical Bid and Financial Bid shall be as detailed under relevant clauses of ITB herein.

2.0 INSTRUCTIONS TO BIDDER

The purpose of these instructions to serve as a guide to Bidders for preparing offer for carrying out the project in all respect.

a) Submission of a tender by a tenderer implies that the bidder has read Each Section of Tender Document, Corrigendum, Addendum and other related correspondence and has made himself aware about the complete scope of work under the tender document. Accordingly, Contract shall be governed by each Section of Tender Document and all other Conditions mentioned in the tender documents.
b) WAPCOS Limited desires that the bidders, suppliers, and sub-contractors under the Project, observe the highest standard of ethics during the performance, procurement and execution of such contracts. In pursuance of this requirement, WAPCOS Limited, defines, for the purposes of this provision, the terms set forth below:
   i. "Corrupt Practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party;
   ii. "Fraudulent Practice" means any act of submission of forged documentation, or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation, or to succeed in a competitive bidding process;
   iii. "Coercive Practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to influence improperly the actions of a party;
   iv. "Collusive Practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party.

Will reject the award of Contract, even at a later stage, if it determines that the bidder recommended/ selected for award/awarded has, directly or through an agent, engaged in Corrupt, Fraudulent, Collusive, Or Coercive Practices incompeting for the Contract; Will sanction a party or its successors, including declaring ineligible, either indefinitely or for a stated period of time, to participate in any further bidding/procurement proceedings under the Project, if it at any time determines that the party has, directly or through an agent, engaged in Corrupt, Fraudulent, Collusive, Or Coercive Practices in competing for, or in executing, the contract; and the party may be required to sign an Integrity Pact, if required; and WAPCOS Limited will have the right to require the bidders, or its suppliers, contractors and consultants to permit WAPCOS Limited to inspect their accounts and records and other documents relating to the bid submission and contract performance and to have them audited by

auditors appointed by WAPCOS Limited at the cost of the bidders.

The Bidder must obtain for himself on his own responsibility and at his own expenses all the information which may be necessary for the purpose of making a bid and for entering into a contract, must examine the Drawings, must inspect the sites of the work, acquaint himself with all local conditions, means of access to the work, nature of the work and all matters pertaining thereto. WAPCOS Limited will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

a) All Bidders are hereby explicitly informed that conditional offers or offers with deviations from the Conditions of Contract, the bids not meeting the minimum eligibility criteria, Technical Bids not accompanied with EMD and Tender Document Fees of requisite amount in acceptable format, Bids in altered/modified formats, or in deviation with any other requirements stipulated in the tender documents are liable to be rejected.
b) The company reserves the right to waive minor deviations if they do not materially affect the capability of the Tenderer to perform the contract
c) The bidders shall not tamper or modify any part of the tender documents in any manner. In case in part of the bid is found to be tampered or modified at any stage, the bids are liable to be rejected, the contract is liable to be terminated and the full earnest deposit/retention money/performance guarantee will be forfeited and the bidder will be liable to be banned from doing any business with WAPCOS Limited.
d) Incomplete Price bid shall be liable to be rejected, at the discretion of WAPCOS Limited. The total bid price shall cover the entire scope of works covered in the tender.

3.0 EARNEST MONEY DEPOSIT (EMD) / BID SECURITY

The Earnest Money Deposit shall be as per the details mentioned in NIT. EMD shall not carry any interest. The Bid Security/ EMD of the unsuccessful bidder shall be returned at the earliest after expiry of final bid validity period and latest by 30th days after the award of the contract. Bid Security shall be refunded to the successful bidder on receipt of Performance Security.

Online Bid documents submitted by intending bidders shall be opened only of those bidders, whose EMD will be received within stipulated time.

The successful bidder shall accept the Letter of Award (LOA) within 15 (Fifteen) days from receipt of the same, failing which the EMD shall be forfeited and the award of work may be liable to be cancelled.

If any bidder withdraws or make any changes in his offer already submitted before the expiry of the validity period or any extension thereof without the written consent of the company, the EMD amount will be forfeited for such act of the bidder.

WAPCOS Limited reserves the right of forfeiture of Earnest Money deposit (EMD) in case of the successful bidder.

i. After opening of Tender, revokes his tender within the validity period or increases his earlier quoted rates.
ii. Does not commence the work within the period as per LOA/Contract. In case the LOA/Contract is silent in this regard then within 15 days after award of contract.

The Bid Security will be forfeited in the bidder

i) withdraws or amends its/ his tender;
ii) impairs or derogates from the tender in any respect within the period of validity of the tender;
iii) If the bidder does not accept the correction of his bid price during evaluation; and
iv) If the successful bidder fails to sign the contract or furnish the required performance security within the specified period.

4.0 LANGUAGE OF BID

The Bid and all related correspondence and documents relating to the Project shall be in English language. Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied by an accurate English translation which shall be certified by a qualified translator. Any material that is submitted in a language other than English and which is not accompanied by an accurate English translation will not be considered.

5.0 BIDDERS RESPONSIBILITY

The Bidder is solely responsible for the details of their Bid and the preparation of bids. In no case shall the WAPCOS be responsible for any part of the tender documents submitted by him. Any Site information given in this tender document is for guidance only. The Bidder is advised to visit and examine the Site of works and its surroundings at their cost and obtain for themself on their own responsibility, all information that may be necessary for preparing the tender and entering into a Contract. Irrespective of whether or not the Bidders have attended the pre-bid meeting, they shall be deemed to have inspected the Site and its surroundings beforehand and taken into account all relevant factors pertaining to the Site and clarifications/ modifications/ additions given in Pre-Bid meeting or addendum issued in the preparation and submission of the Bid.

The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs. WAPCOS Limited shall in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

6.0 PERIOD OF COMPLETION

The completion period shall be as per NIT. The completion period is for the entire work of planning, execution, approvals, arrangement of materials, equipment, delivery at site including transportation, construction/ installation, testing, commissioning, NoCs & statutory approvals from local bodies and successfully handing over of the entire project to the satisfaction of the Principal Employer/ Employer.

7.0 AMENDMENT OF BID DOCUMENTS

At any time prior to the deadline for submission of bids, the Employer may, for any reason (s), whether at their own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by the issuance of a corrigendum/ addendum. No modification of Bid shall be permissible after last date of submission, whatever may be the reason. The Employer may at their discretion may extend the deadline for submission of Tender/ Bid, if considered necessary.
Any corrigendum/ addendum thus issued shall be part of the bidding documents. Prospective Bidders shall download the same from the e-portal and submit along with the submission of Bid as token of acceptance.

8.0 BID VALIDITY PERIOD

Bids validity will be as per NIT. In exceptional circumstances, on expiry / prior to expiry of original bid validity period, the WAPCOS may request the successful bidder for a specified extension in the period of validity. A Bidder may accept OR refuse the request of extension of validity period. A Bidder agreeing Extension of validity period will not be required/nor permitted to modify his bid. In case of refuse of request of extension of validity period tender will be cancelled.

9.0 CURRENCY OF BID

Bid prices shall be quoted in Indian Rupees.

SECTION– II

SELECTION AND QUALIFYING CRITERIA

SECTION-II

SELECTION AND QUALIFYING CRITERIA

1.0 SITE VISIT

- The Intending Bidder(s) are advised to inspect and examine the sites at their own cost and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid. A Bidder(s) shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed.
- The bidder(s) shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder(s) implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.
- The bidder and any of its personnel or agents will be granted permission by the Employer/Owner to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel, and agents will release and Indemnify the Employer/Owner and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

2.0 PRE-BID MEETING

Prospective Bidder requiring any clarification of the bidding documents may notify the Employer via email mentioned in NIT, at least one working day prior to pre-bid meeting. The queries shall be discussed during the pre-bid meeting. Thereafter no further queries/clarifications shall be entertained. The Employer will reply to only those queries which are received before the scheduled time as mentioned above, which are essentially required for submission of bids. The Employer will not reply to the queries which are not considered fit like replies of which can be implied /found in the NIT/Tender Documents or which are not relevant or in contravention to NIT/Tender Documents.

The pre-bid meeting shall be held at the communication address mentioned in NIT. The Addendum/ Corrigendum/Replies to pre bid queries as per Pre bid meeting, shall be uploaded on e-portal & WAPCOS website.

3.0 QUALIFYING CRITERIA: ONLINE TECHNICAL BID SUBMISSION

The intending bidders should only submit bid if he considers himself eligible and possess all the required documents. The Technical Bid shall be uploaded **with coloured scanned copies of following documents. All the documents must be Serial wise as stated below along with check list and clearly marked page no. on each page**

Content of Check List
Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar

Content of Check List				
Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.				
S. No	**Particular of Document**	**Yes**	**No**	**Page Nos. (from – to)**
a)	Authority to Sign the Tender a) In case of proprietary firm, the Proprietor shall sign with full name, current address OR by the authorized person holding Notarized Power of Attorney issued by the Proprietor for signing of business proposal. The Power of Attorney shall **be submitted in original and shall be specific to this Bid submission only and mentioning the name of the work/project** b) In case of a Limited Company or Corporation, the Application shall be signed by an authorized person holding the Power of Attorney for signing of business proposal. A certified copy of the Power of Attorney shall accompany the Application. **Note:** Power of Attorney duly notarized and on a stamp paper of appropriate value, issued for signing the tender documents, make corrections/ modifications, to interact with the Employer and act as the contact person, shall be submitted along with Technical Bid.			
b)	Scanned copy of EMD Documents.			
c)	Letter of Transmittal For Technical Bid and Financial bid along with Declaration by the Bidder on bidder's original letter Head as per given format			
d)	Bidder shall submit "**Financial Information"** regarding Turnover, Profit/Loss and Net Worth certificate for Last 5 (five) years ending on the financial year 2022-23 in **Form-A** duly certified by Statutory Auditor of the firm/company which must carry **UDIN (Unique Document Identification Number)**. • **Profit / loss (after Tax):** The Bidder should not have incurred any loss (profit after tax should be positive) in more than two years during last five years ending 2022-23 duly audited and Attested by the Independent Chartered Accountant. • **Turnover:** Average annual financial turnover on construction works should be at least 50% of the estimated cost of work during the immediate last 3 consecutive financial years ending 2022-23. This should be duly audited by the Chartered Accountant doing Statutory Audit. • **Net Worth:** Net worth of the Bidder should be positive during the last financial year 2022-23. The requisite certificates must be certified by statutory auditor of the firm/company. • Bidder shall attach Balance Sheet and Profit & loss Statement, duly audited by Statutory Auditor of the			

Content of Check List				
	firm for last 5 (five) years ending on the financial year 2022-23 in support of **Form-A** **Note: There is no need to upload entire voluminous balance sheet. However, summarized balance sheet (Audited) and summarized Profit & Loss Account (Audited) for last 05 years shall be uploaded.**			
e)	**Solvency Certificate** The bidder should not be insolvent, in receivership, bankrupt or being wound up, not have had their business activities suspended. Bank Solvency Certificate issued from a Nationalized / Scheduled Commercial Bank approved by Reserve Bank of India (RBI) should be at least 40% of the estimated cost of the work. **The Certificate should be issued between the publishing of NIT & last date of submission of Bids, including extensions if any** and shall be addressed to WAPCOS Limited, 76-C, Institutional Area, Sector-18, Gurugram, Haryana **specific to this Bid submission only and mentioning the name of the work/project. The certificate shall be submitted in original and the colour / b&w copy / scanned copy shall not be accepted.** The certificate should carry name, designation of the bank official, who has the authority to issue Solvency Certificate. **(Form-B)** **Note:** This Certificate will be verified from the issuing authority by WAPCOS.			
f)	**Completed Similar Work Criteria:** The bidder should have satisfactorily completed the similar types of works as mentioned below during the last 7 (seven) years (Form-C) ending previous day of last date of submission of tender. i) One similar completed work costing not less than 80% of the estimated cost of work. Or ii) Two similar completed works of order value each not less than 50% of the estimated cost of work. Or iii) Three similar completed works of order value not less than 40% of the estimated cost of work. Note: **Similar work** shall mean "Construction of residential and or non-residential building(s) with RCC frame structure having minimum one building of Five storey or completing balance construction work of one building (i/c structural work) minimum up to Five storey i/c internal water supply, sanitary installation, sewerage drainage, internal & external EIectrical works, public address system, fire fighting & fire alarm system,CCTV & data networking system, lifts, DG sets, substation equipment etc." The value of executed works shall be brought to the current			

Content of Check List				
	level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the actual date of completion mentioned in the completion certificate to the date of floating of this tender. Components of work executed other than those included in definition of similar work shall be deducted while calculating the cost of similar work. RCC framed structure shall be of RCC slab, beams & columns. The bidder shall submit abstract of cost of work along with supporting documents and certificate issued by the experience issuing authority in support of this. I. Mumty and machine room shall not be reckoned in storey. II. Each basement, stilt constructed in the building shall be considered as a storey. III. E & M services etc., if executed under a separate contract may also be considered for the purpose of assessing the technical competence only without adding its monetary value for determining the eligibility criteria. The bidder's shall submit Completion Certificate(s) mentioning name, nature of work(s), value(s) of the job(s), date(s) of commencement, stipulated date(s) of completion and actual date(s) of completion along-with LOI(s)/W.O(s) from respective Owner(s)/Client(s). The past experience in similar nature of work and also for additional experience should be supported by certificates issued by the Client's organization. In case, the works / certificates are not verified by the issuing authority, WAPCOS reserves the right to not consider for the award of works. For work experience of private sector, the completion certificates shall be supported with copies of corresponding TDS certificates. In case of mismatch in value in TDS certificate & completion certificate, then value mentioned in TDS certificate will be considered during evaluation. For EPC tenders under Mode I Experience of having successfully completed one work during the last 7 years ending last day of the month previous to the one in which tenders are invited One completed work costing not less than 20% of the estimated cost put to tender or Rs 200 crore, whichever is less executed with the structural system technology, as proposed by bidder in the letter of transmittal. This work can be part of eligible work at (g) above (Completed Similar Work) or as a separate work.			

Content of Check List				
	Note: The completion / experience certificates, along with the supporting documents, shall be got verified from the issuing authority / organizations prior to opening of Financial Bid			
g)	List of Projects under execution **(Form - C1)**			
h)	Performance Report **(Form - D)**			
i)	**Verification of Solvency Certificate and Completion & Performance Certificates**. Verification should be done from the official email id of issuing Authorities. The bidder will provide official e-mail, Landline number of the Issuing Authorities in prescribed **Form-'B-1'** with undertaking. Bidder will ensure the email ids and landline are in working condition.			
j)	**Bid Capacity** as prescribed in **Form-E**. The bidding capacity of the Contractor should be equal to or more than the estimated cost of the work put to tender. The bidder should possess the bidding capacity as calculated by the specified formula. The formula generally used is: **Available bid capacity = A x 1.5 x N – B, where** A = Maximum value of engineering (Civil/ Electrical/ Mechanical as relevant to work being procured) works executed in any one year during the last five years (updated at the current price level), taking into account the completed as well as works in progress. N = Number of years prescribed for completion of the work in question. B = Value (updated at the current price level) of the existing commitments and ongoing works to be completed in the next 'N' years. **NOTE:** The bidder shall furnish statements showing the value of existing commitments and on-going works as well as stipulated period of completion remaining for each of the works separately. The value of executed works shall be brought to the current level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the actual date of completion mentioned in the completion certificate to the date of floating of this tender.			
k)	**EPF Registration:** The agency should have EPF registration.			
l)	**GST Registration & PAN:** Bidder shall submit valid GST registration certificate for the state where work is to be executed and PAN Card. If not registered till date of submission of bid, bidder will give undertaking on bidder letter head stating that they will get			

Content of Check List				
	registered in GST as per Govt. norms before submitting of 1st bill of executed works.			
m)	**Indian Registered Company:** The bidder should be an Indian Registered Company under Companies Act 1956/ Proprietorship Firm/ Partnership Firm. **Joint ventures are not accepted**. Copy of Certificate of Incorporation/ Registration/ Partnership Deed Registration or any other relevant document, as applicable, should be submitted along with a copy of address proof. **NOTE:** Proprietor firms shall submit registration details or shall submit the copy of relevant page of Pass book for the Current Account in the name of Proprietor Firm.			
n)	**Structure & Organization:** The bidder will submit Name, address, details of the organization, Name(s) of the Owner/partners/promoters and Directors of the firm/ company as prescribed in **Form-F**.			
o)	**Undertaking for Manpower Deployment:** The bidder will submit "**Undertaking for Manpower Deployment"** as prescribed in **Form-G.**			
p)	**Non - Conviction Certificate:** The bidder will submit the undertaking regarding **"Non – Conviction Certificate"** as prescribed in **Form-H.**			
q)	**No Deviation Certificate:** The bidder will submit **'No Deviation Certificate'** as prescribed in **Form-I.**			
r)	**Undertaking regarding Blacklisting / Non Debarment** The bidder will submit the "Undertaking regarding Blacklisting / Non Debarment" as prescribed in **Form-J.**			
s)	**Undertaking regarding Restriction under Rule 144(XI) of the General Finance Rules (GFRs) 2017** The bidder will submit the "Undertaking regarding Restriction under Rule 144(XI) of the General Finance Rules (GFRs) 2017" as prescribed in **Form -K**.			
t)	**Understanding The Project Site** The bidder will submit the "Understanding The Project Site" as prescribed in **Form -L**.			
u)	Bidder shall submit Information on litigation history, liquidated damages, disqualification etc. in bidder Letter Head as prescribed in **Form-M.**			
v)	**Integrity Pact:** The bidder will submit **'Consent Letter to execute the Integrity Pact'** as prescribed in **Form-N.**			

Content of Check List				
w)	Copy of Valid Electrical license or an undertaking regarding electrical license.			
x)	Each page of the all Volume of Tender document & Addendum/ Corrigendum shall be Digitally signed by the bidders submitting the Tender in token of his/their having acquainted himself/ themselves and accepted the entire tender documents including various conditions of contract. Any Bid with any of the Documents not so signed is liable to be rejected at the discretion of WAPCOS Limited. ***(Do Not Submit with the document of Offline Submission)***			

4.0 OFFLINE SUBMISSIONS OF DOCUMENTS

The Bidder shall submit following Document offline in separate envelope clearly labeled as "OFFLINE DOCUMENTS" for the Work (Write Name of Work/Project as mentioned in NIT) along with Details of Bidders Address, Phone, E-mail on Envelope.

- Original Earnest Money Deposit/ Bid Security
- Original Solvency Certificate

NOTE: - The above offline documents shall be submitted by bidder on WAPCOS address as per date & time mentioned in NIT, otherwise bids will be rejected**.**

However, certified Hard copy of all the scanned and uploaded documents as specified in tender documents shall have to be submitted in two different envelop each for Technical and Financial bid written clearly on each envelop with a covering envelop clearly mentioning the work details on it by the lowest tenderer only within a week of opening of financial bid physically in the office of tender inviting authority.

5.0 CONTENTS OF FINANCIAL BID

The Financial Bid should be uploaded online before last date & time of submission of Tender Document.

Quoted amount by the Bidder with any condition shall not be accepted and same is liable to be rejected Quoted amount by the Bidder shall include all Materials, Tools & Plant, labour, supervision, profit; other levies together with all general risks, liabilities and obligations set out or implied in the contract, applicable Labour Cess, cost of insurance to this contract, all applicable tax liabilities like Income Tax & Surcharges, etc. Any other taxes /cess as per Government directives shall be deducted from each bill paid to the Contractor, from time to time. Quoted amount by the Bidder shall be inclusive of GST.

The Contractor shall submit e-invoice / Tax Invoice (as applicable for the bidder's Firms) to WAPCOS showing (i) Basic amount (ii) GST amount separately in each bill. It is mandatory to bidders to deposit GST within time limit framed by Govt. of India, if applicable. The Goods and Services Tax (GST), shall be reimbursed to the Agency only after uploading of bills by Contractor on GST Portal "to avail Input benefit of GST".

The WAPCOS shall be performing all its duties of deduction of TDS and other deduction on payment made to the contractor as per applicable legislation in force on the date of submission of bid or to be newly/amended introduced during the execution of the Contract.

6.0 OPENING OF FINANCIAL BID

The financial bids of the technically qualified bidders shall be opened at the notified date & time.

7.0 SIGNING OF THE CONTRACT

The letter of Award will be issued to the successful bidder by WAPCOS which will be duly signed & stamped by the successful bidder as token of unequivocal acceptance and confirmation within specified time period. Subsequently, successful bidder shall submit the Performance Security of required value within the specified time period. Thereafter, on specified time period, the successful Bidder or his authorized representative shall attend the office for signing of the Contract Agreement.

Failure on the part of the successful Bidder to comply with the above requirements will constitute sufficient grounds for the annulment of the Award and forfeiture of the Bid Security.

8.0 OTHER IMPORTANT INFORMATION TO BIDDERES

1. The bid submitted shall become invalid and e-Tender processing fee shall not be refunded if any:
   i. The tenderer is found ineligible.
   ii. The tenderer does not upload scanned copies of all the documents stipulated in the tender document.
   iii. If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically by the lowest tenderer in the office of tender opening authority.
   iv. If a tenderer quotes does not quote any percentage above/below/at par on the total amount of the tender or any section/sub head in percentage rate tender, the tender shall be treated as invalid and will not be considered as lowest tenderer.

2. After submission of the bid the bidder can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

3. While submitting the revised bid, the bidder can revise the rate/percentage of one or more item(s) any number of times (he need not re-enter rate of all the items) but before last time and date of submission of bid as notified.

4. WAPCOS Limited does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

5. To become eligible for issue of bid, the bidders shall have to furnish an affidavit as under:

   I/We undertake and confirm that eligible similar works(s) has/have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of Department, then I/we shall be debarred for bidding in WAPCOS in future forever. Also, if such a violation comes to the notice of WAPCOS before date of start of work, the Engineer-in-Charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.
   (Scanned copy to be uploaded at the time of submission of bid).

6. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable to rejection.

7. WAPCOS Limited reserves the right of accepting the whole or any part of the bid and the bidders shall be bound to perform the same at the rate quoted.

8. No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the previous permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the contractor's service.

9. The bid for the works shall remain open for acceptance for a period of bid validity period from the date of opening of Technical bid. Further

   i. If any tenderer withdraws his tender or makes any modification in the terms and conditions of the tender which is not acceptable to the department within 7 days after last date of submission of bids, then the WAPCOS shall without prejudice to any other right or remedy, be at liberty to forfeit 50% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.
   ii. If any tenderer withdraws his tender or makes any modification in the terms and conditions of the tender which is not acceptable to the department after expiry of 7 days after last date of submission of bids, then the WAPCOS shall without prejudice to any other right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.
   iii. In case of forfeiture of earnest money as prescribed in para (i) & (ii) above, the bidders shall not be allowed to participate in the rebidding process of the same work.

10. This notice inviting bid shall form a part of the contract document. The successful bidders/contractor, on acceptance of his bid by the Accepting Authority shall within 30 days from the stipulated date of start of the work, sign the contract consisting of:

    i. The Notice Inviting Bid, all the documents including GCC, SCC, additional conditions, specifications and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading there to.
    ii. All annexures and Form as applicable.

11. The bidder must associate himself with agencies as per NIT conditions.

12. The main contractor has to associate agencies for specialized component(s) conforming to eligibility criteria as defined in the bid document and has to submit detail of such agency(s) to Engineer-in-Charge of relevant component(s) within prescribed time. Name of the agency(s) to be associated shall be approved by Engineer-in-Charge of relevant component(s).

13. In case the main contractor intends to change any of the above agency/agencies during the operation of the contract, he shall obtain prior approval of Engineer-in-Charge of relevant specialized component.

    The new agency/agencies shall also have to satisfy the laid down eligibility criteria. In case Engineer-in-Charge is not satisfied with the performance of any agency, he can direct the contractor to change the agency executing such items of work and this shall be binding on the contractor.

14. The main contractor has to enter into MOU with agencies contractor(s) associated by him. Copy of such MOU shall be submitted to Additional chief engineer, WAPCOS Limited. In case of change

of associate contractor, the main contractor has to enter into agreement with the new contractor associated by him.

15. In case of reduction in scope of work no claim on account of reduction in value of work, loss of expected profit, consequential overheads etc. shall be entertained.

16. The information and instructions for bidders posted on website shall form part of bid document.

17. The WAPCOS reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.

18. The tenderer must associate himself with agencies of the appropriate eligibility for each of specialized nature of items / work listed below individually. Such works shall be got executed only through associated agencies specialized in these fields. The tenderer whose tender is accepted shall indicate the name(s) of his associated specialized agencies those fulfilling the eligibility criteria laid down below after award of work and at least 30 days before commencement of such items / work but within 90 days of award of work whichever is earlier for the approval of the Engineer-in-Charge of that component, whose decision shall be final and binding. If the tenderer, having valid electrical license if applicable for E.I. works, himself fulfils the eligibility criteria laid down below for associated specialized agencies, then the tenderer shall not require to associate with himself the associated specialized agency.

    Any Specialized work as below and not limited to the following (Civil and E&M) work:

    i. Anti-termite Treatment.
    ii. Water Proofing work.
    iii. Expansion joint work.
    iv. Fire fighting work.
    v. HVAC work.
    vi. PA system.
    vii. Audio Visual System Work
    viii. CCTV work.
    ix. IBMS and Scada work.
    x. Acoustic work.
    xi. Auditorium Chairs (auditorium and class room)
    xii. Fire door.
    xiii. Lift.

    For which main contractor is required to associate with specialized agency/firm/Applicator/Channel Partner for execution of work needs to be approved by Engineer In charge/IIT (ISM) Dhanbad. The tenderer shall associate specialized agencies, who have satisfactorily completed

    a. Three specialized works of similar nature of each costing not less than amount equal to 40% of value of corresponding specialized item,
        Or
    b. Two specialized works of similar nature each costing not less than amount equal to 50% of value of corresponding specialized item
        Or
    c. One similar work costing not less than amount equal to 80% of value of corresponding specialized item.

For finalization of sub agency the main contractor has to submit at least 03 nos. of vendor matching above referred criteria to the Engineer In charge.

19. The Contractor shall open an Escrow Account which will be operated jointly by the contractor and Employer. The payments as deemed fit by the Employer will be made to the contractor in that account. The Escrow Account agreement is specified in Tender documents. The Contractor shall maintain separate books of accounts for all payments under this contract and the employer shall have access to these at all times including access to bank statement of the account maintained separately for the work. No payment shall be made to contractor until escrow agreement is signed and escrow account is opened /operational.

SECTION - III

ELIGIBILITY CRITERIA

GENERAL GUIDELINES FOR BIDDERS

1.0 GENERAL

a) Letter of transmittal and forms for deciding eligibility are given in Section - IV.

b) All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a "nil" or "no such case" entry should be made in that column. If any particulars / query are not applicable in case of the bidder, it should be stated as "not applicable". The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the bid being summarily disqualified. Bids received late will not be entertained.

c) References, information and certificates from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent.

d) The bidder may furnish any additional information which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after submission of eligibility criteria document unless it is called for by the Employer.

2.0 DEFINITIONS

In this document the following words and expressions have the meaning hereby assigned to them.

a) Employer: WAPCOS Limited

b) Bidder / Tenderer: Means the individual, proprietary firm, firm in partnership, limited company private or public or corporation.

c) "Year" means "Financial Year" unless stated otherwise.

3.0 METHOD OF APPLICATION

a) If the bidder is an individual, the application shall be signed by him above his full type written name and current address.

b) If the bidder is a proprietary firm, the application shall be signed by the proprietor above his full typewritten name and the full name of his firm with its current address.

c) If the bidder is a firm in partnership, the application shall be signed by all the partners of the firm above their full typewritten names and current addresses, or, alternatively, by a partner holding power of attorney for the firm. In the later case a certified copy of the power of attorney should accompany the application. In both cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.

d) If the bidder is a limited company or a corporation, the application shall be signed by a duly authorized person holding power of attorney for signing the application accompanied by a copy

of the power of attorney. The bidder should also furnish a copy of the Memorandum of Articles of Association duly attested by a Public Notary.

4.0 FINAL DECISION MAKING AUTHORITY

The Employer reserves the right to accept or reject any bid and to annul the process and reject all bids at any time, without assigning any reason or incurring any liability to the bidders.

5.0 PARTICULARS PROVISIONAL

The particulars of the work given in Scope of Work are provisional. They are liable to change and must be considered only as advance information to assist the bidder.

6.0 INITIAL CRITERIA FOR ELIGIBILITY

All the details / conditions given in **Section - II "Selection and Qualifying Criteria"** are for deciding Initial Eligibility of the bidders.

7.0 EVALUATION CRITERIA

The details submitted by the bidders will be evaluated in the following manner:

i. The initial criteria prescribed in para 6.0 above in respect of experience of eligible similar works completed, loss, solvency, financial turn over and bidding capacity etc. will first be scrutinized and the bidder's eligibility for the work be determined.

ii. The bidders qualifying the initial criteria as set out in para 6.0 above will be evaluated for following criteria by scoring method on the basis of details furnished by them.

Sl. No.	Attributes	:	Max. Marks
a	Financial Strength (Form 'A' & 'B')	:	Maximum 20 marks
b	Experience in eligible similar nature of work during last seven years (Form 'C')	:	Maximum 20 marks
c	Performance on works (Form 'D') - Time over run	:	Maximum 20 marks
d	Performance on works as per assessment in (Form 'D-1') (i) Completed works (ii) Ongoing works	:	 Maximum 25 marks Maximum 15 marks
	Total		**100 marks**

iii. To become eligible for short listing the bidder must secure at least fifty (50%) percent marks in each section a, b, c and d (i) & (ii) and sixty percent marks in aggregate.

iv. The department, however, reserves the right to restrict the list of such qualified contractors to any number deemed suitable by it.

Note:

a. The average value of performance of works for time over run and quality for completed works in Form D-1 shall be taken on the basis of performance report of the eligible similar works.

b. Performance of works for ongoing works shall be done by selecting not more than any two ongoing works from the list given.

v. Evaluation of the performance of contractors for eligibility shall be done by the NIT proving authority on the basis of documents submitted or a committee constituted by him. All the eligible similar works executed and submitted by the bidders and ongoing works as well for the works with estimated cost put to tender more than 30 crore (thirty crore) may be got inspected by a committee which may consist of client or any other authority as decided by NIT approving authority. The marks for the quality shall be given based on this inspection, if inspection is carried out and performance of works as assessed by committee.

Scoring method of evaluation: The scoring for evaluation mentioned in these columns shall be done as given in Proforma - 1.

8.0 FINANCIAL INFORMATION

Bidder should furnish the Annual financial statement for the last five year in (Form 'A') and solvency certificate in (Form 'B').

9.0 EXPERIENCE OF SIMILAR WORKS

Bidder should furnish the List of eligible similar nature of works successfully completed during the last seven years in (Form 'C') and ongoing works as well (Form C-1).

10.0 ORGANIZATION INFORMATION

Bidder is required to submit information in respect of his organization in Form 'F'.

11.0 LETTER OF TRANSMITTAL

The bidder should submit the letter of Transmittal attached with the document.

12.0 OPENING OF PRICE BID

After evaluation of applications, a list of short listed agencies will be prepared. Thereafter the financial bids of only the qualified and technically acceptable bidders shall be opened at notified time, date and place in the presence of qualified bidders or their representatives.

13.0 AWARD CRITERIA

13.1 The Employer reserves the right, without being liable for any damages or obligation to inform the tenderer, to:
   a. Amend the scope of work and value of contract.
   b. Reject any or all the applications without assigning any reason.

13.2 Any effort on the part of the bidder or his agent to exercise influence or to pressurize the employer would result in rejection of his bid. Canvassing of any kind is prohibited.

PROFORMA 1

CRITERIA FOR EVALUATION OF THE PERFORMANCE OF BIDDERS FOR PRE-ELIGIBILITY

Sl. No.	Attributes	Max. Marks	Evaluation criteria			
(A)	**Financial strength**	**(20)**	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) - on pro-rata basis			
(i)	Average annual turnover	16				
(ii)	Solvency certificate	4				
(B)	**Experience in similar class of works**	**(20)**	(i) 60% marks for minimum eligibility criteria (ii) 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) - on pro-rata basis			
(C)	**Performance on works (time over run)**	**(20)**	[TOR = AT/ST, where AT = Actual Time; ST=Stipulated Time in the Agreement plus (+) Justified Period of Extension of Time]. **Note:** Marks for value in between the stages indicated above is to be determined by straight line variation Basis. (See Para 7.0 (v))			
			Score			
	If TOR =		**1.00**	**2.00**	**3.00**	**> 3.50**
(i)	Without levy of compensation		20	15	10	10
(ii)	With levy of compensation		20	5	0	-5
(iii)	Levy of compensation not decided		20	10	0	0
(D)	**Performance of works (Quality) as per assessment in form D-1**	**(40)**	**(Total marks assessed in Form D-1)**			
(i)	Completed works	25				
(ii)	Ongoing works	15				

Site Quality Inspection Report

S. No.	*Parameters of Inspection*	*Max. Marks*	*Bidder*		
			1	*2*	*3*
Ongoing Works					
1.	Site Safety	8			
2.	Labour Welfare	7			
3.	On-site Laboratory	8			
4.	Construction Equipment	7			
5.	Manpower	5			
6.	Quality of Civil, Electrical, Mechanical and Plumbing Works	65			
	TOTAL out of 100	**100**			
	TOTAL out of 15	**15**			
Completed Works					
1.	Quality of Civil, Electrical, Mechanical and Plumbing Works	100			
	TOTAL out of 100	**100**			
	TOTAL out of 25	**25**			

Site Quality Inspection Report
Ongoing Works

Inspection Summary Sheet

S. No.	*Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*		
			Bidder 1	*Bidder 2*	*Bidder 3*
1	**2**	**3**	**4**	**5**	**6**
1	Site Safety	08			
2	Labour: Hutment, Health, Hygiene and Welfare	07			
3	Laboratory: Facility, Equipment, Testing records	08			
4	Construction equipment: Quantity, Types and Quantity	07			
5	Manpower: Engineers, Supervisors, Labours	05			
6	Site Quality: Specifications, RCC, Formwork, Bar binding, Masonry work, Finishing, High side Electrical, Low side Electrical, High side HVAC, Low side HVAC, Lifts, Substation, WTP, STP, Roads, other Civil and Electrical works	65			
	Total Marks (Out of 100)	***100***			
	Total Marks (Out of 15)	***15***			

Site Quality Inspection Report
Ongoing Works

Detail Inspection Sheet

	Main parameter of inspection	Site Safety		
	Name of bidder			
	Site location of inspection			
	Date of Inspection			
	Maximum marks	08		
	Marks obtained			
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Officials engaged	08		
b	Qualification of officials	07		
c	Manual followed	05		
d	Induction & tool Box	05		
e	Harness & equipment	05		
f	Inspection notes	05		
g	Accidents & causalities	10		
h	Reward system	05		
i	Training	05		
j	Certification	02		
k	Awards received (if any)	03		
l	On site quality	40		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 08)	***08***		

Detail Inspection Sheet

Main parameter of inspection		Labour: Hutment, Health, Hygiene and Welfare		
Name of bidder				
Site location of inspection				
Date of Inspection				
Maximum marks		07		
Marks obtained				
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Sufficiency of hutment	10		
b	Quality of hutment	10		
c	Quality of toilets	10		
d	Sewerage system	10		
e	Vector control	05		
f	Electricity facility	07		
g	Water facility	08		
h	School at site	05		
i	Creche facility	05		
j	Medical facility	05		
k	Shopping facility	05		
l	Overall cleanliness	05		
m	Overall Hygiene	05		
n	Officials engaged	05		
o	Qualification of officials	05		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 07)	***07***		

Site Quality Inspection Report
Ongoing Works

Detail Inspection Sheet

Main parameter of inspection		Laboratory: Facility, Equipment, Testing records		
Name of bidder				
Site location of inspection				
Date of Inspection				
Maximum marks		08		
Marks obtained				
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Laboratory premise	5		
b	Laboratory equipment	25		
c	Certification & calibration	10		
d	Test records	10		
e	Officials engaged	30		
f	Qualification of officials	20		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 08)	***08***		

Site Quality Inspection Report
Ongoing Works

Detail Inspection Sheet

Main parameter of inspection		Construction equipment: Quality, Types and Quantity		
Name of bidder				
Site location of inspection				
Date of Inspection				
Maximum marks		07		
Marks obtained				
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Maintenance & upkeep	10		
b	Quality	25		
c	Quantity	15		
d	Certification & calibration	10		
e	Officials engaged	30		
f	Qualification of officials	20		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 07)	***07***		

Site Quality Inspection Report
Ongoing Works

Detail Inspection Sheet

	Main parameter of inspection	Manpower: Engineers, Supervisors, Labours		
	Name of bidder			
	Site location of inspection			
	Date of Inspection			
	Maximum marks	05		
	Marks obtained			
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Number of engineers	15		
b	Qualification of engineers	20		
c	Number of supervisors	20		
d	Qualification of supervisors	15		
e	Number of labours	30		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 05)	***05***		

Detail Inspection Sheet

Main parameter of inspection		Site Quality: Specifications, RCC, Formwork, Bar binding, Masonry work, Finishing, High side Electrical, Low side Electrical, High side HVAC, Low side HVAC, Lifts, Substation, WTP, STP, Roads, other Civil and Electrical works		
Name of bidder				
Site location of inspection				
Date of Inspection				
Maximum marks		65		
Marks obtained				
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
a	Foundation	03		
b	Columns	03		
c	Beams	03		
d	Slab	03		
e	Anti-termite treatment	02		
f	Damp proofing	02		
g	Doors & Windows	04		
h	Staircase	03		
i	Masonry	05		
j	Plaster	04		
k	Flooring	04		
l	Plinth protection	02		
m	RCC	05		
n	Formwork	05		
o	Bar binding	05		
p	Plumbing	05		
q	Sanitary work	04		

r	Roads & pathways	04		
s	Trenches	04		
t	STP (Civil)	04		
u	STP (E & M)	02		
v	WTP (Civil)	04		
w	WTP (E & M)	02		
x	High side electrical	03		
y	Low side electrical	03		
z	High side HVAC	02		
aa	Low side HVAC	02		
ab	Lifts	02		
ac	Substation (Civil)	04		
ad	Substation (E & M)	02		
	Total Marks (Out of 100)	***100***		
	Total Marks (Out of 65)	***65***		

Site Quality Inspection Report
Completed Works

Inspection Summary Sheet

S. No.	*Main Parameters of Inspection*	*Maximum Marks*	*Marks Obtained*		
			Bidder 1	*Bidder 2*	*Bidder 3*
1	**2**	**3**	**4**	**5**	**6**
1	Site Quality: Specifications, RCC, Formwork, Bar binding, Masonry work, Finishing, High side Electrical, Low side Electrical, High side HVAC, Low side HVAC, Lifts, Substation, WTP, STP, Roads, other Civil and Electrical works	100			
	Total Marks (Out of 100)	***100***			
	Total Marks (Out of 25)	***25***			

Site Quality Inspection Report
Completed Works

Main parameter of inspection		Site Quality: Specifications, RCC, Formwork, Bar binding, Masonry work, Finishing, High side Electrical, Low side Electrical, High side HVAC, Low side HVAC, Lifts, Substation, WTP, STP, Roads, other Civil and Electrical works		
Name of Bidder				
Site location of inspection				
Date of Inspection				
Maximum marks		100		
Marks obtained				
S. No.	*Break-up of Main Parameters of Inspection*	*Maximum Marks*	*Marks obtained*	*Remarks*
1	**2**	**3**	**4**	**5**
1 (a)	Column	20		
1 (b)	Beam			
1 (c)	Slab			
2 (a)	Plaster	15		
2 (b)	Flooring			
2 (c)	Staircase			
2 (d)	Paint			
2 (e)	Door & Windows			
3 (a)	Plumbing	20		
3 (b)	Sanitary			
3 (c)	STP (Civil)			
3 (d)	STP (E&M)			
3 (e)	WTP (Civil)			
3 (f)	WTP (E&M)			
4 (a)	Low Side Electrical	20		
4 (b)	High Side Electrical			
4 (c)	High Side HVAC			
4 (d)	Low Side HVAC			
4 (e)	Lift			

4 (f)	Substation (Civil)			
4 (g)	Substation (E&M)			
5 (a)	Road	10		
5 (b)	Landscaping			
5 (c)	Street Light			
6	Fire-fighting	15		
	Total Marks (Out of 100)	***100***		

SECTION - III

FORMS

	LETTER OF TRANSMITTAL FOR TECHNICAL BID AND FINANCIAL BID ALONG WITH DECLARATION
FORM-A	**FINANCIAL INFORMATION**
FORM-B	**SOLVENCY CERTIFICATE**
FORM - 'B-1'	**CORRESPONDENCE DETAILS OF ISSUING AUTHORITY**
FORM - C	**DETAILS OF SIMILAR WORKS (COMPLETED)**
FORM - 'C-1'	**DETAILS OF SIMILAR WORKS (UNDER EXECUTION)**
FORM - D	**PERFORMANCE REPORT OF WORKS TO BE CONSIDERED FOR ELIGIBILITY**
FORM - 'D-1'	**ASSESSMENT OF QUALITY FOR COMPLETED AS WELL AS ONGOING WORKS**
FORM - 'D-2'	**FORMAT OF EXPERIENCE OF HAVING SUCCESSFULLY COMPLETED ONE WORK WITH THE STRUCTURE SYSTEM TECHNOLOGY (RCC FRAMED STRUCTURE USING STEEL FRAME WORK)**
FORM - E	**BID CAPACITY**
FORM - F	**STRUCTURE & ORGANIZATION**
FORM - G	**UNDERTAKING FOR MANPOWER DEPLOYMENT**
FORM - H	**NO CONVICTION CERTIFICATE**
FORM - I	**NO DEVIATION CERTIFICATE**
FORM - J	**UNDERTAKING REGARDING BLACKLISTING / NON DEBARMENT**
FORM - K	**UNDERTAKING FOR RESTRICTION UNDER RULE 144(XI) OF GFRS**
FORM-L	**UNDERSTANDING THE PROJECT SITE**
FORM-M	**FORMAT FOR LITIGATION HISTORY, LIQUIDATED DAMAGES, DISQUALIFICATION**
FORM -N	**LETTER FOR INTEGRITY AND INTEGRITY AGREEMENT**
FORM -O	**WORK TENDER AND CONTRACT FOR WORKS ON EPC MODE**
FORM -P	**ESCROW AGREEMENT**

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

LETTER OF TRANSMITTAL FOR TECHNICAL BID

To,
Addl. Chief Engineer
Construction Management Unit-II
WAPCOS Limited
76-C, Institutional Area,
Sector-18, Gurugram, Haryana-122015
Email: rd@wapcos.co.in; ssm@wapcos.co.in
Contact No. +91-124-2399830

Subject: Submission of Bids for (Name of the Work/ Project)

Sir,

Having examined the details given in tender document for the above work, I/we hereby submit the relevant information.

i. I / We acknowledge that the WAPCOS will be relying on the information provided in the Bid and the documents accompanying the Bid & detailed provided in the enclosed "Forms" for selection of the Contractor for the aforesaid Project, and we certify that all information provided in the Bid are true and correct; nothing has been omitted which renders such information misleading; and all documents accompanying the Bid are true copies of their respective originals.
ii. I/we have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
iii. I/we submit the requisite Solvency Certificate, Completion Certificates, Financial Information's and authorize WAPCOS Ltd. to approach the Issuing Authority to confirm the correctness thereof. I/we also authorize WAPCOS Ltd. to approach individuals, employers, firms and corporation to verify our competence and general reputation.
iv. I/ We acknowledge the right of the Authority to reject our Bid without assigning any reason or otherwise and hereby waive, to the fullest extent permitted by applicable law, our right to challenge the same on any account whatsoever.
v. I/we submit the following certificates in support of our suitability, technical knowledge and capability for having successfully completed the following eligible similar works:

Name of work	Certificate from

Certificate:
It is certified that the information given in the enclosed eligibility bid are correct. It is also certified that I/we shall be liable to be debarred, disqualified / cancellation of enlistment in case any information furnished by me/us found to be incorrect.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

LETTER OF TRANSMITTAL FOR FINANCIAL BID

Dated:

To
Addl. Chief Engineer
Construction Management Unit-II
WAPCOS Limited
76-C, Institutional Area,
Sector-18, Gurugram, Haryana-122015
Email: rd@wapcos.co.in; ssm@wapcos.co.in
Contact No. +91-124-2399830

Sub: Financial Bid for (Name of the Work/ Project)

Dear Sir,

With reference to this Tender Document, I/we, having examined the Bidding Documents and understood their contents, hereby submit my/our Bid for the aforesaid Project. The Bid is unconditional and unqualified.

1. The Cost has been quoted by me/us for bid after taking into consideration all the terms and conditions stated in the Tender Document, our own estimates of costs and after a careful assessment of the site and all own the conditions that may affect the project cost and implementation of the project.
2. I / We shall keep this offer valid as period specified in the NIT.
3. I / We hereby submit our FINANCIAL BID and Offer Cost as filled in format given on online portal for undertaking the aforesaid Project in accordance with the Bidding Documents and the Agreement.

Yours faithfully,

Date:

(Signature, name and designation of the Authorized signatory)

Place:

Name and seal of Bidder

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

DECLARATION BY THE BIDDER

This is to certify that We, M/s ……., in submission of this offer confirm that:-

We have inspected the site of work and have made myself/ourselves fully acquainted with local conditions in and around the site of work. We have carefully gone through each & every section of the tender document for the work **(Name of the Work/ Project).**

1. Our tender is offered taking due consideration of all factors mentioned in tender documents.
2. We promise to abide by all the stipulations of the Contract documents and carry out and complete the work to the satisfaction of the Employer/ Principal Employer.
3. We also agree to procure Plants and Machineries at our cost required for the work. We also submit that we have Organizational Structure comprising adequate Technical Personnel in the line of requirement. We also agree to accomplish the job entrusted to us in the stipulated time laid out in document except situations not under our control.
4. We have not made any misleading or false representation in the forms, statement and attachments in proof of the qualification requirements;
5. We do not have records of poor performance such as abandoning the work, not properly completing the Contract, inordinate delays in completion or financial failures etc.
6. We have submitted all the supporting documents and furnished the relevant details as per prescribed format.
7. We are financially sound and have not applied or be under corporate debt restructuring.
8. List of Similar Works satisfying Qualification Criterion as indicated hereinafter, does not include any work which has been carried out by us through a Subcontractor on a back-to-back basis.
9. The Cost has been quoted by me/us for bid after taking into consideration all the terms and conditions stated in the Tender Document, our own estimates of costs and after a careful assessment of the site and all own the conditions that may affect the project cost and implementation of the project.
10. I / We shall keep this offer valid as period specified in the NIT.
11. I / We hereby submit our FINANCIAL BID and Offer Cost for undertaking the aforesaid Project in accordance with the Bidding Documents and the Agreement.
12. In the event of my/ our being declared as the Selected Bidder, I/we agree to enter into a Agreement in accordance with the format of Contract Agreement. We agree not to seek any changes in the aforesaid format of Contract Agreement and agree to abide by the same.

Certificate:

It is certified that the information given in the enclosed bid are correct. It is also certified that I/we shall be liable to be debarred, disqualified / cancellation of enlistment in case any information furnished by me/us found to be incorrect.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

[TO BE SUBMITTED ON ORIGINAL LETTER HEAD OF STATUTORY AUDITOR OF BIDDER]

FORM-A: FINANCIAL INFORMATION

Years	Gross Annual turnover on Construction Works	Profit/Loss (After Tax)	Net worth
2018-2019			
2019-2020			
2020-2021			
2021-2022			
2022-2023			

Above Details are being furnished as per the figures in balance sheet for the last five years in respect of M/s …….(Name & address of firm of bidder), as submitted by the firm to the Income Tax Department.

Date: **(Signature of Statutory Auditor with Seal)**
UDIN No. :

Place:

[TO BE SUBMITTED ON ORIGINAL LETTER HEAD OF ISSUING BANK]

FORM- B: SOLVENCY CERTIFICATE

To
WAPCOS Limited,
76-C, Institutional Area,
Sector-18, Gurugram, Haryana

Name of Work: **(Name of the Work/ Project)**

This is certify that to the best of our knowledge and information that M/s ……(name of bidder & address) having marginally noted address, a customer of our Bank are/is respectable and can be treated as good for any engagement upto a limit of Rs……. (Rupees…… ……..)

This certificate is issued without any Guarantee or responsibility on the Bank or any of the officers.

(Signature for The Bank with seal)
Name:
Designation:
Power of Attorney No.:

NOTE:
E-mail ID of bank/authorized signatory of bank should be clearly mentioned on the certificate so that genuineness of the certificate can be established via email.

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM – 'B-1': CORRESPONDENCE DETAILS OF ISSUING AUTHORITY

Solvency Certificate/ Completion Certificate

Name of Work: (Name of the Work/ Project)

A. Solvency Certificate

Present address of the Issuing Branch	Official Email Id	Landline no.	Other Contact no.

B. Completion Certificate for similar works

Present address of the Issuing Authority	Official Email Id	Landline no.	Other Contact no.

This is to certify that above information is correct and is gathered from the Issuing Authorities by us for the verification of concerned documents.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM-C: DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED DURING THE LAST SEVEN YEARS ENDING PREVIOUS DAY OF LAST DATE OF SUBMISSION OF TENDERS

Sl. No.	Name of work/ project and location	Owner or sponsoring organiza-tion	Cost of work in crores of rupees	Date of commen-cement as per contract	Stipu-lated date of comple - tion	Actual date of comple tion	Litigation / arbitratio n cases pending/ in progress with details*	Name and address / telephone number of officer to whom reference may be made	Whether the work was done on back to back basis Yes/ No
1	2	3	4	5	6	7	8	9	10

***** Indicate gross amount claimed and amount awarded by the Arbitrator.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM - 'C-1': DETAILS OF SIMILAR NATURE OF WORKS UNDER EXECUTION
(Estimated cost put to tender more than 30 crore)

Sl. No.	Name of work/ project and location	Owner or sponsoring organiza-tion	Cost of work in crores of rupees	Date of commen-cement as per contract	Stipu-lated date ofcomple - tion	Upto date percent age progres s of works	Slow progress if any and reasons thereof	Name and address / telephone number of officer to whom reference may be made	Remarks
1	2	3	4	5	6	7	8	9	10

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

[To be submitted by Bidders on Letter Head of Concerned Authority]

FORM-D: PERFORMANCE REPORT OF WORKS REFERRED TO IN FORM 'C'

Performance Certificate

1.	Name of work / project & Location				
2.	Agreement No.				
3.	Estimated (NIT) Cost	Rs.			
4.	Tendered (Awarded) Cost	Rs.			
5.	Date of Start				
6.	Stipulated date of completion				
7.	Actual date of completion				
8.	Amount of compensation levied for delayed Completion, if any				
8.1	Whether case of levy of compensation for delay has been decided or not?	Yes / No			
8.2	If decided, amount of compensation levied for delayed completion, if any.				
9.	Amount of reduced rate items, if any				
10.	Any Litigation during execution of project				
11.	**Performance Report :**				
	a) Quality of work	Outstanding	Very Good	Good	Poor
	b) Progress of work	Outstanding	Very Good	Good	Poor
	c) Technical Proficiency	Outstanding	Very Good	Good	Poor
	d) Financial Soundness	Outstanding	Very Good	Good	Poor
	e) Resourcefulness	Outstanding	Very Good	Good	Poor
	f) General Behaviour	Outstanding	Very Good	Good	Poor

(Signature, name and designation of officer of concerned department)

Official Email:-
Official Contact Number:
Address of department:

FORM - 'D-1': ASSESSMENT OF QUALITY FOR COMPLETED AS WELL AS ONGOING WORKS

Name of work:
Date of inspection:
Date of submission of report:

A.	General Observation & Operational aspects	Yes/ No
1.	Availability of approval from local bodies in case of Construction of private buildings.	
2.	Availability of approved structural drawing	
3.	Observation on seepage/ leakage in the building	
4.	Whether line & level maintained	
5.	In case of basement, observation on seepage, if any	
6.	Any structural defects / distress observed. If yes give details	
7.	Whether safety measures adopted at site as per CPWD Safety Code and or govt. guidelines are adequate or not	
8.	Whether the welfare facilities provided to labour as per clause 19 H of GCC for CPWD works/ and or govt. guidelines are adequate or not.	
9.	Whether AHU getting automatically switched off and fire damps closed in case of fire signal	
10.	Whether thimbles used for termination of wires in DBs, EBDs & panels?	
B.	**Quality of work**	**Marks Assessed**
1.	Quality of plaster/ finishing	
2.	Quality of RCC/ CC work	
3.	Quality of flooring	
4.	Quality of wood work	
5.	Quality of steel work/ aluminum work	
6.	Quality of plumbing and sanitary installation	
7.	Quality of Workmanship	
8.	Quality of waterproofing	
9.	If cladding done, observation on efficiency/ quality of cladding/ brick work	
10.	Quality of internal electrification work	
11.	Quality of DBs, EBDs & panels?	
12.	Quality of E&M equipments, panels & feeder pillar	
13.	Quality of fire alarm system / firefighting system	
14.	Quality of Air Conditioning work	
15.	Quality of Sub-station based on complete live diagram, capacitor panel, power factor, insulating Mat, cleanliness, cable termination, earthing pits,earthing of transformer / DG sets	
16.	Any other aspects (To be elaborated)	

Average marks (To be awarded out of 100 marks based on average of marks assessed on each attribute mentioned at B above).

Note:

1. All the above parameters may be considered for assessing the overall quality of work executed by the contractor.
2. In case, any attribute is not applicable, the same may not be included in assessment and mentioned are not applicable (N/A).
3. The works as assessed above shall be converted on a scale of 25/15 marks for completed/ongoing works respectively.
4. In case of eligible completed works as well as ongoing works being more than one the maximum marks assigned for completed works and ongoing works will be equally distributed among the works.

[To be submitted by Bidders on Letter Head of Owner or sponsoring organization or Concerned Authority]

FORM - 'D-2': CERTIFICATE OF EXPERIENCE IN SUPPORT OF HAVING SUCCESSFULLY COMPLETED ONE WORK WITH THE STRUCTURAL SYSTEM TECHNOLOGY PROPOSED TO BE USED IN THE WORK

1. Name of work / Project & Location:
2. Owner or sponsoring organization:
3. Cost of work in crore of rupees:
4. Date of commencement as per contract:
5. Stipulated date of completion:
6. Actual date of completion:
7. Type of structural system Technology used:
8. Litigation/arbitration cases Pending/in progress with details:
9. Name and address/telephone number of officer to whom reference may be made:
10. Whether the work was done on back to back basis: (yes / no)

Certified that M/s ..... has completed the above work with the structural system technology as per details mentioned above.

(Signature, name and designation of owner or sponsoring organization or officer of concerned department)

Official Email:-
Official Contact Number:
Address of department:

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM- E: BID CAPACITY

Name of Work: **(Name of the Work/ Project)**

Available bid capacity = A x 1.5 x N – B

Where,
A = Maximum value of engineering (Civil/ Electrical/ Mechanical as relevant to work being procured) works executed in any one year during the last five years (updated at the current price level), taking into account the completed as well as works in progress.

N = Number of years prescribed for completion of the work in question.

B = Value (updated at the current price level) of the existing commitments and ongoing works to be completed in the next 'N' years.

Existing Commitments & on-going works details:

Description of work	Location	Contract no.	Name of address of Client	Value of Contract (Rs. Cr.)	Stipulated period of completion	Value of remaining work (Rs. cr.)	Anticipated date of completion

NOTE:

The bidder shall furnish statements showing the value of existing commitments and on-going works as well as stipulated period of completion remaining for each of the works separately.

The value of executed works shall be brought to the current level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the date of completion of last day of the month previous to the one in which applications are invited.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM- F: STRUCTURE & ORGANISATION

S. No.	Particulars	Details
1.	Name & Registered Address of the Bidder	
2.	Address and Email on which correspondence will be made during Tendering & after Award of Work	**Name of Person: …who will sign tender** **Mobile No. :** **Email:** **Address:**
3.	Telephone no./Mobile no./Fax no.	
4.	Legal status of the Bidder (attach copies of original document defining the legal status) (a) A Proprietary Firm (b) A Partnership Firm (c) A Limited Company or Corporation (d)A Company registered under company's Act 1956/2013	
5.	Particulars of Registration with various Government Bodies (Attach attested photocopy) **Organization/Place of Registration** 1. 2. 3.	**Registration No**. 1. 2. 3.
6.	Names and Titles of Directors with designation as per Legal Status of Company	
7.	Designation of Senior Level Officers authorized to act for this work	
8.	Any other information considered necessary but not included above.	

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM- G: - UNDERTAKING FOR MANPOWER DEPLOYMENT

Name of Work: (Name of the Work/ Project)

This is to certify that We, M/s ……., in submission of this offer confirm that:-

I. Our tender is offered taking due consideration of all factors including site requirements information and conditions stated in the detailed Instructions to Bidders to execute the work up to the standards as laid out in Employer's Requirements and other sections of Tender Document.

II. We agree to employ the number of technical staff during the execution of this work as defined in the tender document. We shall deploy additional manpower as deemed fit and required to complete the project within stipulated completion period, without any additional cost to the Employer.

III. WAPCOS shall have full power and without giving any reason to us, immediately to get removed any representative, staff and workmen or employees on account of misconduct negligence or incompetence or whose continued employment may in his opinion be undesirable. We shall not claim any compensation on this account.

IV. In case we fail to deploy the technical staff as mentioned in the tender document, we shall be liable to pay recovery for each month of default as mentioned in Tender Documents. The details of Deployment of Technical Staff will be submitted with each Bill duly certified by The Project Manager, WAPCOS. We shall not raise any objection if deduction is made for the same from Running Bills.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM-H: NO-CONVICTION CERTIFICATE

Name of Work: **(Name of the Work/ Project)**

This is to certify that _____ (Name of the organization), having registered office at _____ (Address of the registered office) has never been convicted or blacklisted or restricted to apply for any such activities by any Central / State Government Department or Court of law anywhere in the country.

This is also to certify that we are not involved in any form of Corrupt and Fraudulent Practices in past and will never be involved in future.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM-I: NO DEVIATION CERTIFICATE

Name of Work: (Name of the Work/ Project)

This is to confirm that as per Tender conditions we have visited site before submission of our Offer and noted the job content and site condition etc. We also confirm that we have not changed/modified the above tender document and in case of observance of the same at any stage it shall be treated as null and void.

We hereby also confirm that we have not taken any deviation from Tender Clause together with other reference as enumerated in the above referred Notice Inviting Tender and we hereby convey our unconditional acceptance to all terms & conditions as stipulated in the Tender Document.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null and void.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM-J: UNDERTAKING REGARDING BLACKLISTING / NON DEBARMENT

Name of Work: **(Name of the Work/ Project)**

We hereby Confirm and declare that we, M/s_____ , is not blacklisted/De-registered/debarred as per the Debarment of firms notification vide Department of Expenditure, Ministry of Finance, Govt. of India Notification No. F1/20/2018/PPD dated: 02-11-2021.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

FORM-K: UNDERTAKING FOR RULE 144 (XI) IN THE GENERAL FINANCIAL RULES-2017

Name of Work: (Name of the Work/ Project)

I / we ……(Name of the Firm) well aware about the Restrictions under RULE 144 (XI) In General Financial Rules (GFR), 2017 on procurement from country which shares a land border with India.. I/ we hereby certify that we are eligible to participate in the tender as per Rule 144 (xi) In The General Financial Rules (GFR), 2017

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

[TO BE SUBMITTED BY BIDDER ON THEIR ORIGINAL LETTER HEAD]

FORM-L: UNDERSTANDING THE PROJECT SITE

Name of Work: (Name of the Work/ Project)

I/we hereby certify that I/we have examined & inspected the site & its surrounding satisfactorily, where the project is to be executed. I/ We are well aware about the following

- Location of the land demarcated for the execution of work and approach/ accessibility to the site.
- Availability of all construction material required for the execution of work.
- Location of the proposed buildings and its allied works on demarcated land.
- Sources from where electric connection is to be taken by contractor at the time of mobilization or other arrangements for electricity is to be made.
- Sources from where suitable water for construction is to be arranged.
- Site clearance and location of matured trees.
- Awareness about the surrounding local conditions, villagers etc.
- Topography, contouring and any other relevant feature like Pond, nallah etc. of the land where the project is to be executed.
- Nature of the ground & sub-soil of the site and accessibility to the site.
- Location of local electrical supply line and other relevant services
- Hindrances / dispute, if any, which may arise during the execution of work

I / We hereby submit our BID considering above all facts gathered during site visit and each & every aspect have been considered in the Quoted percentage Rates / price.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

[TO BE SUBMITTED BY BIDDER ON THEIR ORIGINAL LETTER HEAD]

FORM-M: LITIGATION HISTORY, LIQUIDATED DAMAGES, DISQUALIFICATION

To,
WAPCOS Limited,
76-C, Institutional Area, Sector 18,
Gurgaon, Haryana-122015

Sub: Litigation History, Liquidated Damages, Disqualification for ---------- (Name of Work /Project)

It is hereby declared that our firm (Name of firm with address) neither disqualified, nor have any Litigation history and no Liquidated Damage imposed on the firm by any Department.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

[TO BE SUBMITTED BY BIDDER ON THEIR ORIGINAL LETTER HEAD]

FORM-N: INTEGRITY PACT

To,
WAPCOS Limited,
76-C, Institutional Area, Sector 18, Gurgaon, Haryana-122015

Sub: Integrity Pact for----- (Name of Work / Project)

Dear Sir,

I/We acknowledge that WAPCOS is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document at **Enclosure-I.**

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We will sign the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by WAPCOS. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, WAPCOS shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid is accordance with terms and conditions of the tender/bid.

Yours faithfully,

Date:

(Signature, name and designation of the Authorized signatory)

Place:

Name and seal of Bidder

Enclosure-I

INTEGRITY AGREEMENT

[To be submitted on Stamp paper of At least Rs.100]

This Integrity Agreement is made at ..... on this ..... day of ..... 20.....

BETWEEN

WAPCOS Limited, New Delhi (Hereinafter referred as the **'Principal/Owner',** which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns) **AND**

.....

(Name and Address of the Individual/firm/Company)

through ..... (Hereinafter referred to as the
(Details of duly authorized signatory)

"Bidder/Contractor" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

Preamble

WHEREAS the Principal / Owner has floated the Tender (NIT No .....) (hereinafter referred to as "Tender/Bid") and intends to award, under laid down organizational procedure, contract for .....(Name of work) hereinafter referred to as the "Contract".

AND WHEREAS the Principal/Owner values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s)and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as "Integrity Pact" or "Pact"), the terms and conditionsof which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Pact witnesses as under:-

Article 1: Commitment of the Principal/Owner

(1) The Principal/Owner commits itself to take all measures necessary to prevent corruptionand to observe the following principles:

(a) No employee of the Principal/Owner, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand,take a promise for or accept, for self or third person, any material or immaterial benefitwhich the person is not legally entitled to.

(b) The Principal/Owner will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal/Owner will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential / additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

(c) The Principal/Owner shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.

(2) If the Principal/Owner obtains information on the conduct of any of its employees which isa criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PCAct) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal/Owner will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

(1) It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the WAPCOS all suspected acts of fraud or corruption or Coercion or Collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.

(2) The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

(a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal/Owner's employees involved in the Tender process or execution of the Contract or to any third person any material or other benefitwhich he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

(b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submissionof bids or any other actions to restrict competitiveness or to cartelize in the bidding process.

(c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/ Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

(d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/ representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian Nationality shall disclose names and addresses of foreign agents/representatives, if any.Either the Indian agent on behalf of the foreign principal or the foreign principal directlycould bid in a tender but not both. Further, in cases where an agent participate in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tenderfor the same item.

(e) The Bidder(s)/Contractor(s) will, when presenting his bid, disclose any and all paymentshe has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.

(3) The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

(4) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice means a willful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the WAPCOS interests.

(5) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use Coercive

Practices (means the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/her reputation or property toinfluence their participation in the tendering process).

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal/Owner under law or the Contract or its established policies and laid down procedures, the Principal/Owner shall have the following rights in case of breach of this Integrity Pact by the Bidder(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal/Owner's absolute right:

(2) If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, suchas to put his reliability or credibility in question, the Principal/Owner after giving 14 days notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from theTender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contractor from future contract award processes. The imposition and duration of the exclusion will be determined by the severity of transgression and determined by the Principal/Owner. Such exclusion may be forever or for a limited period as decided by the Principal/Owner.

(3) Forfeiture of EMD/Performance Guarantee/Security Deposit: If the Principal/Owner has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to terminate/determine the Contract according to Article 3(1), the Principal/Owner apart from exercising any legal rights that may have accrued to the Principal/Owner, may in its considered opinion forfeit the entire amount of Earnest Money Deposit, Performance Guarantee and Security Deposit of the Bidder/Contractor.

(4) Criminal Liability: If the Principal/Owner obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractorwhich constitutes corruption within the meaning of IPC Act, or if the Principal/Owner has substantive suspicion in this regard, the Principal/Owner will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

(1) The Bidder declares that no previous transgressions occurred in the last 5 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the Tender process.

(2) If the Bidder makes incorrect statement on this subject, he can be disqualified from the Tender process or action can be taken for banning of business dealings/ holiday listing of the Bidder/Contractor as deemed fit by the Principal/ Owner.

(3) If the Bidder/Contractor can prove that he has resorted / recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal/Owner may, atits own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

(1) The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitmentin conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement/Pact by any of its Subcontractors/sub-

vendors.

(2) The Principal/Owner will enter into Pacts on identical terms as this one with all Bidders and Contractors.

(3) The Principal/Owner will disqualify Bidders, who do not submit, the duly signed Pact between the Principal/Owner and the bidder, along with the Tender or violate its provisionsat any stage of the Tender process, from the Tender process.

Article 6: Duration of the Pact

(1) This Pact begins when both the parties have legally signed it. It expires for the Contractor/Vendor 12 months after the completion of work under the contract or till the continuation of defect liability period, whichever is more and for all other bidders, till the Contract has been awarded.

(2) If any claim is made/lodged during the time, the same shall be binding and continue to be valid despite the lapse of this Pacts as specified above, unless it is discharged/determined by the Competent Authority, WAPCOS

Article 7: Other Provisions

(1) This Pact is subject to Indian Law, place of performance and jurisdiction is the Headquarters ofthe Principal/Owner, who has floated the Tender.

(2) Changes and supplements need to be made in writing. Side agreements have not been made.

(3) If the Contractor is a partnership or a consortium, this Pact must be signed by all the partnersor by one or more partner holding power of attorney signed by all partners and consortiummembers. In case of a Company, the Pact must be signed by a representative duly authorizedby board resolution.

(4) Should one or several provisions of this Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intensions.

(5) It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Agreement / Pact, any action taken by the Owner/Principal in accordance with this Integrity Agreement/ Pact or interpretation thereof shall not be subject to arbitration.

Article 8: LEGAL AND PRIOR RIGHTS

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contactdocuments with regard any of the provisions covered under this Integrity Pact.

IN WITNESS WHEREOF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

.....

(For and on behalf of Principal/Owner)

.....

(For and on behalf of Bidder/Contractor)

WITNESSES:

1. .....

(signature, name and address)

2. .....

(signature, name and address)Place:

Dated :

[TO BE SUBMITTED BY BIDDER ON THEIR ORIGINAL LETTER HEAD]

FORM-O: PERCENTAGE RATE EPC TENDER/ITEM RATE EPC TENDER & CONTRACT FOR WORKS TENDER AND CONTRACT FOR WORKS ON EPC MODE

(A) Tender for the work of:-

.....

.....

(i) To be uploaded by……. hours on …….

(ii) To be opened in presence of tenderers who may be present at ……. hours on ….....……. in the office of .....

TENDER

I/We have read and examined the notice inviting tender, OPERATIVE schedule A, D, E & F Specifications, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rates, other documents , regulations, Acts and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the planning, designing and execution of the work as per scope mentioned in this tender document specified for WAPCOS within the time specified in Schedule 'F' viz., schedule of quantities and in accordance in all respect with the applicable municipal byelaws , regulations, Acts, NGT guidelines, specifications, designs, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in accordance with, such conditions so far as applicable.

I/We agree to keep the tender open for days from the due date of its opening in case of single bid system or….....……days from the date of opening of technical bid in case tenders are invited in 2 /3 bid system for work and not to make any modification in its terms and conditions.

I/We have deposited EMD for the prescribed amount in the office of concerned Additional chief engineer as per the bid document.

A copy of earnest money deposit receipt of prescribed amount deposited in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee (as prescribed) issued by a Commercial Bank, is scanned and uploaded (strike out as the case may be). If I/We, fail to furnish the prescribed performance guarantee within prescribed period, I/We agree that the President of India or his successors, in office shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely.

Further, if I/We fail to commence work as specified, I/ We agree that WAPCOS shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said performance guarantee absolutely. The said Performance Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12 of the tender

form. Further, I/We agree that in case of forfeiture of Earnest Money or Performance Guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of this work.

I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of department, then I/We shall be debarred for tendering in WAPCOS as per enlistment rules applicable. Also, if such a violation comes to the notice of WAPCOS before date of start of work, the Engineer-in-charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Guarantee.

I/We hereby declare that I/We shall treat the tender documents, drawings and other records connected with the work as secret/confidential documents and shall not communicate information derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety & integrity of the State.

Date: (Signature, Name, Designation
of the Authorized signatory with Seal)

Place:

FORM-P: ESCROW AGREEMENT

THIS ESCROW AGREEMENT is entered into on this the …….. day of 20….

AMONGST

1 …… LIMITED, a company incorporated under the provisions of the Companies Act, 1956 and having its registered office at (hereinafter referred to as the "Agency" which expression shall, unless repugnant to the context or meaning thereof, include its successors, permitted assigns and substitutes);

2 ……name and particulars of Additional chief engineer, WAPCOS limited and having its registered office at…….acting for and on behalf of the WAPCOS LIMITED, as their duly authorised agent with regard to matters arising out of or in relation to this Agreement (hereinafter referred to as the "Addl. Chief engineer, WAPCOS Limited" which expression shall, unless repugnant to the context or meaning thereof, include its successors and substitutes);

3 …….name and particulars of the Escrow Bank and having its registered office at …… (hereinafter referred to as the "Escrow Bank" which expression shall, unless repugnant to the context or meaning thereof, include its successors and substitutes); and

4 The WAPCOS Limited, (hereinafter referred to as the "WAPCOS" which expression shall, unless repugnant to the context or meaning thereof, include its administrators, successors and assigns).

WHEREAS:

(A) The WAPCOS, has entered into an Agreement dated with the Agency for **"Name of Work: (Name of Work / Project)."**

NOW, THEREFORE, in consideration of the foregoing and the respective covenants and agreements set forth in this Agreement, the receipt and sufficiency of which is hereby acknowledged, and intending to be legally bound hereby, the Parties agree as follows:

1 DEFINITIONS AND INTERPRETATION

1.1 Definitions

In this Agreement, the following words and expressions shall, unless repugnant to the context or meaning thereof, have the meaning hereinafter respectively assigned to them:

"Agreement" means this Escrow Agreement and any amendment thereto made in nce with the provisions contained herein;

"Cure Period" means the period specified in this Agreement for curing any breach or default of any provision of this Agreement by the Agency, and shall commence from the date on which a notice is delivered by the WAPCOS , or the representative of WAPCOS as the case may be, to the Agency asking the latter to cure the breach or default specified in such notice;

"Escrow Account" means an escrow account established in terms of and under this Agreement, and shall include the Sub-Accounts;

"Escrow Default" shall have the meaning ascribed thereto in Clause 6.1;

"Additional chief engineer, WAPCOS limited" means the person referred to as the Additional chief engineer, WAPCOS limited in the foregoing Recitals;

"Parties" means the parties to this Agreement collectively and "Party" shall mean any of the Parties to this Agreement individually;

1.2 Interpretation

1.2.1 References to Additional chief engineer, Wapcos limited shall, unless repugnant to the context or meaning thereof, mean references to Additional chief engineer, Wapcos limited, acting for and on behalf of WAPCOS.

1.2.2 The words and expressions beginning with capital letters and defined in this Agreement shall have the meaning ascribed thereto herein, and the words and expressions used in this Agreement and not defined herein but defined in the Agreement shall, unless repugnant to the context, have the meaning ascribed thereto in the Agreement.

1.2.3 References to Clauses are, unless stated otherwise, references to Clauses of this Agreement.

2 ESCROW ACCOUNT

2.1 Escrow Bank to act as trustee

2.1.1 The Agency hereby appoints the Escrow Bank to act as trustee for the WAPCOS Limited. the **Additional chief engineer, Wapcos limited** and the Agency in connection herewith and authorizes the Escrow Bank to exercise such rights, powers, authorities and discretion as are specifically delegated to the Escrow Bank by the terms hereof together with all such rights, powers, authorities and discretion as are reasonably incidental hereto, and the Escrow Bank accepts such appointment pursuant to the terms hereof.

2.1.2 The Agency hereby declares that all rights, title and interest in and to the Escrow Account shall be vested in the Escrow Bank and held in trust for the WAPCOS, **Additional chief engineer, Wapcos limited** and the Agency, and applied in accordance with the terms of this Agreement. No person other than the **Additional chief engineer, Wapcos limited** and the Agency shall have any rights hereunder as the beneficiaries of, or as third party beneficiaries under this Agreement.

2.2 Acceptance of Escrow Bank

The Escrow Bank hereby agrees to act as such and to accept all payments and other amounts to be delivered to and held by the Escrow Bank pursuant to the provisions of this Agreement. The Escrow Bank shall hold and safeguard the Escrow Account during the term of this Agreement and shall treat the amount in the Escrow Account as monies deposited by the Agency, WAPCOS, with the Escrow Bank. In performing its functions and duties under this Agreement, the Escrow Bank shall act in trust for the benefit of, and as agent for, the **Additional chief engineer, Wapcos limited** and the Agency or their nominees, successors or assigns, in accordance with the provisions of this Agreement.

2.3 Establishment and operation of Escrow Account

2.3.1 Within 15 (Fifteen) days from the date of this Agreement, the Agency shall open and establish the Escrow Account with the (name of Branch) Branch of the Escrow Bank. The Escrow Account shall be denominated in Rupees.

2.3.2 The Escrow Bank shall maintain the Escrow Account in accordance with the terms of this Agreement and its usual practices and applicable regulations, and pay the maximum rate of interest payable to similar customers on the balance in the said account from time to time.

2.3.3 The Escrow Bank and the Agency shall, after consultation with the **Additional chief engineer, Wapcos limited,** agree on the detailed mandates, terms and conditions, and operating procedures for the Escrow Account, but in the event of any conflict or inconsistency between this Agreement and such mandates, terms and conditions, or procedures, this Agreement shall prevail.

2.3.4 The Account Bank shall operate the Account in the manner as defined Below:

The Account Bank has operated jointly by WAPCOS & Ltd., both the parties will jointly issue letter signed by one authorized representatives of each party. On presenting this request letter to bank, bank will make payments to instructed party by RTGS / NEFT.

2.3.5 The Department and Agency jointly shall be entitled to give any instructions to the Account Bank in respect of the operation, lying and available therein. The Account Bank shall not be required to ascertain the authority of the Department and Agency giving the instruction to the Account Bank in terms of any agreement / arrangement entered into by it with the client or any other person. Such instructions shall be binding on all the parties.

2.4 Escrow Bank's fee

The Escrow Bank shall be entitled to receive its fee and expenses in an amount, and at such times, as may be agreed between the Escrow Bank and the Agency. For the avoidance of doubt, such fee and expenses shall be paid by agency and shall be appropriated from the Escrow Account in accordance with Clause 4.1.

2.5 Rights of the parties

The rights of the **Additional chief engineer, Wapcos limited,** and the Agency in the monies held in the Escrow Account are set forth in their entirety in this Agreement and the WAPCOS, IIT (ISM) Dhanbad, the **Additional chief engineer, Wapcos limited** and the Agency shall have no other rights against or to the monies in the Escrow Account.

3 DEPOSITS INTO ESCROW ACCOUNT

Payments due to ……. (name of agency) & as deemed appropriate by WAPCOS will be deposited in the escrow account.

3.1 Interest on deposits

The Escrow Bank agrees and undertakes that all interest accruing on the balances of the Escrow Account shall be credited to the Escrow Account; provided that the Escrow Bank shall be entitled to appropriate there from the fee and expenses due to it from the Agency to the Escrow Account.

4. WITHDRAWALS FROM ESCROW ACCOUNT

4.1 No disbursement will be made from the account without the written approval of **Additional chief engineer, WAPCOS Limited** Withdrawals during Suspension

Notwithstanding anything to the contrary contained in this Agreement, the WAPCOS site office may exercise all or any of the rights of the Agency during the period of Suspension. Any instructions given by the WAPCOS, to the Escrow Bank during such period shall be complied with as if such instructions

were given by the Agency under this Agreement and all actions of the WAPCOS, hereunder shall be deemed to have been taken for and on behalf of the Agency.

5 OBLIGATIONS OF THE ESCROW BANK

5.1 Segregation of funds

Monies and other property received by the Escrow Bank under this Agreement shall, until used or applied in accordance with this Agreement, be held by the Escrow Bank in trust for the purposes for which they were received, and shall be segregated from other funds and property of the Escrow Bank.

5.2 Communications and notices

In discharge of its duties and obligations hereunder, the Escrow Bank:

(a) may, in the absence of bad faith or gross negligence on its part, rely as to any matters of fact which might reasonably be expected to be within the knowledge of the Agency upon a certificate signed by or on behalf of the Agency;

(b) may, in the absence of bad faith or gross negligence on its part, rely upon the authenticity of any communication or document believed by it to be authentic;

(c) shall, within 5 (five) business days after receipt, deliver a copy to the **Additional chief engineer, Wapcos limited** of any notice or document received by it in its capacity as the Escrow Bank from the Agency or any other person hereunder or in connection herewith; and

(d) shall, within 5 (five) business days after receipt, deliver a copy to the Agency of any notice or document received by it from the **Additional chief engineer, Wapcos limited** in connection herewith.

5.3 No set off

The Escrow Bank agrees not to claim or exercise any right of set off, banker's lien or other right or remedy with respect to amounts standing to the credit of the Escrow Account. For the avoidance of doubt, it is hereby acknowledged and agreed by the Escrow Bank that the monies and properties held by the Escrow Bank in the Escrow Account shall not be considered as part of the assets of the Escrow Bank and being trust property, shall in the case of bankruptcy or liquidation of the Escrow Bank, be wholly excluded from the assets of the Escrow Bank in such bankruptcy or liquidation.

5.4 Regulatory approvals

The Escrow Bank shall use its best efforts to procure, and thereafter maintain and comply with, all regulatory approvals required for it to establish and operate the Escrow Account. The Escrow Bank represents and warrants that it is not aware of any reason why such regulatory approvals will not ordinarily be granted to the Escrow Bank.

6 ESCROW DEFAULT

6.1 Escrow Default

6.1.1 Following events shall constitute an event of default by the Agency (an "Escrow Default") unless such event of default has occurred as a result of Force Majeure or any act or omission of the agency:

(a) the Agency causes the Escrow Bank to transfer funds to any account of the Agency in breach of the terms of this Agreement and fails to cure such breach by depositing the relevant funds into the Escrow

Account or any Sub-Account in which such transfer should have been made, within a Cure Period of 5 (five) business days; or

(b) the Agency commits or causes any other breach of the provisions of this Agreement and fails to cure the same within a Cure Period of 5 (five) business days.

6.1.2 Upon occurrence of an Escrow Default, the consequences thereof shall be dealt with under and in accordance with the provisions of the Agreement.

7 TERMINATION OF ESCROW AGREEMENT

7.1 Duration of the Escrow Agreement

This Agreement shall remain in full force and effect so long as any sum remains to be advanced or is outstanding from the Agency in respect of the debt, guarantee or financial assistance received by it from the WAPCOS or any of its obligations to the WAPCOS remain to be discharged, unless terminated earlier by consent of all the Parties or otherwise in accordance with the provisions of this Agreement.

7.2 Substitution of Escrow Bank

The Agency may, by not less than 45 (forty five) days prior notice to the Escrow Bank, the WAPCOS and **Additional chief engineer, Wapcos limited,** terminate this Agreement and appoint a new Escrow Bank, provided that the new Escrow Bank is acceptable to the **Additional chief engineer, Wapcos limited** and arrangements are made satisfactory to the **Additional chief engineer, Wapcos limited** for transfer of amounts deposited in the Escrow Account to a new Escrow Account established with the successor Escrow Bank. The termination of this Agreement shall take effect only upon coming into force of an Escrow Agreement with the substitute Escrow Bank.

7.3 Closure of Escrow Account

The Escrow Bank shall, at the request of the Agency and **Additional chief engineer, Wapcos limited** made on or after the payment by the Agency of all outstanding amounts under the Agreement and upon confirmation of receipt of such payments, close the Escrow Account and Sub-Accounts and pay any amount standing to the credit thereof to the Agency. Upon closure of the Escrow Account hereunder, the Escrow Agreement shall be deemed to be terminated.

8 INDEMNITY

8.1 General indemnity

8.1.1 The Agency will indemnify, defend and hold the WAPCOS, Escrow Bank harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of any breach by the Agency of any of it's obligations under this Agreement or on account of failure of the Agency to comply with Applicable Laws and Applicable Permits.

8.1.2 The WAPCOS, will indemnify, defend and hold the Agency harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of failure of the WAPCOS, to fulfil any of its obligations under this Agreement materially and adversely affecting the performance of the Agency's obligations under the Agreement or this Agreement other than any loss, damage, cost and expense arising out of acts done in discharge of their lawful functions by the WAPCOS, its officers, servants and agent.

8.1.3 The Escrow Bank will indemnify, defend and hold the Agency harmless against any and all proceedings, actions and third party claims for any loss, damage, cost and expense arising out of failure of the Escrow Bank to fulfil its obligations under this Agreement materially and adversely affecting the performance of the Agency's obligations under the Agreement other than any loss, damage, cost and expense, arising out of acts done in discharge of their lawful functions by the Escrow Bank, its officers, servants and agents.

8.2 Notice and contest of claims

In the event that any Party hereto receives a claim from a third party in respect of which it is entitled to the benefit of an indemnity under Clause 9 or in respect of which it is entitled to reimbursement (the **"Indemnified Party"**), it shall notify the other Party responsible for indemnifying such claim hereunder (the **"Indemnifying Party"**) within 15 (fifteen) days of receipt of the claim and shall not settle or pay the claim without the prior approval of the Indemnifying Party, which approval shall not be unreasonably withheld or delayed. In the event that the Indemnifying Party wishes to contest or dispute the claim, it may conduct the proceedings in the name of the Indemnified Party and shall bear all costs involved in contesting the same. The Indemnified Party shall provide all cooperation and assistance in contesting any claim and shall sign all such writings and documents as the Indemnifying Party may reasonably require.

9 No third party beneficiaries

This Agreement is solely for the benefit of the Parties and no other person or entity shall have any rights hereunder.

10 Waiver

10.1 Waiver by any Party of a default by another Party in the observance and performance of any provision of or obligations under this Agreement:

(a) shall not operate or be construed as a waiver of any other or subsequent default hereof or of other provisions of or obligations under this Agreement;

(b) shall not be effective unless it is in writing and executed by a duly authorised representative of the Party; and

(c) shall not affect the validity or enforceability of this Agreement in any manner.

10.2 Neither the failure by any Party to insist on any occasion upon the performance of the terms, conditions and provisions of this Agreement or any obligation there under nor time or other indulgence granted by any Party to another Party shall be treated or deemed as waiver of such breach or acceptance of any variation or the relinquishment of any such right hereunder.

11 Survival

11.1 Termination of this Agreement:

a. shall not relieve the Parties of any obligations hereunder which expressly or by implication survive termination hereof; and

b. except as otherwise provided in any provision of this Agreement expressly limiting the liability of either Party, shall not relieve either Party of any obligations or liabilities for loss or damage to the other Party arising out of, or caused by, acts or omissions of such Party prior to the effectiveness of such termination or arising out of such termination.

11.2 All obligations surviving the cancellation, expiration or termination of this Agreement shall only survive for a period of 3 (three) years following the date of such termination or expiry of this Agreement.

12 Severability

If for any reason whatever any provision of this Agreement is or becomes invalid, illegal or unenforceable or is declared by any court of competent jurisdiction or any other instrumentality to be invalid, illegal or unenforceable, the validity, legality or enforceability of the remaining provisions shall not be affected in any manner, and the Parties will negotiate in good faith with a view to agreeing to one or more provisions which may be substituted for such invalid, unenforceable or illegal provisions, as nearly as is practicable to such invalid, illegal or unenforceable provision. Failure to agree upon any such provisions shall not be subject to dispute resolution under Clause 10.1 of this Agreement or otherwise.

13 Successors and assigns

This Agreement shall be binding on and shall inure to the benefit of the Parties and their respective successors and permitted assigns.

14 Notices

All notices or other communications to be given or made under this Agreement shall be in writing and shall either be delivered personally or sent by courier or registered post with an additional copy to be sent by facsimile or e-mail. The address for service of each Party, its facsimile number or e- mail is set out under its name on the signing pages hereto. A notice shall be effective upon actual receipt thereof, save that where it is received after 5.30 (five thirty) p.m. on a business day, or on a day that is not a business day, the notice shall be deemed to be received on the first business day following the date of actual receipt. Without prejudice to the foregoing, a Party giving or making a notice or communication by facsimile or e-mail shall promptly deliver a copy thereof personally, or send it by courier or registered post to the addressee of such notice or communication. It is hereby agreed and acknowledged that any Party may by notice change the address to which such notices and communications to it are to be delivered or mailed. Such change shall be effective when all the Parties have notice of it.

15 Language

All notices, certificates, correspondence and proceedings under or in connection with this Agreement shall be in English.

16 Authorized representatives

Each of the Parties shall, by notice in writing, designate their respective authorized representatives through whom only all communications shall be made. A Party hereto shall be entitled to remove and/or substitute or make fresh appointment of such authorized representative by similar notice.

17 Original Document

This Agreement may be executed in four counterparts, each of which when executed and delivered shall constitute an original of this Agreement.

IN WITNESS WHEREOF THE PARTIES HAVE EXECUTED AND DELIVERED THIS AGREEMENT AS OF THE DATE FIRST ABOVE WRITTEN.

THE COMMON SEAL OF AGENCY has been affixed pursuant to the resolution passed by the Board of Directors of the Agency at its meeting held on the …… day of 20…… hereunto affixed in the presence of ……, Director, who has signed these presents in token thereof and ……, Company Secretary / Authorized Officer who has countersigned the same in token thereof:

SIGNED, SEALED AND	SIGNED, SEALED AND
DELIVERED	DELIVERED
For and on behalf of	For and on behalf of
ESCROW BANK by:	WAPCOS LIMITED by:
(Signature)	(Signature)
(Name)	(Name)
(Designation)	(Designation)
(Address)	(Address)
(Fax No.)	(Fax No.)
(e-mail address)	(e-mail address)

In the presence of:

1. 2.

SECTION - V

GENERAL CONDITIONS OF CONTRACT

SECTION - V
GENERAL CONDITIONS TO CONTRACT

1.0 GENERAL RULES AND DIRECTIONS

General Rules & Directions	1.	The work proposed for execution by contract will be notified in a form of invitation to tender by publication in Newspapers and / or posted onwebsite as the case may be. This form will state the work to be carried out, as well as the date for submitting and opening tenders and the time allowed for carrying out the work, also the amount of earnest money to be deposited with the tender, and the amount of the security deposit and Performance guarantee to be deposited by the successful tenderer and the percentage, if any, to be deducted from bills. The work involves execution as per name of work under either EPC Mode I or Mode II or Mode III as specified in Operative Schedule. **Mode I** involves Engineering (preparation of Architectural, structural and services design and drawings), procurement & construction by the contractor based on conceptual architectural drawings attached with the tender documents; **Mode II** involves part Engineering (preparation of structural and services design and drawings), procurement & construction by the contractor based on Preliminary/ Conceptual Architectural design and drawings attached with the tender documents; detailed Architectural design and drawings may be provided by the Engineer-in-Charge in stages/ parts during execution. **Mode III** involves procurement & construction by the contractor based on Architectural, structural and services design and drawings attached with the tender documents or to be provided by the Engineer-in-Charge in stages / parts during execution. The Type of building i.e Permanent or Semi-Permanent, based on the expected economic life of the building, shall be as specified in Schedule-F. Tenders invited in Mode I and Mode II are technology neutral. Bidders can choose any of the approved technologies depending upon type of building, other suitability conditions (such as seismic zone, number of storeys etc.) as per Operative Schedule under Mode I and II as per structural design, subject further to the condition that the structural system technologies categorized under Pre-cast Construction System and adopted for buildings under Seismic Zone IV as per IS 1893(Part-I) :2016 amended from time to time, shall have passed the full scale type testing for pseudo-static reversed cyclic test as detailed below: Pseudo-Static Reversed -Cyclic Test The test shall be conducted on typical three storeys of multi-storey building, which (a) are built with the full-scale components precast as per technology (b) are the weakest and/or most flexible, and (c) have all the typical connections of the building in precast, namely interior, exterior and corner wall to wall (vertical) connections, wall to slab (horizontal)

		connections and wall to wall (horizontal) connections, if any, as built in the original system with minimum four room layout plan. The bottom of the first storey shall be connected to the strong floor of the test facility, and the floors of the upper storeys to the Displacement-controlled actuators of the requisite Displacement (and force) capacity. This proto-type shall be loaded with the due vertical gravity load representing service level dead and live loads. The profile of displacement loading shall be as per the force distribution profile specified in IS 1893 (part I):2016 in the Equivalent Static Method of design. Displacement controlled loading: At least 3 loading cycles (Full positive and Full negative) at Each of the displacement excursions of 0.1%, 0.2%, 0.3%,0.4%, 0.5%, 0.75%, 1%, 1.5%, 2%, 2.5%, 3%, 3.5%, 4%, 5% and 6% drift of specimen, or failure of the specimen, whichever is earlier. (i) 6% drift requirement is an upper limit. Actual drift is expected to be lesser than 6% depending on: Deformability of the building, and Flexibility of the connections. The test may be stopped when either 6% drift or the maximum lateral force of 3 times the design base shear is reached. (ii) Pseudo-static reversed cyclic test does not require a Shake Table facility. Number of samples and Frequency: One sample shall be tested unless the structure shows premature failure before reaching at least 6% overall drift, either elastically or in elastically. If the structure fails to meet 6% drift requirement, then another sample be tested to reconfirm the failure pattern observed in the first specimen. If both samples fail, said configuration of the technology shall not be adopted in the work. One test for every new type of connection system adopted shall be conducted. If the connection type / combination of elements under approved technology are changed, either in part or in full, the system will be treated as new. The test should have been already got conducted from any government academic institute of repute or government R&D organization in India. The testing charges shall be borne by the contractor.
	2.	In the event of the tender being submitted by a Partnership firm, it must be signed separately by each partner thereof or in the event of the absence of any partner/director, it must be signed on his behalf by a person holding a Power of Attorney authorizing him to do so, such power of attorney to be produced with the tender, and it must disclose that the firm/company is duly registered under the applicable Indian Partnership Act 1932/ Companies Act 2013..
	3.	Receipts for payment made on account of work, when executed by a firm/company, must also be signed by all the partners/directors, except where contractors are described in their tender as a firm/company, in which case the receipts must be signed in the name of the firm by one of the partners/directors (duly authorized by the firm/company), or by some other person

		having due authority to give effectual receipts for the firm/company.
	4A	**Applicable for Percentage RateEPC Tender only** In case of Percentage Rate EPC tenders, contractor shall fill up percentage below/ above (in figures as well as in words) the total estimated cost given in Schedule of Quantities at Schedule-A, he will be willing to execute the work. The tender submitted shall be treated as invalid if :- I. The contractor does not quote percentage above/below on the total amount of tender or any section/sub head of the tender. II. The percentage above/below is not quoted in figures & words both on the total amount of tender or any section/sub head of the tender. III. The percentage quoted above/below is different in figures &words on the total amount of tender or any section/sub head of the tender. Tenders, which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort including conditional rebates, will be summarily rejected.
	4B	In case the lowest tendered amount (estimated cost + amount worked on the basis of percentage above/below) of two or more contractors is same, such lowest contractors will be asked to submit sealed revised offer in the form of letter mentioning percentage above/ below on estimated cost of tender including all sub sections/sub heads as the case may be, but the revised percentage quoted above/below on tendered cost or on each sub section/ sub head should not be higher than the percentage quoted at the time of submission of tender. The lowest tender shall be decided on the basis of revised offers. In case any of such contractor refuses to submit revised offer, then it shall be treated as withdrawal of his tender before acceptance and 50% of earnest money shall be forfeited. If the revised tendered amount of two more contractors received in revised offer is again found to be equal, the lowest tender, among such contractors, shall be decided by draw of lots in the presence of designated committee of WAPCOS & the lowest contractors those have quoted equal amount of their tenders. In case all the lowest contractors those have quoted same tendered amount, refuse to submit revised offers, then tenders are to be recalled after forfeiting 50% of EMD of each contractor. Contractor(s), whose earnest money is forfeited because of non- submission of revised offer, shall not be allowed to participate in the re-tendering process of the work.

	5.	The designated committee will open tenders in the presence of any intending contractors who may be present at the time, and will enter the amounts of the several tenders in a comparative statement in a suitable form. In the event of a tender being accepted, a receipt for the earnest money shall thereupon be given to the contractor who shall thereupon for the purpose of identification sign copies of the specifications and other documents. In the event of a tender being rejected, the earnest money shall thereupon be returned to the contractor remitting the same, without any interest.
	6.	WAPCOS shall have the right of rejecting all or any of the tenders andwill not be bound to accept the lowest or any other tender
	7.	The receipt of an accountant or clerk for any money paid by the contractor will not be considered as any acknowledgment or payment to the officer inviting tender and the contractor shall be responsible for seeing that he procures a receipt signed by the officer inviting tender or a duly authorized Cashier.
Applicable for Item Rate EPC Tender	8.	In the case of Item Rate EPC Tenders, only rates quoted shall be considered. Any tender containing percentage below/above the rates quoted is liable to be rejected. Rates quoted by the contractor in item rate EPC tender in figures and words shall be accurately filled in so that there is no discrepancy in the rates written in figures and words. However, if a discrepancy is found, the rates which correspond with the amount worked out by the contractor shall unless otherwise proved be taken as correct. If the amount of an item is not worked out by the contractor or it does not correspond with the rates written either in figures or in words, then the rates quoted by the contractor in words shall be taken as correct. Where the rates quoted by the contractor in figures and in words tally, but the amount is not worked out correctly, the rates quoted by the contractor will unless otherwise proved be taken as correct and not the amount. In event no rate has been quoted for any item(s), leaving space both in figure(s), word(s), and amount blank, it will be presumed that the contractor has included the cost of this/these item(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly. However, if a tenderer quotes nil rates against any item in item rate EPC tender, the tender shall be treated as invalid and will not be considered as lowest tenderer and earnest money deposited shall be forfeited.
In case of Percentage Rate EPC Tenders only	9.	In case of Percentage Rate EPC Tenders only percentage quoted shall be considered. Any tender containing item rates is liable to be rejected. Percentage quoted by the contractor in percentage rate EPC tender shall be accurately filled in figures and words, so that there is no discrepancy.
Applicable for Percentage Rate EPC Tender only	10.	In Percentage Rate EPC Tender, the tenderer shall quote percentage below/above (in figures as well as in words) at which he will be willing to execute the work. He shall also work out the total amount of his offer and the same should be written in figures as well as in words in such a way

		that no interpolation is possible. In case of figures, the word 'Rs.' should be written before the figure of rupees and word 'P' after the decimal figures, e.g. 'Rs. 2.15P and in case of words, the word 'Rupees' should precede and the word 'Paisa' should be written at the end
	11.	i. The Contractor whose tender is accepted, will be required to furnish performance guarantee at specified percentage of the tendered amount as mentioned in Operative Schedule and within the period specified in Operative Schedule. This guarantee shall be in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee of any Commercial Bank. ii. The contractor whose tender is accepted will also be required to furnish by way of Security Deposit for the fulfillment of his contract, an amount equal to 4% of the tendered amount of the work. The Security deposit will be collected by deductions from the running bills as well as final bill of the contractor at the rates mentioned above. The Security amount will also be accepted in the shape of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks will be accepted for this purpose provided confirmatory advice is enclosed
	12.	On acceptance of the tender, the name of the accredited representative(s) of the contractor who would be responsible for taking instructions from the Engineer-in-Charge shall be communicated in writing to the Engineer-in-Charge.
	13.	GST or any other tax applicable in respect of inputs procured by the contractor for this contract shall be payable by the Contractor and Government will not entertain any claim whatsoever in respect of the same. However, component of GST at time of supply of service (as provided in CGST Act 2017) provided by the contract shall be varied if different from that applicable on the last date of receipt of tender including extension if any. Accordingly payment or recovery shall be done.
	14.	The contractor shall give a list of WAPCOS employees related to him.
	15.	The tender for composite work includes, in addition to building work, allother works such as sanitary and water supply installations drainage installation, electrical work, horticulture work, roads and paths etc.

2.0 CONDITIONS OF CONTRACT

Definitions	1.	The EPC Contract means the documents forming the tender and acceptance thereof and the formal agreement executed between the WAPCOS and the Contractor, together with the documents referred to therein including conditions, specifications, designs, drawings and instructions issued from time to time by the Engineer-in- Charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another
	2.	In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them:- "Employer" shall mean "WAPCOS Limited", A Government of India undertaking- Ministry of Water Resources, River Development & Ganga Rejuvenation, for execution of the Work / Project as mentioned in NIT. i. having their Registered office at 5th floor, Kailash building, 26-Kasturba Gandhi Marg, New Delhi-110001, India & include their successors & permitted assigns as well as their authorized officer / representatives ii. The "COMPANY / WAPCOS" shall mean WAPCOS Limited. iii. **Owner/Client** / IIT(ISM) Dhanbad shall means Indian Institute of Technology(Indian School of Mines) Dhanbad iv. The expression **works** or **work** shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional. v. The **Site** shall mean the land, places on, into or where work is to be executed under the contract or any adjacent land, path or street or where work is to be executed under the contract or any adjacent land, path or street which may be temporally allotted or used for the purpose of carrying out the contract vi. The **Bidder /Contractor** shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of suchfirm or company and the permitted assignees of such individual, firmor company who are participating in Bidding process and will Execution the project after award of the works as Contractor. vii. The **Engineer-in-Charge** means the Engineer Officer appointed by WAPCOS or his duly authorized representative who shall

		direct, supervise and be incharge of the work for the purpose of this Contract as mentioned in Operative Schedule hereunder viii. **Accepting Authority** shall mean the authority mentioned in Operative Schedule '. ix. **Tenderer / Bidder** shall mean the firm/party who intends to participate in this Notice Inviting Tender x. **Excepted Risk** are risks due to riots (other than those on account of contractor's employees), war (whether declared or not) invasion, act
		of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft, acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by Government of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to Government's faulty design of works. xi. **Market Rate** shall be the rate as decided by the Engineer-in-charge on the basis of the cost of materials and labour at the site where the work is to be executed plus applicable overheads and profits as mentioned in Operative Schedule. Provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the contractor as per terms of contract. xii. **Schedule(s)** referred to in these conditions shall mean the relevant schedule(s) annexed to the tender papers or the standard Schedule of Rates of the government mentioned in operative schedule hereunder, with the amendments thereto issued upto the date of receipt of the tender. xiii. **District Specifications** means the specifications followed by the StateGovernment in the area where the work is to be executed. xiv. The **Contractor/Successful Bidder** shall mean the firm or company whose bid has been accepted by WAPCOS. xv. **Consultant** shall mean any consultant nominated by the WAPCOS xvi. **Tendered value** means the value of the entire work as stipulated in the letter of award. xvii. **Date of commencement of work:** The date of commencement of work shall be the date of start as specified in operative schedule or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document

		xviii. GST shall mean Goods and Service Tax - Central, State and Inter State.
Scope and Performance	3.	Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gendershall whenever required include feminine gender and vice versa.
	4.	Headings and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.
	5.	The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications, Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the tender documents. None of these documents shall be used for any purpose other than that of this contract.
Works to be carried out	6.	The work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all labourers, materials, tools, plants, equipment and transport which may be required for full and entire execution and completion of the works. The descriptions given in the Schedule of Quantities (As per Operative Schedule) shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labours necessary in and for the full and entire execution and completion of the work as aforesaid in accordance with good practice and recognized principles,
Sufficiency of Tender	7.	The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the Cost quoted in the Schedule of Quantities/ Building Components, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the works.
Discrepancies and Adjustment of Errors	8.	The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.

	8.1	In the case of discrepancy between the schedule of Quantities/Building Components, the Specifications and/ or the Drawings, the following order of preference shall be observed:- i. Description of Schedule of Quantities/ Building Components. ii. Particular Specification and Special Condition, if any. iii. Drawings. iv. CPWD Specifications. v. Indian Standard Specifications of B.I.S.
	8.2	If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.
	8.3	Any error in description, quantity or rate in Schedule of Quantities or anyomission therefrom shall not vitiate the Contract or release the Contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from anyof his obligations under the contract.
Signing of Contract	9.	The successful tenderer/contractor, on acceptance of his tender by the Accepting Authority, shall, within 30 days from the stipulated date of start of the work, sign the contract consisting of:- i. The notice inviting tender, all the documents including drawings, if any, forming the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto. ii. Forms and annexures , Special Conditions of Contract consisting and various documents as mentioned in Operative Schedule consisting of: a) Various standard clauses with corrections up to the date stipulated in Operative Schedule along with annexures thereto. b) Safety Code. c) Model Rules for the protection of health, sanitary arrangementsfor workers employed WAPCOS or its contractors. d) Contractor's Labour Regulations. e) List of Acts and omissions for which fines can be imposed.
		iii. No payment for the work done will be made unless contract is signedby the contractor.

3.0 CLAUSES OF CONTRACT

CLAUSE 1: PERFORMANCE GUARANTEE

i. The contractor shall submit an irrevocable Performance Guarantee at specified percentage of the tendered amount as mentioned in Operative Schedule, in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within period specified in Operative Schedule from the date of issue of letter of acceptance. This period can be further extended by the Engineer- in-Charge up to a maximum period as specified in Operative schedule on written request of the contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This Guarantee shall be in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks. In case a fixed deposit receipt of any Bank is furnished by the contractor to the WAPCOS as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the WAPCOS to make good the deficit.

ii. **The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 06 months claim period beyond that**. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the performance guarantee shall be returned to the contractor, without any interest. However, in case of contracts involving maintenance of building and services/any other work after construction of same building and services/other work, then 50% of Performance Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

iii. In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full.

iv. The Performance Guarantee shall be refunded to the Contractor soon after the completion of works and issuance of the completion certificate.

CLAUSE 1A: RECOVERY OF SECURITY DEPOSIT

The person/persons whose tender(s) may be accepted (hereinafter called the contractor) shall permit WAPCOS at the time of making any payment to him for work done under the contract to deduct a sum at the rate of 4.0 % of the gross amount of each running and final bill till the sum deducted will amount to security deposit of 4.0 % of the tendered value of the work. Such deductions will be made and held by WAPCOS by way of Security Deposit unless he/they has/have deposited the amount of Security at the rate mentioned above in cash or in the form of Government Securities or fixed deposit receipts. In case a fixed deposit receipt of any Bank is furnished by the contractor to the WAPCOS as part of the security deposit and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the WAPCOS to make good the deficit.

All compensations or the other sums of money payable by the contractor under the terms of this contract may be deducted from, or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the contractor by WAPCOS on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid, the contractor shall within 10 days make good in cash or fixed deposit receipt tendered by the State Bank of India or by Scheduled Banks endorsed in favour of WAPCOS LIMITED, any sum or sums which may have been deducted from, or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills and the final bill of the contractor at the rates mentioned above.

The security deposit as deducted above can be released against bank guarantee issued by a scheduled bank, on its accumulations to a minimum of Rs. 5 lac subject to the condition that amount of such bank guarantee, except last one, shall not be less than Rs. 5 lac. Provided further that the validity of bank guarantee including the one given against the earnest money shall be in conformity with provisions contained in clause 17 which shall be extended from time to time depending upon extension of contract granted under provisions of clause 2 and clause 5.

The Security Deposit shall be released after successful completion of Defect Liability Period and maintenance period.

In case of contracts involving maintenance of building and services/any other work after construction of same building and services/other work, then 50% of Performance Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately

Note-1: Government papers tendered as security will be taken at 5% (five per cent) below its market price or at its face value, whichever is less. The market price of Government paper would be ascertained by the Engineer-in-charge at the time of collection of interest and the amount of interest to the extent of deficiency in value of the Government paper will be withheld if necessary.
Note-2: Government Securities will include all forms of Securities mentioned in Rule No. 274 of the G.F. Rules except fidelity bond. This will be subject to the observance of the condition mentioned under the rule against each form of security.
Note-3: Note 1 & 2 above shall be applicable for both clause 1 and 1A

CLAUSE 2: COMPENSATION FOR DELAY

If the contractor fails to maintain the required progress in terms of clause 5 or to complete the work and clear the site on or before the stipulated completion date or justified extended date of completion determined as per clause 5 (excluding any extension under clause 5.5) also considering any extension granted under clauses 12 and 15, he shall, without prejudice to any other right or remedy available under the law to the Government on account of such breach, pay as compensation, the amount calculated as below :

(i) Compensation for delay of work @ 0.75% of accepted tendered amount per month of delay (to be computed on per day basis) Provided further that the total amount of compensation for delay to be paid under this condition shall not exceed 5 % (five percent) of the accepted Tendered Value of work or of the accepted Tendered Value of the Sectional part of work as mentioned in Operative Schedule for which a separate period of completion is originally given.
The period of delay solely attributable to contractor shall be computed as the time taken by contractor

going beyond the 'justified date of completion' as determined by the authority specified in Operative Schedule under clause 5. Further, in case where the contractor is entitled to additional time under clause 12 and /or clause 15, that shall also be accounted for while deciding the net period of delay. In case, the authority specified in Operative Schedule decides to levy compensation during the progress of work, the period of delay attributable to contractor shall be computed (by such authority) as the period by which the progress is behind the schedule on date of such decision, after due consideration of justified extension at that stage of work.

In case no compensation has been decided by the authority in Operative Scheduleduring the progress of work, this shall be no waiver of right to levy compensation by the said authority if the work remains incomplete on final justified extended date of completion.

If the Engineer in Charge decides to give further extension of time allowing performance of work beyond the justified extended date the contractor shall be liable to pay compensation for such extended period. The levy of compensation under this clause shall be without prejudice to the right of action by the Engineer-in-charge under clause 3 or any other clause in contract.

In case action under clause 2 has not been finalized and the work has been determined under clause 3, the right of action under clause 2 shall remain post determination of contract and in such case the levy of compensation shall be for days the progress is behind the schedule on date of determination, as assessed by the authority in Operative Schedule, after due consideration of justified extension. The compensation for delay, if not decided before the determination of contract, shall be decided after of determination of contract. Further, in such case where the contract has been determined, the total amount of recovery against compensation under clause 2 plus that under clause 3 (i.e. forfeiture of security deposit, performance guarantee) shall not exceed 8 % of the accepted tendered value of work.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with the Government.
In case, the contractor does not achieve a particular milestone mentioned in Operative Schedule, or the re-scheduled milestone(s) in terms of Clause 5, the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied as above. With-holding of this amount on failure to achieve a milestone, shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. The amount so withheld can be released against BG/ FDR from a commercial bank of equivalent amount. Further, no interest, whatsoever, shall be payable on such withheld amount.

CLAUSE 3: WHEN CONTRACT CAN BE DETERMINED

Subject to other provisions contained in this clause, the Engineer-in-Charge may, without prejudice to his any other rights or remedy against the contractor in respect of any delay, not following safety norms , inferior workmanship, any claims for damages and/or any other provisions of this contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:

i. If the contractor having been given by the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient

or otherwise improper or un-workman like manner shall omit to comply with the requirement of such notice for a period of seven days thereafter.

ii. If the contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence so that in the opinion of the Engineer-in-Charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.

iii. If the contractor fails to complete the work within the stipulated date or items of work with individual date of completion, if any stipulated, on or before such date(s) of completion and does not complete them within the period specified in a notice given in writing in that behalf by the Engineer-in-Charge.

iv. If the contractor persistently neglects to carry out his obligations under the contract and/ or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge.

v. If the contractor shall offer or give or agree to give to any person in WAPCOS service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for WAPCOS.

vi. If the contractor shall enter into a contract with WAPCOS in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge.

vii. If the contractor had secured the contract with WAPCOS as a result of wrong tendering or other non-bonafide methods of competitive tendering or commits breach of Integrity Agreement.

viii. If the contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.

ix. If the contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to appoint a receiver or a manager or which entitle the court to make a winding up order.

x. If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.

xi. If the contractor assigns (excluding part(s) of work assigned to other agency(s) by the contractor as per terms of contract), transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer -in-Charge. When the contractor has made

himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of the President of India shall have powers:

a) To determine the contract as aforesaid so far as performance of work by the Contractor is concerned (of which determination notice in writing to the contractor under the hand of the Engineer-in-Charge shall be conclusive evidence). Upon such determination, the performance guarantee shall stand forfeited in full, Security Deposit already recovered and Security deposit recoverable shall be liable to be forfeited and shall be absolutely at the disposal of the WAPCOS.

b) After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another contractor to complete the work. The contractor, whose contract is determined as above, shall not be allowed to participate in the tendering process for the remaining work which may include any new items to complete the work. In the event of above courses being adopted by the Engineer- in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provision aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

CLAUSE 3A NOT APPLICABLE

In case, the work including planning designing and execution as per scope of contract cannot be started due to reasons not within the control of the contractor within 1/8th of the stipulated time for completion of work or 180 days whichever is higher, either party may close the contract by giving notice to the other party stating the reasons. In such eventuality, the Performance Guarantee of the contractor shall be refunded within 30 days of closing of the contract.

Neither party shall claim any compensation for such eventuality. This clause is not applicable for any breach of the contract by either party.

CLAUSE 4: CONTRACTOR LIABLE TO PAY COMPENSATION EVEN IF ACTION NOT TAKEN UNDERCLAUSE 3

In any case in which any of the powers conferred upon the Engineer-in-Charge by Clause-3 thereof, shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or anytools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor, or procured by the contractor and intended to be used for the execution of the work/or any part thereof, paying or allowing for the same in account at the contract rates, or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose certificate thereof shall be final, and binding on the

contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and his risk in all respects and the certificate of the Engineer-in-Charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

CLAUSE 5: TIME AND EXTENSION FOR DELAY

The time allowed for execution of the Works as specified in the Operative Scheduleor the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the work shall commence from such date as mentioned in Operative Scheduleor from the date of handing over of the site, as notified by the Engineer-in-Charge, whichever is later. If the Contractor commits default in commencing the execution of the work as aforesaid and such default continues even after 10 days after a notice in writing has been given by the Engineer in charge, the performance guarantee shall be forfeited by the Engineer in Charge and shall be absolutely at the disposal of the WAPCOS without prejudice to any other right or remedy available in law. The contract shall stand determined when such decision regarding the forfeiture of the performance guarantee is communicated to the contractor.

5.1 As soon as possible after the Contract is concluded, the Contractor shall submit a Time and Progress Chart for each mile stone and get it approved by the WAPCOS. The Chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate programme has been agreed upon) complete the work as per mile stones given in Special Conditions of Contract.

(a) Project Management shall be done by using project management software for works costing more than Rs. 5 Crore.
(b) The project management shall be done using M.S. Project software for works costing more than Rs. 5 Crore and up to Rs. 20 Crore.
(c) For works costing more than Rs. 20 Crore, project management shall be done using Primavera Software.

PROGRAMME CHART

(i) The Contractor shall prepare an integrated programme chart in MS Project/Primavera software for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfillment of the programme within the stipulated period or earlier and submit the same for approval to the Engineer-in- Charge within ten days of award of the contract. A recoveryof Rs. 2500/- (for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more thanRs. 20 Crores) shall be made

on per day basis in case of delay in submission of the above programme.

(ii) The programme chart should include the following:

(a) Descriptive note explaining sequence of the various activities.
(b) Network (PERT / CPM / BAR CHART).
(c) Programme for procurement of materials by the contractor.

Programme of procurement of machinery / equipments having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor. In addition to above, to achieve the progress of Work as per programme, the contractor must bring at site adequate shuttering material required for cement concrete and R.C.C. works etc. for three floors within one month from the date of start of work till the completion of RCC work as per requirement of work. The contractor shall submit shuttering schedule adequate to complete structure work within laid down physical milestone.

(iii) If at any time, it appears to the Engineer-in-Charge that the actual progress of work does not conform to the approved programme referred above or after rescheduling of milestones, the contractor shall produce a revised programme within 7 (seven) days,showing the modifications to the approved programme to ensure timely completion of thework. The modified schedule of programme shall be approved by the Engineer in Charge. A recovery of Rs. 2500/- (for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more than Rs. 20 Crores) shall be made on per day basis in case of delay in submission of the modified programme.

(iv) The submission for approval by the Engineer-in-Charge of such programme or such particulars shall not relieve the contractor of any of the duties or responsibilities under thecontract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.

(v) The contractor shall submit the progress report using MS Project/Primavira software with base line programme referred above for the work done during previous month to the Engineer-in-charge on or before 5th day of each month failing which a recovery Rs. 2500/ -

(for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more than Rs. 20 Crores) shall be made on per day basis in case of delay in submission of the monthly progressreport.

5.2 If the work(s) be delayed by :-

(i) force majeure, or
(ii) abnormally bad weather, or
(iii) serious loss or damage by fire, or
(iv) civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or
(v) delay on the part of other contractors or tradesmen engaged by Engineer-in-Charge in executing work not forming part of the Contract, or
(vi) any other cause which, in the absolute discretion of the Engineer-in-Charge is beyond the Contractor's control.

then upon the happening of any such event causing delay, the Contractor shall immediatelygive

notice thereof in writing to the authority as indicated in operative schedule but shall nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Engineer-in-Chargeto proceed with the works.

5.3 Request for rescheduling of Mile stones and extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay on the prescribed form to the authority as indicated in schedule 'F. The Contractor may also, if practicable, indicate in such a request the period for which extension is desired.

5.4 In any such case the authority as indicated in operative schedule may give a fair and reasonable extension of time and reschedule the mile stones for completion of work. Such extension or rescheduling of the milestones shall be communicated to the Contractor by the authority as indicated in Special Conditions of Contract in writing, within 3 months or 4 weeks of the date of receipt of such request respectively. Non application by the contractor for extension of time/ rescheduling of the milestones shall not be a bar for giving a fair and reasonable extension/ rescheduling of the milestones by the authority as indicated in operative schedule and this shall be binding on the contractor.

CLAUSE 6: COMPUTERIZED MEASUREMENT BOOK

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurementthe value of work done in accordance with the contract.

All measurements of all items having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book having pages of A-4 size as per the format of the WAPCOS so that a complete record is obtained of all the items of works performed under the contract.

All such measurements and levels recorded by the contractor or his authorized representative fromtime to time, during the progress of the work, shall be got checked by the contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections made bythe Engineer-in-Charge, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in- Charge for the dated signatures by the Engineer-in- Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment, the contractor would initially submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The contractor will, thereafter, incorporate such changes as may be done during these checks/test checks in his draft computerized measurements, and submit to the WAPCOS a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in- Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

The final, fair, computerized measurement book given by the contractor, duly bound, with its

pages machine numbered, should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a freshcomputerized MB with its pages duly machine numbered and bound. The contractor shall submit two spare copies of such computerized MB's for the purpose of reference and records.

The contractor shall also submit to the WAPCOS separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the bill. Thereafter, this bill will be processed by the Engineer-In-Charge

The contractor shall, without extra charge, provide all assistance with every appliance, labour andother things necessary for checking of measurements/levels by the Engineer-in- Charge or his representative.

Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

The contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work ithout consent in writing of the Engineer-in-Charge or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the WAPCOS to check the measurements recorded by contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.It is also a term of this contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE 7: PAYMENT ON INTERMEDIATE CERTIFICATE TO BE REGARD AS ADVANCE---------NOT APPLICABLE

No payment shall be made for work, estimated to cost Rs. Twenty thousand or less till after the whole of the work shall have been completed and certificate of completion given. For works estimated to cost over Rs. Twenty thousand, the interim or running account bills shall be submitted by the contractor for the work executed on the basis of such recorded measurements on the formatof the WAPCOS in triplicate on or before the date of every month fixed for the same by the Engineer- in-Charge. The contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment/ adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Special Conditions of Contract, in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified by taking or causing to be taken, where necessary, the requisite measurements of the work. In the event of the failure of the contractor to submit the bills, Engineer-in-Charge shall prepare or cause to be prepared such bills in which event no claims whatsoever due to delays on payment including that of interest shall be payable to the contractor. Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge. The amount admissible shall be paid by 10th working day after the day of presentation of the bill by the Contractor to the Engineer-in-Charge together with the account of the material issued by the WAPCOS, or dismantled materials, if any. In the case of works outside the headquarters of the Engineer- in-Charge, the period of ten working days will be extended to fifteen working days.

All such interim payments shall be regarded as payment by way of advances against final paymentonly and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-Charge relating to the work done or materials delivered forming part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-in-Chargeunder the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the WAPCOS to take action under the terms of this contract for delay in the completion of work, if the extension of date of completion isnot granted by the competent authority.

The Engineer-in-Charge in his sole discretion on the basis of a certificate from the Engineer-In-Charge to the effect that the work has been completed up to the level in question make interim advance payments without detailed measurements for work done (other than foundations, items to be covered under finishing items) up to lintel level (including sunshade etc.) and slab level, for each floor working out at 75% of the assessed value. The advance

payments so allowed shall be adjusted in the subsequent interim bill by taking detailed measurements thereof.

In case of composite tenders, running payment for the major component shall be made by Engineer- In-Charge of major discipline to the main contractor. Running payment for minor component shall be made by the Engineer-in-Charge of the discipline of minor component directly to the main contractor.

In case main contractor fails to make the payment to the contractor associated by him within 15 days of receipt of each running account payment, then on the written complaint of contractor associated for such minor component, Engineer in charge of minor component shall serve the show cause to the main contractor and if reply of main contractor either not received or found unsatisfactory, he may make the payment directly to the contractor associated for minor component as per the terms and conditions of the agreement drawn between main contractor and associate contractor fixed by him. Such payment made to the associate contractor shall be recovered by Engineer-in-charge of major or minor component from the next R/A/ final bill due tomain contractor as the case may be.

Clause 7A

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the contractor to the Engineer-in-Charge.

Clause 7B - Payment to third party

If the exigencies of the work so demand, the engineer-in-charge may allow payment to a third party, who is creditor to the contractor, after fulfilling the following conditions.

(a) The contractor gives an authority letter addressed to the engineer-in-charge on a non- judicial stamp paper of Rs.100 in the format given below.

I/We authorize the WAPCOS to pay directly on my/our behalf to (name of the third party) an amount of Rs.....(Rupees in words) for the work done or supplies made by (name of the third party). I/We shall be responsible for the quality and quantity of the same under the provisions of agreement number .....

Signature of the contractor

(b) The total payment to third party (or parties) shall not exceed 10% of the agreement cost of the work.

Full reasons for proposing such third party payment shall be recorded and prior written approval of the next higher authority shall be obtained before making such payment.

CLAUSE 8: COMPLETION CERTIFICATE AND COMPLETION PLANS

Within ten days of the completion of the work, the contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice, the Engineer-in- Charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the contractor and/or (b) for which payment

will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning offdirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials or final cleaning works as aforesaid except for any sum actually realizedby the sale thereof.

CLAUSE 8A: COMPLETION PLANS TO BE SUBMITTED BY THE CONTRACTOR

The contractor shall submit completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work.

In case, the contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum of 1 %(one percent) of Tendered Value or limit prescribed in Operative Schedule whichever is more as may be fixed by the authority as mentioned in Operative Schedule and in this respect the decision of the that authority shall be final and binding on the contractor.

CLAUSE 9: PAYMENT OF FINAL BILL

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within one month of the date of the final certificate of completion furnished by the Engineer-in- Charge. No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period specified hereinunder, the period being reckoned from the date of receipt of the bill by the Engineer-in-Charge or hisauthorized Engineer, complete with account of materials issued by the WAPCOS and dismantled materials.

a) Tendered value of work is up to Rs. 45 lac — 2 months

b) If the Tendered value of work is more than Rs. 45 lac and up to Rs. 2.5 Crore — 3 months

c) If the Tendered value of work exceeds Rs. 2.5 Crore : — 6 months

CLAUSE 9A: PAYMENT OF CONTRACTOR'S BILLS TO BANKS

Payments due to the contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank; registered financial,co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by WAPCOS or his signature on the bill or other claim preferred against WAPCOS before settlement by the Engineer- in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions. While the receipt given by such banks; registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank; registered financial, co-operative or thrift societies or recognized financial institutions any rights or equities vis-à-vis the WAPCOS.

CLAUSE 10A: MATERIALS TO BE PROVIDED BY CONTRACTOR

The contractor shall, at his own expense, provide all materials, required for the works other than those which are stipulated to be supplied by the WAPCOS

The contractor shall, at his own expense and without delay, supply to the Engineer-in- Charge samples of materials to be used on the work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid downor referred to in the contract. The contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Engineer-in- Charge shall within thirty days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer-in-Charge for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shallbe issued after the test results are received.

The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in- Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer-in-Charge and bear all charges and cost of testing unless specifically provided for

otherwise elsewhere in the contract or specifications. The Engineer-in- Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

The contractor shall at his own expense, provide a material testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified in operative schedule.

CLAUSE 10B:

(i) SECURED ADVANCE ON NON-PERISHABLE MATERIALS

The contractor, on signing an indenture in the form to be specified by the Engineer-in- Charge, shall be entitled to be paid during the progress of the execution of the work up to 75 % of the assessed value of any materials which are in the opinion of the Engineer-in- Charge non-perishable, non-fragile and non-combustible and are in accordance with the contract and which have been brought on the site in connection therewith and are adequately stored and/or protected against damage by weather or other causes but which have not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be recovered/ deducted from the next payment made under any of the clause or clauses of this contract.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-Charge shall be final and binding on the contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel etc.

(ii) MOBILISATION ADVANCE

Mobilization advance not exceeding 10% of the tendered value may be given, if requested by the contractor in writing within one month of the order to commence the work. Such advance shall be in two or more installments to be determined by the Engineer-in- Charge at his sole discretion. The first installment of such advance shall be released by the Engineer-in-charge to the contractor on a request made by the contractor to the Engineer-in-Charge in this behalf. The second and subsequent installments shall be released by the Engineer-in-Charge only after

the contractor furnishes a proof of the satisfactory utilization of the earlier installment to the entire satisfaction of the Engineer-in-Charge.

Before any installment of advance is released, the contractor shall execute a Bank GuaranteeBond from Scheduled Bank for the amount equal to 110% of the amount of advance and valid for the contract period. This (Bank Guarantee from Scheduled Bank for the amount equal to 110% of the balance amount of advance) shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery.

(iii) PLANT MACHINERY & SHUTTERING MATERIAL ADVANCE---------- NOT APPLICABLE

An advance for plant, machinery & shuttering material required for the work and brought to site by the Contractor may be given if requested by the contractor in writing within one month of bringing such plant and machinery to site. Such advance shall be given on such plant and machinery which in the opinion of the Engineer-in-charge will add to the expeditious execution of work and improve the quality of work. The amount of advance shall be restricted to 5% percent of the tender value. In the case of new plant and equipment to be purchased for the work, the advance shall be restricted to 90% of the price of such new plant and equipment paid by the contractor for which the contractor shall produce evidence satisfactory to the Engineer-in-Charge. In the case of second hand and used plants and equipment, the amount of such advance shall be limited to 50% of the depreciated value of plant and equipment as may be decided by the Engineer-in-Charge. The contractor shall, if so required by the Engineer-in-Charge, submit the statement of value of such old plant and equipment duly approved by a Registered Valuer recognized by the Central Board of Direct Taxes under the Income- Tax Act, 1961. No such advance shall be paid on any plant and equipment of perishable nature and on any plant and equipment of a value less than Rs. 50,000/- Seventy five per cent of such amount of advance shall be paid after the plant & equipment is brought to site and balance twenty five percent on successfully commissioning the same.

Leasing of equipment shall be considered at par with purchase of equipment and shall be covered by tripartite agreement with the following:

1. Leasing company which gives certificate of agreeing to lease equipment to thecontractor.
2. Engineer in Charge, and
3. The contractor.

This advance shall further be subject to the condition that such plant and equipment (a) areconsidered by the Engineer-in-Charge to be necessary for the works; (b) and are in working order and are maintained in working order; (c) hypothecated to the WAPCOS as specified by the Engineer-in-Charge before the payment of advance is released. The contractor shall not be permitted to remove from the site such hypothecated plant and equipment withoutthe prior written permission of the Engineer-in-Charge. The contractor shall be

responsible for maintaining such plant and equipment in good working order during the entire period of hypothecation failing which such advance shall be entirely recovered in lump sum. For this purpose, steel scaffolding and form work shall be treated as plant and equipment.

The contractor shall insure the Plant and Machinery for which mobilization advance is sought and given, for a sum sufficient to provide for their replacement at site. Any amounts not recovered from the insurer will be borne by the contractor.

(iv) INTEREST & RECOVERY

The mobilization advance in (ii) above bear simple interest at the rate of 08 per cent per annum and shall be calculated from the date of payment to the date of recovery, both days inclusive, on the outstanding amount of advance. Recovery of such sums advanced shall be made by the deduction from the contractors bills commencing after first 10% of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time 80% of the gross value of the contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the installment.

(v) If the circumstances are considered reasonable by the Engineer-in-Charge, the period mentioned in (ii) for request by the contractor in writing for grant of mobilization advance and plant and equipment advance may be extended at the discretion of the Engineer-in-Charge.

CLAUSE 10CC: PAYMENT DUE TO INCREASE/DECREASE IN PRICES/WAGES (EXCLUDING MATERALS COVERED UNDER CLAUSE 10 CA) AFTER RECEIPT OF TENDER FOR WORKS

If the prices of materials and/or wages of labour required for execution of the work increase, the contractor shall be compensated for such increase as per provisions detailed below and the amount of the contract shall accordingly be varied, subject to the condition that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the contract including the justified period extended under the provisions of clause 5 of the contract without any action under clause 2. Such compensation for escalation in the prices of materials and labour, when due, shall be worked out based on the following provisions:

(i) The base date for working out such escalation shall be the last stipulated date of receipt of tenders including extension, if any.

(ii) The cost of work on which escalation will be payable shall be reckoned as below :

(a) Gross value of work done up to this quarter : (A)

(b) Gross value of work done up to the last quarter : (B)

(c) Gross value of work done since previous quarter (C)= (A-B)

(d) Full assessed value of Secured Advance fresh paid in this quarter : (D)

(e) Full assessed value of Secured Advance recovered in this quarter : (E)

(f) Full assessed value of Secured Advance for which escalation Payable in this quarter, (F)= (D-E)

(g) Advance payment made during this quarter: (G)

(h) Advance payment recovered during this quarter: (H)

(i) Advance payment for which escalation is payable in this Quarter (I)= (G-H)

(j) Amount paid based on prevailing market rates due to deviations/variations as per clause 12 during this quarter:(J)

Then, M = C+F+I-J

Cost of work for which escalation is applicable (W) = 0.85M

Components for materials, labour, etc. shall be pre-determined for every work and incorporated in the conditions of contract attached to the tender documents included in Operative Schedule. The decision of the Engineer-in-Charge in working out such percentage shall be binding on the contractors.

(iii) The following principles shall be followed while working out the payment/recovery on account of variation of prices of materials and/ or wages of labour.

(a) The compensation for escalation shall be worked out at quarterly intervals and shall be with respect to the cost of work done as per bills paid during the three calendar months of the said quarter. The date of submission of bill by the contractor to the department shall be the guiding factor to decide the bills relevant to the quarterly interval. The first such payment shall be made at the end of three months after the month (excluding the month in which the letter of commencement of work is issued by the Engineer-in-Charge) and thereafter at three months' interval. At the time of completion of the work, the last period for payment might become less than 3 months, depending on the actual date of completion.

(b) The indices as defined below (excluding LI) relevant to any quarter/period for which such compensation is to be paid shall be the arithmetical average of the indices relevant to the three calendar months. If the period up to the date of completion after the quarter covered by the last such installment of payment, is less than three months, the indices shall be the average of the indices for the months falling within that period.

(c) The minimum wage of an unskilled Mazdoor shall be the higher of the wage notified by Government of India, Ministry of Labour and that notified by the local administration both relevant to the place of work and the period of reckoning.

(d) The escalation for labour also shall be paid at the same quarterly intervals when escalation due to increase in cost of materials is paid under this clause. If such revision of minimum wages takes place during any such quarterly intervals, the escalation compensation shall be payable at revised rates only for work done in subsequent quarters;

(e) Irrespective of variations in minimum wages of any category of labour, for the purpose of this clause, the variation in the rate for an unskilled Mazdoor alone shall form the basis for working out the escalation compensation payable on the labour component.

(iv) In the event the price of materials and/or wages of labour required for execution of the work decreases, there shall be a downward adjustment of the cost of work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this contract and in this regard the formula herein stated below under this Clause 10CC shall mutatis mutandis apply.

(v) The contract price shall be adjusted for increase or decrease in rates and prices of labour, cement, steel reinforcement bar, fuel and lubricants and other input materials as per percentage of materials/labour specified in Operative Schedule and in accordance with the principles, procedures and formulae specified below:

(a) Price adjustment for change in cost shall be paid in accordance with the following formulae:

(i) For Construction:

$$V_W = W*(1/100)*[C_P * (C_I-C_O)/C_O + L_P* (L_I-L_O)/L_O+CM_P*(CM_I-CM_O)/CM_O+EM_P*(EM_I-EM_O)/EM_O +F_P* (F_I-F_O)/F_O+S_P* (S_I- S_O)/S_O+ B_p *(B_I- B_o)/B_O]$$

(ii) For Maintenance:

$$V_W = W*(1/100)*[L_P* (L_I-L_O)/L_O +CM_P* (CM_I-CM_O)/CM_O+EM_P* (EM_I-EM_O)/EM_O + B_p*(B_I- B_o)/B_O]$$

Where, W=cost of work done as per para (ii) above.

V_W (Variation of cost of Work) =Increase or decrease in the cost of works during the period under consideration due to change in the rates for relevant components.

Percentage components of materials &labour as specified in the Operative Schedule are defined as under:-

C_P - Cement component,

L_P - Labour component,

CM_P - Civil component of other construction materials,

EM_P - E & M component of construction materials

F_P - POL (Diesel) component

S_P - Reinforcement steel bars/TMT bars/structural steel (including strands and cables) component

B_P - Bitumen component

Indices for various components of materials & labour to be used for the purpose of this

Clause are defined as under:

C_o = Wholesale Price Index for Pozzolana Cement published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of last date of receipt of tender including extension, if any.

C_I = Wholesale Price Index for Pozzolana Cement published byoffice of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

L_O = Minimum daily wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as on the last date of receipt of tender including extension, if any.

L_I = Minimum wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration.

CM_O = Price Index for civil components of other construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Civil) or successor.

CM_I = Price Index for civil components of other construction materials for the period under consideration and as issued by the office of CE CSQ (Civil) or successor.

EM_O = Price Index for E & M components of construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Electrical) or successor.

EM_I = Price Index for E & M components of construction materials for the period under consideration and as issued by the office of CE CSQ (Electrical) or successor.

F_O = Wholesale Price Index of HSD (High Speed Diesel)published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any.

F_I = Wholesale Price Index of HSD (High Speed Diesel) published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

S_O = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any

S_I = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

B_O = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any

B_I = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

(vi) No upward price variation will be admissible beyond the original scheduled delivery date for defaults on the part of the supplier. However, a downward price variation would be availed by the purchaser as per the denial clause in the letter of extension of the delivery period

CLAUSE 10D: DISMANTLED MATERIAL WAPCOS PROPERTY

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as WAPCOS's property and such materials shall be disposed off to the best advantage of WAPCOS according to the instructions in writing issued by the Engineer-in-Charge.

CLAUSE 11: WORKS TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS, DRAWINGS, ORDERS AS PER MODE MENTIONED IN SCHEDULE' F'

The contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design,drawings and instructions in writing in respect of the work signed by the Engineer-in-Charge and the contractor shall be furnished free of charge of one copy of the contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications specified in Special Conditions of Contract or in any Bureau of Indian Standard or any other, published standard or code or, Schedule of Rates or any other printed publication referred to elsewhere in the contract.

The contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

At least to 10% of prescribed Tests as per Central Public Works Department Manual/IS Codes of construction materials shall be carried out from the outside approved/NABL recognized Laboratoryas may be approved by WAPCOS without any extra expenditure to WAPCOS.

The Contractor shall establish a field test laboratory on the site with latest equipment's for carrying out field tests of construction materials and will maintain proper records of all the test results.

CLAUSE 12: DEVIATIONS / VARIATIONS EXTENT AND PRICING

The Engineer-in-Charge shall have power (i) to make alteration in, omissions from, additions to, or substitutions for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and (ii) to omit a part

of the works in case of non-availability of a portion of the site or for any other reasons and the contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall form part of the contract as if originally provided therein and any altered, additional or substituted work which the contractor may be directed to do in the manner specified above as part of the works, shall be carried out by the contractor on the same conditions in all respects including price on which he agreed to do the main work except as hereafter provided.

12.1 The time for completion of the works shall, in the event of any deviations resulting in additional cost over the tendered value sum being ordered, be extended, if requested by the contractor, as follows:

(i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original tendered value plus

(ii) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

12.2 Payment of deviations/variations beyond 0.25% of the accepted tendered amount.

In case there is any change in scope as defined in the contract, the contractor shall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 0.25% (zero point two five percent) of the accepted tendered amount and worked out as per sub-clause 12.3 below. Variations/deviations upto 0.25% (zero point two five percent) of the accepted tendered amount shall be deducted from overall variations/ deviations for making payment.

12.3 DETERMINATION OF RATES

In the event, there is any deviations/variations in work as defined in the contract, the contractor shall submit the complete proposal to Engineer-in-charge within 15 days duly supported with:-

(a) Analysis of rates for items involved, along with relevant documents, rates of materials, tools/plants and labour, etc.

(b) The impact, if any, which the deviations/variations is likely to have on the project completion schedule,

On receipt of such proposal, either individually or covering group of items, the Engineer- in-charge shall examine the proposal regarding its admissibility and finalize the proposal/rates within 45 days after receipt of proposal with all requisite details and documents from the contractors, after giving due consideration to the proposal, analysis and rates of materials and labours, etc.

12.3.1 The increase/decrease in the rates due to deviations/variations shall be decided based on the following criteria:-

(i) Pricing of deviations

(a) If the item of work as stipulated in the schedule of quantity/scope of work deviates on plus side, then the rate for the deviated quantity shall be paid at the agreement rate upto the deviation limit as specified in operative schedule with the same terms & conditions of the contract. Beyond deviation limit as specified in the Operative schedule, rate shall be payable on market rates to be determined based on the relevant documents and prevailing market rates, as per Para

(ii) below

(b) If the item of work as stipulated in the schedule of quantity/scope of work deviates on minus side, then the amount for such deviated quantity shall be deducted proportionately at the agreement rate.

(ii) Pricing of variations

If there are changes in the quantity/specifications/ alterations/ substitutions/additions, etc. in the items, other than mentioned in para-

(i) above, the rates shall be determined based on detailed analysis of rates with original stipulated scope of items & newly proposed/provided items. The difference of rates so determined shall be payable to/ recoverable from the contractor. The rates for both the components i.e. materials &labour shall be based on prevailing market rates. The rate finalized by the Engineer-in-Charge shall be final and binding.

12.3.2 In case of either non-submission of timely proposal or incomplete proposal by the contractor for deviations/variations, the Engineer-in-Charge shall give final opportunity to the Contractor to submit the complete proposal for change of cost within next 15 days. In case of non-submission or further incomplete submission by the contractor within the stated period, the Engineer-in-Charge shall initiate the proposal and decide the change of cost. In such case the proposal finalized by the Engineer-in-Charge shall be final and binding on the contractor.

12.4 **Restrictions on Deviations/Variations**

(i) Work(s) due to deviations/variations shall be executed only after getting the instructions of Engineer-in-charge, save except to meet any work of emergent nature.

(ii) Notwithstanding anything to the contrary in this clause 12, any change arising from default of the contractor in the performance of his obligations under this agreement shall not be deemed to be deviations/variations, and shall not result in any adjustment of the contract price or the project completion schedule.

CLAUSE 13: FORECLOSURE OF CONTRACT DUE TO ABANDONMENT OR REDUCTION IN SCOPE OFWORK

If at any time after acceptance of the tender, Engineer-in-charge shall decide to abandon or reduce the scope of the works for any reason whatsoever and hence not require the whole or any part of the works to be carried out, the Engineer-in-Charge shall give notice in writing to that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive inconsequence of the foreclosure of the whole or part of the works.

The contractor shall be paid at contract rates, full amount for works executed at site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the work to the full extent in view of the foreclosure;

(i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.

(ii) WAPCOS shall have the option to take over contractor's materials or any part thereof either brought to site or of which the contractor is legally bound to accept delivery from suppliers(for incorporation in or incidental to the work). For materials taken over or to be taken over by WAPCOS, cost of such materials as detailed by Engineer-in- Charge shall be paid. The cost shall, however, take into account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody ofthe contractor.

(iii) If any materials supplied by WAPCOS are rendered surplus, the same except normal wastage shall be returned by the contractor to WAPCOS at rates not exceeding those at which these were originally issued, less allowance for any deterioration or damage which may have been caused whilst the materials were in the custody of the contractor. In addition, cost of transporting such materials from site to WAPCOS stores, if so required by WAPCOS, shall be paid.

(iv) Reasonable compensation for transfer of T & P from site to contractor's permanent storesor to his other works, whichever is less. If T & P are not transported to either of the said places, no cost of transportation shall be payable.

The contractor shall, if required by the Engineer- in-Charge, furnish to him, books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable himto certify the reasonable amount payable under this condition.

The reasonable amount of items on (i) & (iv) above shall not be in excess of 2% of the cost ofthe work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted tender less the cost of work actually executed under the contract and less the cost of contractor's materials at site taken over by the WAPCOS as per item (ii) above. Provided always that against any payments due to the contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due from the contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the WAPCOS from the contractor under

the terms of the contract.

Clause 14 - Pre-Construction Activities

The data supplied by the Department, if any, are for General Guidance only. The contractor shall be responsible for carrying out pre- construction activities for construction of work as defined in the tender documents. The contractor shall also carry out site investigations to verify site details / Data at his own cost.

CLAUSE 15: SUSPENSION OF WORK

(i) The contractor shall, on receipt of the order in writing of the Engineer-in-Charge, (whose decision shall be final and binding on the contractor) suspend the progress of the works or any part thereof for such time and in such manner as the Engineer-in-Charge may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of the following reasons:

(a) on account of any default on the part of the contractor or;

(b) for proper execution of the works or part thereof for reasons other than the default of the contractor; or

(c) for safety of the works or part thereof. The contractor shall, during such suspension, properly protect and secure the works to the extent necessary and carry out the instructions given in that behalf by the Engineer-in- Charge.

(ii) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:

(a) the contractor shall be entitled to an extension of time equal to the period of every such suspension PLUS 25%, for completion of the item or group of items of work for which a separate period of completion is specified in the contract and of which the suspended work forms a part, and;

(b) If the total period of all such suspensions in respect of an item or group of items or work for which a separate period of completion is specified in the contract exceeds thirty days, the contractor shall, in addition, be entitled to such compensation as the Engineer-in- Charge may consider reasonable in respect of salaries and/or wages paid by the contractor to his employees and labour at site, remaining idle during the period of suspension, adding thereto 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in-Charge within fifteen days of the expiry of the period of 30 days.

(iii) If the works or part thereof is suspended on the orders of the Engineer-in-Charge for more than three months at a time, except when suspension is ordered for reason (a) in subpara (i) above, the contractor may after receipt of such order serve a written notice on the Engineer-in-Charge requiring permission within fifteen days from receipt by the Engineer- in-Charge of the said notice, to proceed with the work or part thereof in regard to which progress has been suspended and if such permission is not granted within that time, the contractor, if he intends to treat the suspension, where it affects only a part of the works as an omission of such part by WAPCOS or where it affects whole of the works, as an abandonment of the works by WAPCOS, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to

the Engineer-in-Charge. In the event of the contractor treating the suspension as an abandonment of the contract by WAPCOS, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the work in full but which he could not derivein consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer-in-Charge may consider reasonable, in respect of salaries and/or wages paidby him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in-Charge within 30 days of the expiry of the period of 3 months.

CLAUSE 16: ACTION IN CASE WORK NOT DONE AS PER SPECIFICATIONS

All works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Engineer-In-charge, his authorizedsubordinates in charge of the work and all the superior officers, officer of the Quality Assurance Unit of the WAPCOS or any organization engaged by the WAPCOS for Quality Assurance and of the Chief Technical Examiner's Office, and the contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the contractor himself.

If it shall appear to the Engineer-in-charge or his authorized subordinates incharge of the work or to the Chief Engineer in charge of Quality Assurance or his subordinate officers or the officers of the organization engaged by the WAPCOS for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any work has been executed with unsound, imperfect, or unskillful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the contractor shall, on demand in writing which shall be made within twelve months (six months in the case of work costing Rs. 10 Lac and below except road work) of the completion of the work from the Engineer-in-Charge specifying the work, materials or articles complained of notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer-in- Charge in his demand aforesaid, then the contractor shall be liable topay compensation at the same rate as under clause 2 of the contract (for non-completion of the work in time) for this default.

In such case the Engineer-in-Charge may not accept the item of work at the rates applicable under the contract but may accept such items at reduced rates as the authority specified in Operative Schedulemay consider reasonable during the preparation of on account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the work outright without any payment and/or get it and other connected and incidental items rectified, or removed and re-executed at the risk and cost of

the contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same willbe final and binding on the contractor.

Clause 17

17.1 During progress of work

Damages and Defects liability

If the contractor or his working staff or workers damage any part of the work in the scope of contract, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass, grassland, cultivated ground, etc. contiguous to the premises on which the work or any part of it is being executed, the contractor shall make good the same at his own cost.

Contractor shall repair/replace and restore the damaged structures/services in a time bound manner as required and as directed by the Engineer-in-Charge. Contractor shall not be given any benefit of hindrance caused in the execution of the work owing to such damaged structure/service and time taken in its restoration by the contractor.

17.2 During defect liability period

The contractor shall be responsible for all the defects and deficiencies in the work within the scope of this contract, during the defect liability period which shall be for 3 (three) years after the date of actual completion of work as recorded by the Engineer- in-Charge. The liability of contractor for defects and deficiencies may arise due to:

(a) Improper planning and design of the project, if in the scope of contract.

(b) Works, Tools, Plant & Machinery, Materials or Workmanship not being in accordance with this contract.

(c) Improper upkeep & maintenance during construction of the work.

(d) Improper upkeep, operation and/or maintenance during defect liability period, if these are in the scope of this contract.

(e) Failure by the contractor to comply with any other obligation under this contract.

Such defects and deficiencies shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice.

However, contractor need not wait for instructions/notice from Engineer-in-Charge for rectification of defects in work which come to his notice and he should initiate action for needful rectification of defect on priority, under intimation to Engineer-in-Charge, to avoid any untoward incident.

17.3 Structural soundness

The contractor shall follow the good engineering practice for safety, serviceability and structural soundness of the building/ structure/road work etc. as covered in the scope of contract.

17.3.1 **Structure design in the scope of contract**

The contractor shall have obligation to rectify all defects in the structural elements or any other part of building/structure/road etc. due to design deficiency at his own cost for 10 (ten) years

from the date of completion as recorded in the completion certificate by the Engineer-in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per the methodology duly approved by the Engineer-in-Charge.

17.3.2 **Structure design not in the scope of contract**

The contractor shall not be liable for design deficiency.

17.3.3 **Liability for execution**

The contractor shall be fully liable for any deficiency in structural soundness of work owing to execution of the work under the scope of this contract. The contractor shall have obligation to rectify all defects in the structural elements owing to any deficiency in execution of work at his own cost for 10 (ten) years from the date of completion as recorded in the completion certificate by Engineer-in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per methodology duly approved by the Engineer-in-Charge.

17.4 **Methodology for rectification of defects**

The design, methodology and quality of rectification of defects carried out by the contractor shall be as per sound engineering practice.

17.5 **Contractor's failure to rectify defects as defined in the sub-clauses 17.1, 17.2, 17.3 & 17.4.**

In the event that the contractor fails to repair or rectify the defect or deficiency within the period specified by the Engineer-in-Charge, the Engineer-in-Charge shall be entitled to get the same repaired, rectified or remedied at the contractor's cost and recover such amount from any dues like performance guarantee, security deposits etc. available with Engineer-in-Charge. Engineer-in-Charge may take action for debarment of contractor from tendering in the department by following due process. For inaction or failure to rectify the defects covered under sub clause 17.3 within specified time limit, the Engineer-in-Charge may also initiate legal and/or other actions under other applicable laws in addition to other remedies available in the contract.

17.6 **Release of security deposit**

Fifty percent (50%) of the security deposit of the contractor shall be retained for a period of 18 (eighteen) months from the date of completion of work as per completion certificate issued by the Engineer-in-Charge or till the final bill has been passed whichever is later. This balance fifty percent (50%) security deposit shall be released after completion of defect liability period.

Provided further, that the security deposit shall be released within a month of its due date as stated above only if satisfactory performance is observed during the said period and after deduction of Government dues from the contractor, if any.

CLAUSE 18A: RECOVERY OF COMPENSATION PAID TO WORKMEN

In every case in which by virtue of the provisions sub-section (1) of Section 12, of the Workmen’s Compensation Act, 1923, WAPCOS is obliged to pay compensation to a workman employed by the contractor, in execution of the works, WAPCOS will recover from the

contractor, the amount of the compensation so paid; and, without prejudice to the rights of the WAPCOS under sub-section (2) of Section 12, of the said Act, WAPCOS shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by WAPCOS to the contractor whether under this contract or otherwise. WAPCOS shall not be bound to contest any claim made against it under sub-section (1) of Section 12, of the said Act, except on the written request of the contractor and upon his giving to WAPCOS full security for all costs for which WAPCOS might become liable in consequence of contesting such claim.

CLAUSE 18B: ENSURING PAYMENT AND AMENITIES TO WORKERS, IF CONTRACTOR FAILS

ln every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition)Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, WAPCOS is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules under Clause 19H or under the C.P.W.D.

Contractor's Labour Regulations, or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by C.P.W.D. Contractors, WAPCOS will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the WAPCOS under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, WAPCOS shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by WAPCOS to the contractor whether under this contract or otherwise WAPCOS shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the WAPCOS full security for all costs for which WAPCOS might become liable in contesting such claim.

CLAUSE 19: LABOUR LAWS TO BE COMPLIED BY CONTRACTOR

The contractor shall comply with the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971. The contractor shall also obtain a valid license under the said Act before the commencement of the work, and continue to have a valid license until its completion.

The contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.

The contractor shall also abide by the provisions of the Child Labour and Adolescent Labour (Prohibition and Regulation) Act, 1986.

The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfill these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the work.

CLAUSE 19A

No labour below the age of Eighteen years shall be employed on the work.

CLAUSE 19B: PAYMENT OF WAGES

5.1 The contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as defined in the C.P.W.D. Contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971,wherever applicable.

5.2 The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engagedby his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.

5.3 In respect of all labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply with or cause to be compliedwith the Contractor's Labour Regulations made by WAPCOS from time to time in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorizedly made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

5.4 (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non- observance of the Regulations.

(b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default,the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge concerned.

In the case of Union Territory of Delhi, however, as the all inclusive minimum daily wages fixed under Notification of the Delhi Administration No.F.12(162)MWO/DAB/ 43884-91,dated 31-12-1979 as amended from time to time are inclusive of wages for the weekly day of rest, the question of extra payment for weekly holiday would not arise.

5.5 The contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefits Act, 1961, and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made thereunder from time to time.

5.6 The contractor shall indemnify and keep indemnified WAPCOS against payments to be made under and for the observance of the laws aforesaid and the C.P.W.D. Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.

5.7 The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

5.8 Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the contractor to the workmen directly without the intervention of Jamadar and that Jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.

5.9 The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen.

CLAUSE 19C

In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per C.P.W.D. Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of as mentioned in Operative Schedule for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

CLAUSE 19 D

The contractor shall submit by the 4th and 19th of every month, to the Engineer-in-Charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively:-

(1) The number of labourers employed by him on the work,

(2) Their working yours,

(3) The wages paid to them,

(4) The accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them, and

(5) The number of female workers who have been allowed maternity benefit according to Clause 19F and the amount paid to them.

Failing which the contractor shall be liable to pay to WAPCOS, a sum as mentioned in Operative Schedule for each default or materially incorrect statement. The decision of the Engineer-In-Charge shall be final in deducting from any bill due to the contractor; the amount levied as fine and be binding on the contractor.

CLAUSE 19 E

In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the WAPCOS and its contractors.

CLAUSE 19 F

Leave and pay during leave shall be regulated as follows:-

1. Leave :

(i) in the case of delivery - maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,

(ii) in the case of miscarriage - upto 3 weeks from the date of miscarriage.

2. Pay :

(i) in the case of delivery - leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined or at the rate of Rupee one only a day whichever is greater.

(ii) in the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.

3. Conditions for the grant of Maternity Leave:
No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The contractor shall maintain a register of Maternity (Benefit) in the Prescribed Form as shown in appendix -I and II, and the same shall be kept at the place of work.

CLAUSE 19 G

In the event of the contractor(s) committing a default or breach of any of the provisions of the WAPCOS, Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and' Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Government a sum as mentioned in Operative Schedulefor every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to as mentioned in Operative Scheduleper day for each day of default subject to a maximum of 5 per cent of the estimated cost of the work put to tender. The decision of the Engineer-in-Charge shall be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the contractor(s) is/are not properly observing and complying with the provisions of the C.P.W.D. Contractor's Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the contractor(s) (hereinafter referred as "the said Rules") the Engineer-in- Charge shall have power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with and/observe the said Rules and to provide the amenities to the work- people as aforesaid, the Engineer-in-

Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/their own expense and to approved standards all necessary huts and sanitary arrangements required for his/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the contractor(s).

CLAUSE 19 H

The contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

(i) (a) The minimum height of each hut at the eaves level shall be 2.10m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sq.m. (30 sq.ft.) for each member of the worker's family staying with the labourer.

(b) The contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.

(c) The contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.

(d) The contractor(s) shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.

(ii) (a) All the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground.The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the contractor shall ensure that throughout the period of their occupation, the roofs remain water-tight.

(b) The contractor(s) shall provide each hut with proper ventilation.

(c) All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.

(d) There shall be kept an open space of at least 7.2m (8 yards) between the rows of huts which may be reduced to 6m (20 ft.) according to the availability of site with the approvalof the Engineer-in-Charge. Back to back construction will be allowed

(iii) **Water Supply** - The contractor(s) shall provide adequate supply of water for the use of labourers. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which may be of metal or masonry,

shall be provided. The contractor(s) shall also at his/ their own cost make arrangements for laying pipe lines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore.

(iv) The site selected for the camp shall be high ground, removed from jungle.

(v) **Disposal of Excreta** - The contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration which shall be according to the requirements laid down by the Local Health Authorities. If trenching or incineration is not allowed, the contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee/authority for the removal of the excreta. All charges on this account shall be borne by the contractor and paid direct by him to the Municipality/authority. The contractor shall provide one sweeper for every eight seats in case of dry system.

(vi) **Drainage** - The contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy.

(vii) The contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.

(viii) **Sanitation -** The contractor(s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

CLAUSE 19 I

The Engineer-in-Charge may require the contractor to dismiss or remove from the site of the workany person or persons in the contractors' employ upon the work who may be incompetent or misconduct himself and the contractor shall forthwith comply with such requirements. In respect of maintenance/repair or renovation works etc. where the labour have an easy access to the individual houses, the contractor shall issue identity cards to the labourers, whether temporary or permanent and he shall be responsible for any untoward action on the part of such labour.

CLAUSE 19J

It shall be the responsibility of the contractor to see that the building under construction is not occupied by any body unauthorizedly during construction, and is handed over to the Engineer-in- Charge with vacant possession of complete building. If such building though completed is occupiedillegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy upto 5% of tendered value of work may be imposed

by the WAPCOS whose decision shall be final both with regard to the justification and quantum andbe binding on the contractor.

However, WAPCOS, through a notice, may require the contractor to remove the illegal occupationany time on or before construction and delivery.

CLAUSE 19K: Employment of Skilled / Semi Skilled Workers

The contractor shall, at all stages of work, deploy skilled/semi skilled tradesmen who are qualified and possess certificate in particular trade from Industrial Training Institute/National Institute of construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer in Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

Clause 19L

Contribution of EPF and ESI

The ESI and EPF contributions on the part of employer in respect of this contract shall be paid by the contractor. These contributions on the part of the employer paid by the contractor shall be reimbursed by the Engineer-in-charge to the contractor on actual basis. The verification of deployment of labour will be done through biometric attendance system or any other suitable method by the Engineer-in-charge. The applicable and eligible amount of EPF & ESI shall be reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment provided same are in order.

CLAUSE 20: MINIMUM WAGES ACT TO BE COMPLIED WITH

The contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time and rules framed thereunder and other labour laws affecting contract labour that may be brought into force from time to time.

CLAUSE 21: WORK NOT TO BE SUBLET. ACTION IN CASE OF INSOLVENCY

The contract shall not be assigned or sublet without the written approval of the Engineer-in Charge. And if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given, promised or offered by the contractor, or any of his servants or agent to any public officer or person in the employ of WAPCOS in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-Charge on

behalf of the WAPCOS shall have power to adopt the course specified in Clause 3 hereof in the interest of WAPCOS and in the eventof such course being adopted, the consequences specified in the said Clause 3 shall ensue.

Clause 22

QUALITY ASSURANCE AND SUPERVISION FOR EXECUTION PART of WORK

22.1 **Quality of Materials and Workmanship**

(i) The Contractor shall ensure that the Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Sound Engineering practice. The work shall be of the specified quality and standard, both in respect of ingredients as well as the intended functions it is supposed to perform for service life.

(ii) The Contract warrants that all Materials shall be new, unused, not reconditioned, unless otherwise allowed as per contract or by Engineer-in-Charge, and in conformity with Specification and Standards, Applicable Laws and Sound Engineering Practice, and that the Contractor shall not use any materials which are generally recognized as being deleterious under Sound Engineering Practice.

22.**2** **Quality Assurance System**

The Contractor shall devise a quality assurance mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

(i) The Contractor shall, submit to the Engineer-in-Charge, its Quality Assurance Plan 15 (fifteen) days in advance of start of the execution stage specified in the NIT. The Engineer-in-Charge shall convey its comments to the Contractor within a period of 7 (seven) days of receipt of the QAP stating the modifications, if any, required and the Contractor shall incorporate those in the QAP conforming with the provisions of this clause. The QAP shall include the following:

(a) Contractor's Organization & structure, duties and responsibilities of individual key personnel, quality policy of contractor, procedure for control of non-conformities and corrective action, inspections and documentation.

(b) Internal quality audit system.

(c) Machinery, Shuttering, other Tool & Plants, etc. required to be deployed at site.

(d) Method statement of important activities. These can be submitted as per the sequencing of the activities of the work.

(e) Quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, proforma for testing and calibration in accordance with the Specifications and Standards and Sound Engineering Practice; and Material Lot size, number of required tests and frequency of testing for different construction materials.

All the relevant and applicable codes, specifications and standards, as well as the acceptance criteria for various items of work, workmanship, materials and process employed needs to be mentioned.

(f) Check-list for various items and materials.

(g) Formats for site documentation, monthly reports on implementation of QAP.

(ii) **Sampling of materials**

All samples of materials including Cement Concrete Cubes shall be taken by the QA engineers deployed by the Contractor and shall be witnessed by the Engineer-in-Charge or his authorized

representatives as specified in NIT. All the necessary assistance, facilities and safety shall be provided by the contractor. Cost of sample of materials and testing charges shall be borne by the contractor and he/she is responsible for safe custody of samples to be tested at site.

(iii) **Testing of Materials**

The contractor shall establish temporary field laboratory of adequate size with all necessary facilities. Field laboratory shall be equipped with the testing equipment for conducting routine field tests as per this contract. It will also have copies of standards, BIS codes, IRC codes, relevant publications.

All the tests in field lab setup at construction site shall be carried out by the QA Staff deployed by the contractor and shall be witnessed by the Engineer-in- Charge or his authorized subordinates as specified in NIT. The contractor shall provide all necessary facility to them for witnessing the tests in the field laboratory. In general, contractor shall carry out 90% of field tests in site laboratory and 10% tests shall be got carried out from outside laboratory as indicated below. Contractor shall endeavour to obtain test reports for tests conducted from outside laboratory in a reasonable time.

(iv) **Maintenance of Register of Test -**

- All the entries in the register of test are to be made by the designated QA Engineers of the contractor and same is to be regularly reviewed by the field officers as well as the Engineer-in-Charge. The contractor shall allow inspection of such records any time as desired by Engineer-in-Charge or his authorized representative.
- All the tests carried out at construction site or outside laboratories are to be maintained by the contractor in the prescribed format in the test registers provided by the contractor and duly authenticated by Engineer-in- Charge.The test reports shall also be maintained in hard file.
- Contractor is responsible for maintenance and safe custody of all the test registers and test records.
- Mandatory test conducted as per approved proforma shall be attached with each Running bill. Submission of copy of all test registers and material at site register along with each alternate Running Account Bill and with Final Bill is mandatory.
- All the Mandatory register to be maintained at site as per standard guidelines of CPWD Works manual, SOP and upto date guidelines amended time to time.

(v) **Maintenance of Material at Site (MAS) Register-**

MAS register of the key materials including Cement and Steel Registers shall be maintained in the proforma approved by Engineer-in-Charge. All the entries in the MAS registers are made by the designated staff of the contractor and same is regularly reviewed by the field officers as well as the Engineer-in-Charge. Contractor is responsible for maintenance and safe custody of MAS registers.

(vi) The Contractor shall procure all relevant codes, publications, apparatus and instruments, fuel, consumables, water, electricity, labour, materials, samples and qualified personnel as are necessary for examining and testing the Works, Materials and workmanship in accordance with the Quality Assurance Plan.

(vii) All the cost of testing including cost of samples, packaging, transportation, testing charges of Construction, Materials and workmanship under this clause shall be borne by the contractor.

(viii) The contractor shall submit monthly quality progress report on implementation of the

provisions of Quality Assurance Plan on the format approved by the Engineer-in-Charge.

22.3 Samples

The Contractor shall, at its own expense and without delay, provide the samples of Materials and relevant information like Manufacturer's test reports, standard samples of manufactured Materials and Samples of such other Materials as the Engineer-in- Charge may require for review and approvals in accordance with Clause 10A of GCC before actual use.

22.4 **Test**

(i) For determining that the Works conform to the Specifications and Standards, the Engineer-in-Charge shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreementand in accordance with sound engineering practice for quality assurance. Frequency and the manner in which tests shall be conducted shall be in the following order of preference:

(a) Contract provisions.
(b) CPWD specifications.
(c) BIS codes.
(d) IRC codes.
(e) MoRTH Specifications.
(f) International Codes.
(g) Manufacturer's specifications.

Outside tests shall be conducted at Government labs /IITs/NITs and other approved laboratories by the Engineer-in-Charge for testing of materials

(ii) The Contractor shall, with due diligence, carry out all the tests in accordance with the Agreement and furnish the results thereof to the Engineer-in-Charge. The Engineer-in-Charge or his authorized representative shall witness or participate during the testing as specified in NIT. The contractor shall provide all necessary assistance for witnessing/participating in the field tests.

(iii) In the event that results of any tests conducted under this clause establish any defects or deficiencies in the Works, the Contractor shall carry out remedial measures at its own cost and furnish a report to the Engineer-in-Charge in this regard. The Engineer-in-Charge shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the works into compliance with the Specifications and standards and the procedure shall be repeated until such Works conform to the Specifications and Standards.

22.5 **Method Statement**

The 'Method statement' is a statement by which the construction procedures for important activities are stated, checked, and approved. The method statement shall be prepared for important activities as identified by the contractor as mentioned in QAP or any other activity as instructed by Engineer-in Charge. The 'Method statement', should have a description of the item with elaborate procedure in steps to implement the same, the specifications of the materials involved, equipment to be deployed, measures for ensuring safety, their testing and acceptance criteria, precautions to be taken, mode of measurement, etc. The Contractor shall, at least 15 (fifteen) days prior to the commencement of activities, submit to the Engineer-in-Charge for review, the method statements proposed to be adopted for executing the various items of work. The Engineer-in-Charge shall complete the review and convey its comments, if any, to the Contractor within a period of 07 (seven) days from the date of receipt of the

proposed methodology from the Contractor.

22.6 **Inspection & review by the Engineer-in-Charge and External Audit.**

The Engineer-in-Charge, his authorized subordinates, senior officers of department, QA unit or any other third party may inspect and review the progress and quality of the work and issue appropriate directions to the Contractor for taking remedial action in the event the work is not in accordance with the provisions of this Agreement. The work may be inspected at any time/stage by external inspection teams like CTE or TE, Third Party Quality assurance agency, WAPCOS team etc. may conduct inspection of the quality of the works. The findings of the inspections shall be notified to the Contractor for taking remedial action in accordance with the agreement. The Contractor shall provide all assistance as may be required by the inspection teams in the conduct of its inspection here under.

Suitable actions shall be taken as per the provisions contained in the relevant clauses of the agreement, if the work is not found to be as per specifications or quality as specified in the agreement.

22.7 **Inspection of records**

The Engineer-in-Charge or his authorized representative shall have the right to inspect the records of the Contractor relating to the works.

22.8 **Inspection of Works**

(i) The Engineer-in-Charge and his authorized subordinates shall at all times;

(a) have full access to all parts of the site and to all places from which natural materials are being obtained for use in the works; and

(b) during production, manufacture and construction at the site and at the place of production, be entitled to examine, inspect, measure and test the materials and workmanship and to check the progress of the manufacturer of Materials.

(ii) The Contractor shall give the Engineer-in-Charge and its authorized representative access, facilities and safety equipment for carrying out their obligations under this Agreement.

22.9 **Examination of work before covering up/ Test Check of item of Work**

In respect of the work which the Engineer-in-Charge or his authorized representatives are required to examine, inspect, measure or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Engineer-in-Charge whenever any such work is ready and before it is covered up. The Engineer-in-Charge shall then either carry out the examination, inspection or testing without unreasonable delay within 7 days, or promptly give notice to the Contractor that the Engineer-in-Charge does not require him to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3(three) business days' notice, to the Engineer-in-Charge to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Engineer-in-Charge within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Engineer-in- Charge, the Contractor shall be entitled to assume that the Engineer-in-Charge would not undertake the said inspections.

22.10 **Rejection**

(i) If, as a result of an examination, inspection, measurement or testing, any Plant, Materials,

design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Engineer-in-Charge may reject such piece of work, Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the requirements of this Agreement.

(ii) If the Engineer-in-Charge requires a Piece of work, Plant, Material, design or workmanship to be retested, the tests shall be repeated on the same terms and conditions, as applicable in each case. If the rejection and retesting cause the department to incur any additional costs, such costs shall be recoverable by the Engineer-in-Charge from the Contractor and may be deducted by the Engineer- in-Charge from any amount due to be paid to the Contractor.

(iii) The Contractor shall not be entitled to any extension of time on account of rectifying any defect or retesting as specified in this clause.

(iv) Examination, inspection, measurement or testing of any Plant, Material, design or workmanship by the Engineer-in-Charge or its failure to convey its observations or to examine, inspect, measure or test shall neither relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Engineer-in-Charge be liable for the same in any manner.

22.11 Remedial work

(i) Notwithstanding any previous test or certification, the Engineer-in-Charge may I nstruct the Contractor to:

(a) remove from the site and replace any piece of work,plant or materials which are not in accordance with the provisions of this Agreement.

(b) remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; and execute any work which is urgently required for the safety of the Project, whether because of an accident, unforeseeable event or otherwise.

(ii) If the Contractor fails to comply with the instructions issued by the Engineer-in- Charge under aforesaid para, within the time specified in the notice or as mutually agreed, the Engineer-in-Charge may get the work executed by another agency. The cost so incurred by the Engineer-in-Charge for undertaking such work shall, without prejudice to the rights of the Engineer-in-Charge to recover damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Engineer-in-Charge from any amount due to be paid to the Contractor.

22.12 **Quality Control Records**

The Contractor shall hand over authenticated copy of all its quality control records and documents to the Engineer-in-Charge before the Completion Certificate is issued.

22.13 **Video recording**

During the Construction Period, the Contractor shall provide to the Engineer-in- Charge for every calendar quarter, a video recording which will be compiled into a 15 (fifteen) minutes digital video covering the status and progress of work in that quarter. Video recording should show different activities, stage of work, quality assurance activities etc. including animation, graphs, digital maps, commentary, sub titles, etc. spread over the quarter. The video recording shall be provided to the Engineer- in-Charge no later than 15 (fifteen) days after the close of

each quarter to be reckoned from next full month of date of start of work.

22.14 **Suspension of unsafe Construction Works**

(i) Upon recommendation of the Engineer-in-Charge to this effect, or on his own volition in cases of emergency or urgency, the Engineer-in-Charge may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of Engineer-in-Charge, as the case may be, such work threatens the safety of the Users and or other persons on or about the Project. Provided, however, that in case of an emergency, the Engineer-in-Charge may suomoto issue the notice referred to hereinabove.

(ii) The Contractor shall, pursuant to the notice underabove para, suspend the Works or any part thereof for such time and in such manner as may be specified by the Engineer-in-Charge and thereupon carry out remedial measures to secure the safety of suspended works, the Users, other persons and vehicles on or about the Project. The Contractor by notice require the Engineer-in-Charge to inspect such remedial measures forthwith and request for revocation of suspension. Upon reviewing the remedial measures, the Engineer-in-Charge shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary and reasonable and the procedure set forth in this Clause shall be repeated until the suspension hereunder is revoked.

(iii) Subject to other provisions of the agreement, all reasonable cost incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "Preservation Costs") shall be borne by the contractor, if in the opinion of Engineer-in-Charge suspension is on account of reasons attributable to the contractor.

(iv) If suspension of Work is for reasons not attributable to the Contractor, the Engineer-in-Charge shall determine any Time Extension, if required, in accordance with the provisions of clause-5.

22.15 **Online maintenance of Site records including testing records.**

(i) The Engineer-in-Charge may require the contractor to upload all the site records in any online system devised by him. The contractor shall have to ensure that all the required site records, as desired by the Engineer-in-Charge shall be uploaded in this online system. Nothing extra on this account shall be payable to the contractor. In case these records are to be maintained in any online module then contractor shall comply with this.

CLAUSE 23: CHANGES IN FIRM'S CONSTITUTION TO BE INTIMATED

Where the contractor is a partnership firm/company/LLP, the prior approval in writing of the Engineer-in-charge shall be obtained before any change is made in the constitution of the firm/company/LLP. Where the contractor is an individual or a Hindu undivided family business concern, such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the works hereby undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of clause 21 hereof and the same action may be taken, and the same consequences shall ensue as provided in the said clause 21.

Clause 24

Life Cycle Cost

Deleted vide OM No. DG/CON/329 dated 03.06.2022

Clause 25: Settlement of Disputes & Arbitration Amicable Resolution and Mediation

25.1 Settlement of Disputes

Except where otherwise provided in the contract, all questions and disputes relating to the Meaning of the specifications, design, drawings and instructions here-in before mentioned and as to the quality of workmanship or materials used on the work or as to any other question, claim,right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the cancellation, termination, completion or abandonment there of shall be dealt with as mentioned hereinafter:

i) If the Contractor considers any work demanded of him to be outside the requirements of the Contract, or disputes any drawings, record or decision given in writing by the Engineer-inCharge On any matter in connection with or arising out of the Contract or carrying out of the work, to be unacceptable, he shall promptly within 15 days request Engineer-in-Charge in writing for written instruction or decision. Thereupon, the Engineer-in-Charge shall give his written instructions or decision within a period of one month from the receipt of the Contractor's letter.

ii) In case the Contractor is not satisfied with the decision of Engineer-in-Charge, he may proceed for arbitration as detailed in Clause 25.2 hereinafter.

iii) It is a term of Contract that each party invoking arbitration must exhaust the aforesaid mechanism of settlement of claims/disputes prior to invoking arbitration.

iv) Performance of this Agreement/ Contract shall continue during arbitration proceedings or any other dispute resolution mechanism pursuant to Clause 25.2. No payment due or payable by the Employer shall be withheld on account of pending reference to the arbitration or other dispute resolution mechanism except to the extent that such payment of dispute.

25.2 Arbitration

Any dispute, controversy of claims arising out of or relating to this Agreement or the breach, termination or invalidity thereof, shall be settled through following mechanism:

a. Firstly, the aggrieved party shall write a letter to the other party detailing its grievances and calling upon the other party to amicably resolve the dispute by convening a joint meeting. Accordingly, the parties as per their convenience shall jointly convene the said meeting(s), wherein minutes of the said meeting(s) shall be prepared and countersigned by all the parties. It is mandatory to prepare minutes of meeting(s) and to be countersigned by all the parties, Irrespective of the outcome of the said meeting(s).

b. In the event the parties are unable to reach on any settlement in the said meeting(s), then the aggrieved party shall mandatorily resort to pre-litigation mediation mechanism with Delhi High Court Mediation Cell, New Delhi.

c. It is only upon failure of the pre-litigation mediation mechanism with Delhi High Court Mediation Cell, then the aggrieved party shall resort to resolution of disputes through arbitration of a Sole Arbitrator. The appointing authority of Sole Arbitrator is CMD, WAPCOS

Limited, to which neither of the parties have any objection nor they shall ever object.

d. Subject to the parties agreeing otherwise, the Arbitration proceedings shall be conducted in Accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996 (amended as on date).

e. It is also acknowledged and accepted that the Employer is only working as intermediary between the Contractor and the Principal Employer/Owner/Client, thus in the event, any dispute arises under the present agreement and referred to Arbitration for adjudication, then subject to corresponding clause in the Contract between Principal Employer/Owner/Client & the Employer, Principal Employer/Owner/Client shall also be made party to the said Arbitration proceedings. Also, the award including costs if any passed against the Employer and costs incurred in the proceedings shall be the sole responsibility of Principal Employer/Owner/Client. The said clause if found inapplicable, even then the other terms of the Arbitration Clause shall survive and shall be acted upon.

f. The place/seat of arbitration shall be Delhi and any award whether interim or final, shall be made, and shall be deemed for all purposes between the parties to be made, in Delhi. The arbitral procedure shall be conducted in English language and any award or awards shall be rendered in English. The procedural law of the arbitration shall be Indian Law. The award of the arbitrator shall be final and conclusive and binding upon the Parties.

g. The Contract and any dispute or claim arising out of or in connection with it or its subject matter or formation (including non-contractual disputes or claims) shall be governed by and construed in accordance with the laws of India and the Parties submit to sole & exclusive jurisdiction of courts at Delhi."

CLAUSE 26: CONTRACTOR INDEMNIFY WAPCOS AGAINST PATENT RIGHTS

The contractor shall fully indemnify and keep indemnified the WAPCOS against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made under or action brought against WAPCOS in respect of any such matters as aforesaid, the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise therefrom, provided that the contractor shall not be liable to indemnify the WAPCOS if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

CLAUSE 27: WITHOLDING AND LIEN IN RESPECT OF SUM DUE FROM CONTRACTOR

Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in- Charge or the

WAPCOS shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalisation or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the WAPCOS or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or WAPCOS will be kept withheld or retained as such by the Engineer-in-Charge or WAPCOS till the claim arising out of or under the contract is determined by the arbitrator(if the contract is governed by the arbitration clause) by the competent court, as the case may be and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

a) WAPCOS shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over- payment and it shall be lawful for WAPCOS to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by WAPCOS to the contractor, without any interest thereon whatsoever.

Provided that the Government shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the WAPCOS on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by WAPCOS.

CLAUSE 28: LIEN IN RESPECT OF CLAIMS IN OTHER CONTRACTS

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-in-Charge or the WAPCOS or any other contracting person or persons through Engineer-in-Charge against any claim of the Engineer-in-Charge or WAPCOS or such other person or persons in

respect of paymentof a sum of money arising out of or under any other contract made by the contractor with the Engineer-in-Charge or the WAPCOS or with such other person or persons.

It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-in-Charge or the WAPCOS will be kept withheld or retained as such by the Engineer-in-Charge or the WAPCOS or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

CLAUSE 29: EMPLOYMENT OF COAL MINING OR CONTROLLED AREA LABOUR NOT PERMISSIBLE

The contractor shall not employ coal mining or controlled area labour falling under any category whatsoever on or in connection with the work or recruit labour from area within a radius of 32 km (20 miles) of the controlled area. Subject as above the contractor shall employ imported labour onlyi.e., deposit imported labour or labour imported by contractors from area, from which import is permitted.

Where ceiling price for imported labour has been fixed by State or Regional Labour Committees notmore than that ceiling price shall be paid to the labour by the contractor.

The contractor shall immediately remove any labourer who may be pointed out by the Engineer-in-Charge as being a coal mining or controlled area labourer. Failure to do so shall render the contractor liable to pay to WAPCOS a sum calculated at the rate of Rs.100/- per day per labourer. The certificate of the Engineer-in-Charge about the number of coal mining or controlled area labourer and the number of days for which they worked shall be final and binding upon all parties to this contract.

It is declared and agreed between the parties that the aforesaid stipulation in this clause is one in which the public are interested within the meaning of the exception in Section 74 of Indian ContractAct, 1872.

Explanation:- Controlled Area means the following areas:

Districts of Dhanbad, Hazaribagh, Jamtara - a Sub-Division under Santhal Pargana Commissionery, Districts of Bankuara, Birbhum, Burdwan, District of Bilaspur.

Any other area which may be declared a Controlled Area by or with the approval of the Central Government.

CLAUSE 30: WATER FOR WORKS

The contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

(i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

(ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the riskand cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water

are in the opinion of the Engineer-in- Charge, unsatisfactory.

CLAUSE 31: ALTERNATE WATER ARRANGEMENTS

The contractor shall be allowed to construct temporary wells in the proposed land for Construction for taking water for construction purposes only after he has got permission of the Engineer-in- Charge in writing. No charges shall be recovered from the contractor onthis account, but the contractor shall be required to provide necessary safety arrangements to avoid any accidents or damage to adjacent buildings, roads and service lines. He shall be responsible for any accidents or damage caused due to construction and subsequent maintenance of the wells and shall restore the ground to its original condition after the wells are dismantled on completion of the work.

Clause 32

Employment of Technical Staff and employees

Contractors Superintendence, Supervision, Technical Staff & Employees

(i) The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.

As per tendered amount (worked out on the basis of quoted rate of individual items)and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in Operative Schedule. Even of the contractor (or partner(s) in case of firm/ company)is himself / herself an Engineers, it is necessary on the part of the contractor to Employ principal technical representative / technical representative (s) as per stipulation in Operative Schedule.

The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the contractor in this respect. Such a principal technical representative and other technical representative(s) shall be appointed by the contractor soon after receipt of the approval from Engineer-in- charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s) The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required, to the Engineer-in-Charge and/or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in-Charge and

shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements/checked measurements/ test checked measurements. The representative(s) shall not look after any other work. Substitutes, duly approved by Engineer-in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the contractor as specified in Operative Scheduleand the decision of the Engineer-In-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor. Further if the contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/areappointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every on account bill/ final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

(ii) The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in- Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

Clause 33

Levy/Taxes payable by Contractor

(i) All the taxes except GST applicable in respect of this contract shall be payable by the Contractor and WAPCOS will not entertain any claim whatsoever in respect of the same.

(ii) The contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, etc. from local authorities.

(iii) If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the WAPCOS and does not any time become payable by the contractor to the State Government, Local authorities in respect of any material used by the contractor in the works, then in such a case,it shall be lawful to the WAPCOS and it will have the right and be entitled to

recover the amount paid in the circumstances as aforesaid from dues of the contractor.

CLAUSE 34: Clause 34
Conditions for reimbursement of levy/taxes if levied after receipt of Tenders

(i) All tendered cost shall be inclusive of all taxes and levies (except GST) payable under respective statutes. However, if any further tax or levy or cess is imposed by Statute, after the last stipulated date for the receipt of tender including extensions if any and the contractor thereupon necessarily and properly pays such taxes/levies/cess, the contractor shall be reimbursed the amount so paid, provided such payments, if any, is not, in the opinion of the WAPCOS attributable to delay in execution of work within the control of thecontractor.

(ii) The contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the WAPCOS and/or the Engineer-in-Charge and shall also furnish such other information/document as the Engineer-in-Charge may require from timeto time.

(iii) The contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, give a written notice thereof to the Engineer-in-charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

CLAUSE 35: TERMINATION OF CONTRACT ON DEATH OF CONTRACTOR

Without prejudice to any of the rights or remedies under this contract, if the contractor dies, the Engineer-In-Charge on behalf of the WAPCOS shall have the option of terminating the contract without compensation to the contractor.

CLAUSE 36: IF RELATIVE WORKING IN WAPCOS THEN THE CONTRACTOR NOT ALLOWED TOTENDER

The contractor shall not be permitted to tender for works in the WAPCOS responsible for award and execution of contracts in which his near relative is posted in WAPCOS. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Officer in the WAPCOS. Any breach of this condition by the contractor would render him liable to be debarred from tendering in WAPCOS any breach of this condition.

NOTE: By the term “near relatives” is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

CLAUSE 37: NO GAZETTED ENGINEER TO WORK AS CONTRACTOR WITHIN ONE YEAR OF RETIREMENT

No engineer of gazetted rank or other gazetted officer employed in engineering or administrative duties in an engineering department of the Government of India shall work as a contractor or employee of a contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This

contract is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government of India as aforesaid, before submission of the tender or engagement in the contractor's service, as the case may be.

Clause 38
Theoretical consumption ofMaterial

(i) After completion of the work and also at any intermediate stage in the event of Non reconciliation of materials issued theoretical quantity of materials used in the work shall be calculated on the basis and method given hereunder:

(a) Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of work as shown in the Schedule of Rates mentioned in Schedule 'F'. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above mentioned schedule/statement or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.

(b) Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in- Charge, including authorized lappages, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual, each diameter wise, section wise and category wise separately.

(c) Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 5% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 10%), such determination & comparison being made diameter wise & category wise.

(d) For any other material as per actual requirements.

Over the theoretical quantities of materials so computed a variation shall be allowed as specified in Operative ScheduleFor non-scheduled items, the decision of the WAPCOS regarding theoretical quantities of materials which should have been actually used, shall be final and binding on the contractor

(ii) The said action under this clause is without prejudice to the right of the WAPCOS to take action against the contractor under any other conditions of contract for not doing the work according to the prescribed specifications

CLAUSE 39: COMPENSATION DURING WARLIKE SITUATION ---------- NOT APPLICABLE
The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from

him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvagedfrom the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge, such payments being in addition to compensation upto the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Engineer-In-Charge upto Rs. 5,000/- and by the WAPCOS for a higher amount. The contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such precautions against air raid as are deemed necessary by the A.R.P. Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work.

In the event of the contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Engineer-In-Charge.

CLAUSE 40: APPRENTICES ACT PROVISIONS TO BE COMPLIED WITH

The contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and the WAPCOS may, in his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

CLAUSE 41: RELEASE OF SECURITY DEPOSIT AFTER LABOUR CLEARANCE

Release of Security Deposit of the work shall not be refunded till the contractor produces a clearance deposit after labour certificate from the Labour Officer. As soon as the work is virtually complete the contractor shall apply for the clearance certificate to the Labour Officer under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the Labour Officer to intimate if any complaint is pending against the contractor in respect of the work. If no complaint is pending, on record till after 3 months after completion of the work and/or no communication is received from the Labour Officer to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate and the Security Deposit will be released if otherwise due.

CLAUSE 42: INSURANCE

1. **Requirements**

Before commencing execution of works, unless stated otherwise in the special conditions of contract, it shall be obligatory for the contractor to obtain at his own cost stipulated insurance cover under the following requirements:

a) Contractor's all risk and Third Party Cover.
b) Liability under the workmen's compensation Act, 1923, Minimum Wages Act, 1948 and Contract Labour (Regulation and Abolition) Act, 1970.
c) Accidents to staff, Engineers, Supervisors and others who are not governed by workmen's compensation Act.
d) Damage to material, machinery and works due to fire theft etc.
e) Any other risk to be covered by insurance as may be specified by the employer in the special conditions of contract.

2. **Policy in Joint Names of Contractor and Employer**

The policy referred to under sub-clause 46(1) above shall be obtained in the joint names of the contractor and the employer and shall inter-alia provide coverage against the following, arising out of or in connection with execution of works, their maintenance and performance of the contract.

a) Loss of life or injury involving public, employee of the contractor, or that of employer and Engineer, labour etc.
b) Injury, loss or damage to the works or property belonging to public, government bodies, local authorities, utility organizations, contractors, employer or others.

3. **Currency of Policy**

The policies shall remain in force throughout the period of execution of the works and till the expiry of the defect liability period. The contractor shall, whenever called upon, produce to the engineer or his representative the various insurance policies obtained by him as also the rates of premia and the premia paid by him to ensure that the polices indeed continue to be in force.If the contractor fails to effect or keep in force or provide adequate cover in the insurance policies mentioned in the sub clause 46(1) or any other insurance he might be required to effect under the contract, then in such cases, the employer may effect and keep in force any such insurance or further insurance and the cost and expenses incurred by him in this regard shall be deductible from payments due to the contractor or from the contractor's performance security.

CLAUSE 48: PAYMENT

1. **Payment Schedule**

The Payment Schedule includes a schedule setting out each Milestone Event to be achievedin a month for the Works.

2. **Contractor's Application for Payment**

From the date of issue of the Notice to Proceed, on the 5th (fifth) Business Day of any month,the Contractor may submit a Request for Payment, to WAPCOS Limited Representative in respect of the preceding month.

Within each Request for Payment the Contractor shall show separately:

(i) the amounts which the Contractor claims to be payable as the cost of the Works completed during that month; and

(ii) the cumulative amount of all prior payments made by WAPCOS Limited; and

(iii) Any amounts to which the Contractor considers are due and payable to it in accordance with the provisions of the Contract.

The Contractor's Request for Payment shall:

(i) be prepared on forms in the form and in a number advised by WAPCOS Limited Representative; and

(ii) contain confirmation of the relevant Milestone Events which, in the opinion of the Contractor have been achieved in that month which applies to each such Milestone Event; and

(iii) be accompanied by:

(a) Copy of relevant records of measurement of works, jointly taken and signed by both the parties;

(b) A status report describing in such detail as may reasonably request, the percentage of any uncompleted Milestone Event for the month in question and the work to be undertaken by the Contractor prior to the next Request for Payment;

(c) Certification by WAPCOS Limited Representative confirming that the Milestone Events referred to in the Request for Payment have been achieved.

(d) Confirmation by the Contractor of any amounts due and owing from the Contractor to WAPCOS Limited pursuant to the Contract;

(e) The Contractor's certification that the quality of all completed Works accords with the requirements of the Contract;

(f) The Contractor's certification that each obligation, item of cost or expense mentioned in that Request for Payment has not been the basis of any previous payment.

(g) The Contractor's certification that it has reviewed all financial and budget data contained in the Request for Payment;

(h) The Contractor's certification that the quality of all completed Works accords with the requirements of the Contract;

(i) The Contractor's certification that each obligation, item of cost or expense mentioned in that Request for Payment has not been the basis of any previous payment; and

(j) The Contractor's certification that each Subcontractor who performed part of the Works which was included in the immediately preceding Certificates of Payment was paid all amounts then due to it for such Works

(k) The Contractor providing evidence of the validity of the Contractor’s Insurances.

3. Certificates of Payment

Within [14 (fourteen)] Business Days of receipt of the Contractor's Request for Payment under Clause 48(2) [Contractor's Application for Payment], WAPCOS Limited and WAPCOS Limited Representative shall review such request and, shall issue to the Contractor, a Certificate of Payment certifying what amounts WAPCOS Limited shall pay. Each Certificate of Payment shall be for an amount which in the opinion of WAPCOS Limited, is the basis of the Request for Payment and pursuant to the Contract, is properly due to the Contractor (the “Gross Certifiable

Amount") less (i) the cumulative amounts of payments previously certified as due to the Contractor, (ii) any deduction on account of recovery of Advance Payment, and (iii) Retention Amount.

In the event that the Contractor fails to achieve any Milestone Event specified in the Payment Schedule, the Contractor shall not be entitled to the payment value attributable to that Milestone Event until the relevant Milestone Event has been achieved. When the relevant Milestone Event is achieved, the Contractor may include the payment valueattributable to the Milestone Event in the next Request for Payment.

No sum shall be included in the Certificate of Payment in respect of Materials yet to be incorporated into the Permanent Works unless the WAPCOS Limited Representative is satisfied that:

(i) such Materials have been properly acquired and properly and not prematurely delivered to the Project Site;

(ii) such Materials have been properly stored on the Project Site and fully protected against loss, damage or deterioration;

(iii) the Contractor's records of the requisitions, orders, receipts and use of any Materialsare kept in a form approved by the WAPCOS Limited Representative, and such records are available for inspection by the WAPCOS Limited Representative; and

(iv) The Contractor has submitted a proper statement of the cost of acquiring the Materials together with such documents as may be required for evidencing such cost.

Without prejudice to any other rights of WAPCOS Limited to withhold payment to the Contractor, WAPCOS Limited may withhold from any payment due to the Contractor such amount as WAPCOS Limited deems reasonably necessary or appropriate:

(i) if in the opinion of the WAPCOS Limited Representative the progress of the Works at the time of the Request for Payment is behind the progress of the Works as set out in the Programme; and/or

(ii) to protect it from any losses, expenses, costs or liability because of any one or more of the following reasons:

(a) defects and deficiencies in any Works, whether or not payment has been made;

(b) unsatisfactory performance of the Contract;

(c) the filing of third party claims relating to the Works or any of its commitmentparts for which the Contractor is liable;

(d) the Contractor's failure to make payments to Subcontractors;

(e) failure by the Contractor to provide or procure replacement Performance Security in accordance with the Contract;

(f) failure by the Contract to provide evidence of insurance coverage in accordance with the Contract;

(g) reasonable evidence that Completion will not occur by the Time for Completion;

(h) any overpayments made by WAPCOS Limited with respect to a previous payment;

(i) failure by the Contractor to submit a properly updated monthly Programme; and

(j) failure by the Contractor to provide satisfactory evidence that the costs of all labour and Materials and other obligations arising out of the Contract have been fully satisfied and

discharged by the Contractor and/or to otherwise fail to submit adequate supporting documentation for any Request for Payment.

Any Provisional Sum Works shall only be executed in whole or part upon the WAPCOS Limited Representative's instruction. If the WAPCOS Limited Representative issues no such instruction, the Provisional Sum Works shall not form part of the Works and the Contractor shall not be entitled to payment for it. The Contractor shall be deemed to have allowed the necessary time and resources to enable design and Execution of the Provisional Sum Worksin so far as the scope and nature of the Provisional Sum Works was reasonably foreseeable.

The Contractor shall be entitled only to such amount in respect of the Provisional Sum Works as the WAPCOS Limited Representative determines in accordance with this Clause 48(3). The WAPCOS Limited Representative shall notify the Contractor of any such determination. The WAPCOS Limited Representative shall have the authority to issue instructions to the Contractor for every Provisional Sum Works for which the Contractor shall be entitled to a part of the Provisional Sum as determined by the WAPCOS Limited Representative.

The Contractor shall produce to the WAPCOS Limited Representative all quotations, vouchers, invoices, accounts or receipts in connection with the expenditure in respect of the Provisional Sum Works, except where the Provisional Sum Works is valued in accordance with the item wise rates quoted by the Contractor in its bid submitted to the Employer.

In respect of every Provisional Sum the WAPCOS Limited Representative shall have authority to issue instructions for the execution of work or for the supply of goods, materials, Plant Sums or services by the Contractor, in which case the Contractor shall be entitled to an amount equal to the value thereof determined in accordance with Clause 48(3).

4. Payment

WAPCOS Limited shall pay the amount certified in a Certificate of Payment less the amountpaid earlier in accordance with Clause 48(3) [Certificate of Payment], no later than [15 (fifteen)] Business Days from the date of such Certificate of Payment.

SECTION - VI

SPECIAL CONDITIONS OF CONTRACT

SECTION - VI

SPECIAL CONDITIONS OF CONTRACT

1.0 SPECIAL CONDITIONS OF CONTRACT

The Special Condition of Contract (SCC) shall be followed by the Contractor in addition to the General Condition of Contract (GCC) of tender document. The following General Condition of Contract of this tender are modified/added as detailed below. In case of any discrepancy between GCC and SCC, the SCC will succeed over GCC.

Clause No.	Description	Applicability/Modified/ Added
DEFINITIONS		
2(iv)	Work / Project Means: **As Mentioned in NIT**	
2(v)	Site / Location Means **As Mentioned in NIT**	
CLAUSES OF CONTRACT		
Clause 1	Performance Guarantee i. Performance Guarantee if contractor quotes abnormallylow	**Applicable** The amount of 5% of Performance Bank Guarantee (PBG) will increase if L1 Bidder will quote abnormally low cost. The additional amount of PBG will be the difference of average quoted cost of all the other bidders who have participated in the bidding process and cost quoted by the L1 bidder who has quoted abnormally low. The decision to decide abnormally low cost will be in full discretion of the tender evaluation committee of WAPCOS.
	ii. Validity of Performance Guarantee	The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 06 month for 100 % performance gurantee amount, out of which 50% will be refunded on completion plus 06 months of claim period and then 50% of Performance Guarantee shall be retained as Security Deposit for maintenance period of 02 years, which will be reckoned after completion of defect liability period.

		The same shall be returned year wise proportionately
Clause 1A	Security Deposit Release of security Deposit	Applicable 4% of Tendered Value The Security Deposit as deducted above shall be released within year wise within the Defect Liability Period of 03 (Three) years i.e., 1st year: 50% of total SD; 2nd Year: 25% of total SD; and 3rd Year: 25% of total SD.
Clause 2	Compensation for Delay	(a) The work shall throughout the stipulated period of the contract be proceeded with all due diligence and the contractor shall pay as compensation an amount equal to ½ (Half) % or such smaller amount as the Engineer-In-Charge (whose decision in writing shall be final) may decide on the amount of the whole work as shown in the agreement, for every week that the work remains non-commenced or unfinished after the proper dates subject to a maximum of 10 (Ten) % of the contract value. (b) Further to ensure good progress during the execution of the work, the contractor shall be bound in all cases in which the time allowed for any work exceeds one month (save for special jobs) to complete 1/8th (One-Eighth) of the whole of the work before 1/4th (One-Fourth) of the whole time allowed under the contract has elapsed; 3/8th (Three-Eighth) of the work before ½ (One-Half) of such time has elapsed, and 3/4th (Three-Fourth) of the work before 3/4th (Three-Fourth) of such time has elapsed. However, for special jobs if

		a time schedule has been submitted by the contractor and the same has been accepted by the Engineer-In-Charge, the contractor shall comply with the said time schedule. In the event of the contractor failing to comply with this conclusion, he shall be liable to pay as compensation an amount equal to half per cent or such smaller amount as the Engineer-In-Charge (whose decision in writing shall be final) may decide on the said cost of the work for every week that the due quantity of work remains incomplete. Provided that the entire compensation to be paid under the provisions of this clause shall not exceed ten percent on the cost of the work as shown in the agreement.
Clause 3A	Start of Work	Not Applicable
Clause 5	Time and Extension for Delay	Applicable
New Clause 7A (Added)	Payment	It is clearly agreed and understood by the Contractor that notwithstanding anything to the contrary that may be stated in the Agreement between WAPCOS and the Contractor; the contractor shall become entitled to payment only after WAPCOS has received the corresponding payment(s) from the Client/ Owner for the work done by the contractor. Any delay in the release of payment by the Client/ Owner to WAPCOS leading to a delay in the release the corresponding payment by WAPCOS

		to the contractor shall not entitle the contractor to any compensation/ interest from WAPCOS. All payments shall be released by way of e-transfer through RTGS in India directly at their Bank account by WAPCOS
Clause 10 B(i)	Secured Advance on Non-Perishable Materials	Applicable Recovery of Secured Advance: Recovery shall be made by the deduction from the contractors bills commencing after first 10% of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time 80% of the gross value of the contract is executed and paid.
Clause 10 B(iii)	Plant Machinery & Shuttering Material Advance	Not Applicable
Clause 10 B(iv)	Recovery of Mobilization advance	Applicable Added (14.75%) interest per annum for the period in case of non-return of mobilization advance after stipulated due date.
Clause 10 CC	Payment due to Increase / Decrease in Prices / Wages (Excluding Materials covered under Clause 10 CA) after Receipt of Tender for Works	Applicable
Clause 12	Deviations / Variations Extent and Pricing	
Clause 17	Contractor liable for Damages, Defects during Defect Liability Period.	Applicable Added/Modified: Three years from the date of successful completion of each component of the project in all respect

SECTION - VII

ADDITIONAL CONDITIONS OF CONTRACT

SECTION - VII

ADDITIONAL CONDITIONS OF CONTRACT

2.0 ADDITIONAL CONDITIONS

1. The Contractor shall be responsible for consequential effects arising out during the inspection done by the Chief Technical Examiner Cell, Central Vigilance Commission or Project Management Group (PMG) or any other committee constituted by the IIT (ISM) Dhanbad or construction site visiting team of IIT (ISM) Dhanbad or Director of IIT (ISM) Dhanbad or by the Building Works Committee or third party authorized by IIT/WAPCOS or any statuary committee or by any duly authorized representative of WAPCOS, during the progress or any time after the construction and development of project up to the defect liability period, and will take appropriate action for rectification of defective work and modifications as suggested by the above teams/ group/ individual. Rectification of defective works or replacement of sub-standard materials or articles or modifications, as pointed out by the Chief Technical Examiner Cell, Central Vigilance Commission or Project Management Group (PMG) or any other committee constituted by the IIT (ISM) Dhanbad or construction site visiting team of IIT (ISM) Dhanbad or Director of IIT (ISM) Dhanbad or by the Building Works Committee or third party authorized by IIT/WAPCOS or any statuary committee or by any duly authorized representative of WAPCOS will be carried out or replaced/ modified by the Contractor at his own risk and cost.

2. Handing Over of the Project: Contractor will hand over the project to Owner /Client after successful completion of each component of the project in all respect and complete satisfaction of IIT(ISM) Dhanbad/ Engineer-In-charge. Contractor shall also provide necessary Completion Certificate/NOC from all local Government/ Statuary Authorities including Fire, Forest, Electrical, Environment, Lift, DG Set, Complete inventory list, duly signed as-build drawings, required before handing over the project to the client. The defect liability period will be one year after such handing over. Completion certificate for the work will only be issued to the contractor after complete handing over of the project to the client and issuance of completion certificate by Owner /Client to WAPCOS. The partial handing over of works components shall not be considered.

3. The payment of final bill will be made after successful completion and handing over of the works to the client with complete satisfaction of IIT (ISM) Dhanbad

4. The contractor shall deploy the resources at site to start the construction after clearance from the Owner of the project and subsequent written approval from WAPCOS. No claim shall be entertained for idle labour, idle machinery, idle technical / non-technical staff, idle T&P if any, due to delay in start of the works.

5. If any dispute/ hindrance may arise during construction due to any reason whatsoever, the contractor is not liable for any financial claim or damages due to such circumstances.

6. All mass Reinforced Cement Concrete work shall be design mix concrete of specified grade and initial design mix shall be carried out from the Govt. approved Laboratory/NABL accredited lab/ NIT/IIT.

7. The contractor shall provide 2 (two) computer operator for preparation of bill, record of measurements etc. The contractor shall provide 2 Computers having latest generation processor, MS Windows-10, A-3 Coloured Inkjet & A-4 Laserjet Printers, Scanners, photocopier, internet connection, UPS etc.in office of Engineer-in-Charge. The contractor shall also provide 2 (Two) inspection vehicles (Innova or equivalent) for WAPCOS during the currency of work i.e. from date of start to completion of entire work, at disposal of Engineer-in-Charge. Vehicles are to be provided to facilitate work inspection, quality control, coordination with multiple agencies and better liasioning. The average mileage of each inspection vehicle may be approx. 2500 km per month. The inspection vehicle should be in good condition and should not be more than four years old. Agency will provide inspection vehicle for all the times (including night hours during work at site) as and when required at site/office work as per direction of Engineer-in-Charge. The inspection vehicle shall make available for 12 hours per day on daily basis i/c holidays as per direction of the Engineer-in-Charge. The running cost of inspection vehicles along with all incidental charges i.e. cost of fuels, lubricant, services /maintenance of vehicles, pay of driver etc. will be borne by the agency and nothing will be paid by WAPCOS. An amount equal to 1% of the gross amount of running account bills and final bill will be deducted, if above facilities are not provided at site.

8. The Contractor shall render all help and assistance in documenting the total sequence of this project by way of photography, slides, etc. nothing extra shall be payable to the agency on this account.

9. Contractor should provide R.O. Plant sufficient for workers employed at site, his technical staff and site staff.

10. Quoted amount by contractor shall be firm and fixed for entire contract period as well as extended period for completion of the works. No escalation shall be applicable on this contract.

11. Quoted amount by the contractor shall be all inclusive and shall apply to all heights lifts, leads and depths of the building and nothing extra shall be payable on this account.

12. The contractor shall make his own arrangements for obtaining electric connection and water Connection/arrangement (if required). The water charges and electricity charges as charged by IIT(ISM) Dhanbad will be paid by the Contractor. No dispute in this regard shall be entertained.

13. The contractor shall deploy the resources at site to start the construction after clearance from the Owner of the project and subsequent written approval from WAPCOS. No claim shall be entertained for idle labour, idle machinery, idle technical / non-technical staff, idle T&P if any, due to delay in start of the works.

14. The Contractor shall dispose of all the dismantled materials, debris, garbage, waste outside of the campus of the works at his own cost and provide clear and clean site at the time of handing over the works

15. Some restrictions may be imposed by the security staff etc. on the working and for movement for labour materials etc. The contractor shall be bound to follow all such restrictions / instructions and nothing extra shall be payable on this account.

16. The contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignment, the level and correctness of every part of the work and shall rectify effectively any

errors or imperfections therein. Such rectifications shall be carried out by the contractor at his own cost to the instructions and satisfaction of the Engineer-in-Charge.

17. The cost/rates quoted by the contractor are deemed to be inclusive of site clearance, setting out work, profile, establishment of reference bench mark, spot levels, construction of all safety and protection devices, barriers, earth embankments, preparatory works, all testing of materials working during monsoon, working at all depths, height and locations etc. unless specified in the schedule of quantities.

18. Royalty at the prevailing rates wherever payable shall have to be paid by the contractor on the boulders, metal, shingle, sand and bajri etc. Or any other material collected by him for the work direct to revenue authorities and nothing extra shall be paid by the department for the same.

19. The contractor shall provide at his own cost suitable weighing, surveying and leveling and measuring arrangements as may be necessary at site for checking. All such equipment shall be got calibrated in advance from laboratory, approved by the Engineer-in-Charge. Nothing extra shall be payable on this account.

20. The contractor shall comply with proper and legal orders and directions of the local or public authority or municipality and abide by their rule and regulations and pay all fees and charges which he may be liable.

21. The contractor shall give a performance test of the entire installation (s) as per standing specification before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

22. Any cement slurry added over base surface (or) for continuation of concreting for better bond is deemed to have been in-built in the items and nothing extra shall be payable (or) extra cement considered in consumption on this account.

23. Samples of various materials required for testing shall be provided free of charges by the contractor. Testing charges, if any, unless otherwise provided shall be borne by the Contractor. All other expenditure required to be incurred for taking the samples, conveyance, packing etc. shall be borne by the contractor himself.

24. The contractor shall have to make approaches road to the site, if so required and keep them in good condition for transportation of labour and materials as well as inspection of works by the Engineer-in-charge. Nothing extra shall be paid on this account.

25. No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The contractor shall be fully responsible for any damage to the govt. property and work for which the payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The contractor shall be fully responsible for safety and security of his material, T&P, Machinery brought to the site by him.

26. The terms machine batched, machine mixed and machine vibrated concrete used elsewhere in agreement shall mean the concrete produced in concrete batching and mixing plant and if necessary transported by transit concrete mixers, placed in position by the concrete pumps,

tower crane and vibrated by surface vibrator /needle vibrator / plate vibrator, as the case may be to achieve required strength and durability.

27. Wherever work is specified to be done or material procured through specialized agencies, their names shall be got approved well in advance from Engineer in charge. Failure to do so shall not justify delay in execution of work. It is suggested that immediately after award of work, contractor should negotiate with concerned specialist agencies and send their names for approval to Engineer in charge. Any material procured without prior approval of Engineer in charge in writing is liable to be rejected. Engineer in charge reserves right to get the materials tested in laboratories of his choice before final acceptance. Non-standard materials shall not be accepted.

28. The construction joints shall be provided in predetermined locations only as decided by Engineer in charge. The cost of shuttering for these construction joints shall be included in item of Concrete work / RCC work and nothing extra shall be payable on this account to the contractor.

29. The gradation of fine sand to be used in plaster work, shall be strictly as per Table 3.1 (clause 3.1.3) of CPWD Specification 2009 Vol.-I conforming to IS 1542-1977. The plastered surface shall be fairly smooth without any undulation of any kind for applying paint/white wash.

30. No chase cutting/dismantling of plaster/RCC/CC shall be allowed, so contractor has to execute the electrical work accordingly.

31. The contractor shall invariably prepare the samples of finishing items i.e. flooring of different types, external & internal finishing i/c colour scheme of paint, tiles in dado, flooring in platforms & staircase, water supply & sanitary fittings and any other item as per direction of Engineer-in-charge. The contractor shall proceed with further finishing items only after getting the samples of these items approved in writing from Engineer-in-charge.

32. One sample room complete in all shape for each category, shall be prepared by the contractor and got approved from Engineer-in-charge in writing. The contractor shall be allowed to proceed with further rooms only after getting the sample room approved in writing from Engineer-in-charge No extra claim whatsoever beyond the payments due at agreement rates will be entertained from the contractor on this account.

33. Royalty at the prevalent rates shall be payable by the contractor on all the boulders, metals, shingle, sand and bajri etc. collected by him for the execution of the work, direct to the Revenue authority or authorized agent of the state Government concerned or Central Government. No such claim of Contractor on royalty shall be entertained by the WAPCOS.

34. The contractor shall establish a fully equipped site laboratory and shall provide electrically operated cube crushing and testing machine appliance at site, such as weighing, scale, graduated cylinder, standard sieves, thermometer, slump cones etc. all relevant tests for BMC / RMC as per prescribed IS codes in order to enable the Engineer in charge to conduct field tests to ensure that the quality is consistent with the prescribed specifications and nothing extra shall be paid on this account.

35. The contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case, he or his authorized representative is not present or does not associate himself, the results or such tests and consequences thereon shall be binding on the contractor.

36. The contractor shall get the water tested with regard to its suitability of use in the works and get written approval from the Engineer in charge before he proceeds with the use of same of execution of works. The suitable water for construction shall be arranged by Contractor at his own cost and nothing extra shall be paid to the contractor on this account.

37. The material shall conform to the quality and make as per attached list. However for the items not appearing in the list preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the Contractor shall be judged by the standard laid down in the relevant ISI specification/CPWD specification. All materials and articles brought by the contractor to the site for use shall conform to the samples approved, which shall be preserved till the completion of the work. However, such articles which bear ISI mark but stand banned by WAPCOS/Owner will not be used. Notwithstanding the case of materials of "Preferred Make" as given provisions of Clause 10A of the General Conditions of Contract shall be applicable on the materials of "Preferred Make" also.

38. It must be ensure that all materials to be used in work bear BIS certification mark. In cases where BIS certification system is available for a particular material/product but not even a single producer has so far approached BIS for certification the material can be used subject to the condition that it should confirm to CPWD specification and relevant BIS codes. In such case written approval of the Engineer-In-Charge may be obtained before use of such material in the work.

39. The final approval of the brand to be used shall be as per the direction of Engineer-in-Charge. The brand used shall be one of the brands in case specified in the list of preferred make / materials.

40. In case of non-availability of material of the brands specified in the list of approved materials an equivalent brand may be used after getting written approval of WAPCOS giving details to indicate that the brand proposed to be used is equivalent to the brands mentioned in the agreement.

41. **Special conditions for Cement**

The contractor shall procure 43 grade Ordinary Portland Cement (conforming to IS : 8112), Portland pozzolona cement (confirming to IS : 1489 : Part –I) as required in the work, from reputed manufacturers of cement as per the list of approved makes or from any other reputed cement manufacturer, having a production capacity not less than one million tones per annum as approved by WAPCOS. The tenderers may also submit a list of names of cement manufacturers which they propose to use in the work. The tender accepting authority reserves right to accept or reject name(s) of cement manufacture(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority

does not accept the list of cement manufactures, given by the tenderer, fully or partially. The cement brought to the site for execution of work shall be in bags bearing manufacturer's name & ISI marking. Weight of cement in each bag shall be 50 kg. Samples of cement arranged by the contactor shall be taken by the Engineer- in- Charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected and it shall be removed from the site by the contractor at his own cost within 7 days of written order from the Engineer-in-Charge to do so.

42. **Special Conditions for Steel:-**

The contractor shall procure TMT bars of Fe500/Fe500D/Fe550/Fe550D grade (the grade to procured is to be specified) from primary steel producers as per the list of approved makes or any other producer as approved by WAPCOS who are using iron ore as the basic raw material / input and having crude steel capacity of 2.0 Million tonnes per annum and above.

43. **Removal of rejected/sub-standard materials.**

The following procedure shall be followed for the removal of rejected/sub-standard materials from the site of work:

(i) Whenever any material brought by the contractor to the site of work is rejected, entry thereof should invariably be made in the Site Order Book under the signature of the Engineer-In-Charge, giving the approximate quantity of such materials.

(ii) As soon as the material is removed, a certificate to that effect shall be recorded by the Engineer-In-Charge against the original entry, giving, the date of removal and mode of removal, i.e., whether by truck, carts, or by manual labour. If the removal is by truck, the registration number of the truck should be recorded.

(iii) When it is not possible for the Engineer-In-Charge to be present at the site of work at the time of actual removal of the rejected/sub-standard materials from the site, the required certificate should be recorded by the Authorized Representative of WAPCOS, and the Engineer-In-Charge should countersign the certificate recorded by the Authorized Representative.

44. In case of works where a ready mix concrete (RMC) is stipulated to be used from an approved source/manufacturer, cement register need not be maintained. However, the computerized dispatch slips that are sent with each dispatch of RMC shall be kept as record.

45. If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. The contractor has to take permission from the police & local authorities etc. if required for work during night hours. No claim / hindrance on this account shall be considered if work is not allowed during night time. The requisite supervision shall be made available by the WAPCOS along with necessary issue of material under joint custody.

46. Contractor should hand over the warranty of the specialized items to the WAPCOS.

47. Contractor shall submit all the Guarantee/ Warranty bond for the water proofing and Anti-Termite Treatment works with 10 years of service warranty

48. The contractor is required to deploy resources as per availability of site. However no claim will be entertained for idle labour, idle machinery, idle technical/no-technical staff, idle T&P etc.

49. Contractor shall not divert any advance payments or part thereof for any work other than that needed for completion of the contracted work. All advance payments received as per terms of the contract (i.e. mobilization advance, secured advance against materials brought at site, secured advance against plant & machinery and/or for work done during interim stages, etc.) are required to be re-invested in the contracted work to ensure advance availability of resources in terms of materials, labour, plant & machinery needed for required pace of progress for timely completion of work.

50. **ORDER OF PREFERENCE**

Should there be any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work (including special conditions) and I.S. Codes etc., the following order of preference shall be observed.

(i) Schedule of finishes and specifications.
(ii) Particular specifications
(iii) Additional Conditions
(iv) CPWD Specifications including correction slips issued up to the last date of submission of tender.
(iv) Tendered drawings
(vi) National Building Code 2016.
(viii) ASTM, BS, or other foreign origin code mentioned in tender document.
(ix) Manufacturer's specifications and as decided by the Engineer-in-Charge.
(x) Sound Engineering practices or well established local construction practices.

51. **CONSTRUCTION VEHICLES TYRE WASHING FACILITIES**

All the vehicles leaving the site shall be loaded in such a manner that the excavated materials, mud or debris will not be deposited on roads. All such loads shall be covered or protected to prevent dust being emitted. The wheels of all vehicles shall be washed properly before leaving the site to avoid the deposition of mud and debris on the roads. The contractor shall provide a wash pit and a wheel washing facility with high pressure water jets for this purpose. Also, the contractor shall make necessary arrangements for sweeping and removal of mud from roads if it is deposited even after washing of wheels of vehicles leaving site. A penalty of Rs 10,000 per day for violation of such measures shall be levied. Nothing extra shall be paid for providing and maintaining this facility.

52. The huts for labour are not to be erected at the site of work by the contractors. He is required to make his own arrangements for labour accommodation and nothing extra shall be paid by WAPCOS on this account. However, Vendor shall be given Space for installation of fully automatic concrete batch plant, yard for keeping various materials, cement/ steel store Inside of IIT (ISM) Dhanbad campus. Also for keeping chowkidar, site office, lab, samples room, toilets for labour etc., working yard and other essential requirements such as cement store for day to day requirement, some space shall be made available inside the campus. All labour and staff of contractor shall possess valid identity cards such as Aadhar Card, Voter Card etc. Before tendering, he shall visit the site and assess the manner in which he is able to arrange the

above facilities. The Engineer-in-Charge shall in no way be responsible for any delay on these accounts and no claim, whatsoever, on these accounts shall be entertained.

The contractor has to built his site office for housing their staff and engineers, sample rooms, testing laboratories, conference hall etc. The conference room should be air-conditioned and have at least capacity of 30 persons around a conference table.

53. The contractor shall provide one sample each from at least three (3) preferred makes for an item for approval of Engineer In charge/IIT (ISM) Dhanbad.

54. The contractor needs to submit BOQ and detailed specification of items within 03 Months of issuance of LOA. The detailed Specification of each item will be approved by Engineers In charge in consultation with IIT (ISM) Dhanbad.
55. The Distribution system shall comprising of 1x2 MVA 33/11 kV substation with a future provision of one number extra Transformer with auxiliaries expandable till 2 MVA .
    The 11 kV system shall also be compatible to receive two incomers with bus coupler system with interlocking arrangement and total four numbers outgoing feeder.

56. Preference to Make In India

1. The provisions of revised 'Public Procurement (Preference to Make in India) Order 2017 Revision' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no.-P45021/2/2017-PP (BE-II) as amended on 16.09.2020 shall be applicable to the bidding process and award of the contract shall be done accordingly.
2. Verification of Local Content

i. The bidder at the time of tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement of the tender. They shall also give details of the location(s) at with the local value addition is made.
ii. In cases of procurement for a value in excess of Rs 10 Crores, the bidder shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than companies) giving the percentage of local content.

57. Rule 144 (xi) in General Financial Rules (GFRs) 2017

i. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.
ii. "Bidder "(including the term 'tenderer', 'consultant' or 'service provider' in certain contexts) means any person or firm or company, including any member of a consortium or joint venture (that is an association of several persons, or firms or companies), every artificial juridical person not falling in any of the descriptions of bidders stated hereinbefore, including any agency branch or office controlled by such person, participating in a procurement process.
iii. "Bidder from a country which shares a land border with India" for the purpose of this Order means:-
a) An entity incorporated, established or registered in such a country; or b) A subsidiary of an entity incorporated, established or registered in such a country; or
c) An entity substantially controlled through entities incorporated, established or registered in such a country; or
d) An entity whose beneficial owner is situated in such a country; or
e) An Indian (or other) agent of such an entity; or

f) A natural person who is a citizen of such a country; or
g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above
iv. The beneficial owner for the purpose of clause 33 (iii) above will be as under:
1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercise control through other means.
Explanation-
2. "Controlling ownership interest" means ownership of or entitlement to more than twenty- five per cent. Of shares or capital or profits of the company;
3. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;
4. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
5. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone of together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profit of such association or body of individuals;
6. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
7. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.
v. An Agent is a person employed to do any act for another, or to represent another in dealings with third person. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

58. All payments in the form of Monthly bills and Final bills are subjected to the submittal of the following documents to WAPCOS by the Contractor and verification of the said documents by owner/client of the respective billing month:

    i) Compliance Reports to all Non-Compliance Reports (NCR), Red Flag Report or any such reports issued by owner/client, WAPCOS and/or the TPQA Consultant;

    ii) All Quality Test Reports

    iii) Monthly Progress Report (Physical and financial)

    iv) Inspection reports towards site and material

    v) Copy of Inspection Register

    vi) Copy of Site Order Book

    vii) All other relevant documents which shall be communicated by owner/client/WAPCOS before commencement of any work

SECTION - VIII

OPERATIVE SCHEDULE

SECTION VIII

OPERATIVE SCHEDULES

SCHEDULE 'A'

Schedule of quantities As per Index

SCHEDULE 'D' Extra schedule for specific requirements/document for the work, if any.	NIL
SCHEDULE 'E' Reference to General Conditions of Contract	General Conditions of Contract of the tender document
Name of Work	Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.
Estimated cost of work	Rs.131,67,54,019/- (One Hundred Thirty one Crore Sixty Seven Lacs Fifty Four Thousand and Nineteen Rupees Only)
Earnest Money Deposit (EMD) / Bid Security	Rs. 1,41,67,540/- (One Crore Forty One Lakh Sixty Seven Thousand Five Hundred and Forty Rupees Only)
Performance guarantee	5% of Tendered Value
Security deposit	4% of Tendered Value plus 50% of PG for maintenance tendered value
SCHEDULE 'F'	
GENERAL RULES & DIRECTIONS: Officer inviting tender	Additional Chief Engineer (WAPCOS Limited)
Applicable mode of EPC Contract	EPC Mode -1
Type of Building	Permanent
List of Approved Construction	Cast-in-Situ Structural Systems RCC framed structure system using steel formwork

Technologies	
Maximum percentage for quantity of items of work to be executed beyond which rates are to be determined in accordance with Clauses 12.2 & 12.3.	See below
Definitions:	
Engineer-in-Charge	Additional Chief Engineer (WAPCOS Limited)
Accepting Authority	Additional Chief Engineer (WAPCOS Limited)
Percentage on cost of materials and labourto cover all overheads and profits:	15%
Standard Schedule of Rates	1. Plinth Area Rate 2021 plus Cost Index. 2. DSR 2021 (Civil works) plus cost index. 3. DSR 2022 (E&M) with correction slip(s) up to last date of submission of bid and market rates. 4. DSR (Wet Riser and Sprinkler System) 2019 with correction slip(s) up to last date of submission of bid and market rates 5. Market Rates for Non DSR Items.
Department	WAPCOS
Clause 1	
(i)Time allowed for submission of Performance Guarantee, Programme chart (time and progress) and applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance.	15 days
(ii) Maximum allowable extension with late fee at 0.1% per day of performance guarantee amount beyond the period provided in (i) above	15 days

Clause 2	
Authority for fixing compensation underclause 2	Addl. Chief Engineer, WAPCOS limited.
Clause 5	
Time allowed for execution of work	24 Months (3 months for planning & designing and obtaining approvals and 21 months for execution of original work)
Number of days from the date of issue of letter of acceptance for reckoning date ofstart	15 days

Table of Milestones			
S. No.	**Description**	**Period of completion**	**Amount to be withheld in case of non-achievementof milestone**
1	On submission and getting approval of detailed working architectural, structural and MEP services and development works (civil) drawings from competent Authority including Design basis report of Architectural, structural and MEP drawings.	3 months	0.45% of tendered amount
2	Completion of RCC foundation works of buildings upto ground floor level	7 months	0.65% of tendered amount
3	40% completion of RCC works of buildings in superstructure of centenary building	9 months	0.65% of tendered amount
4	100% completion of RCC works of buildings in superstructure of centenary building Preparation of one sample class room and one toilet block of centenary building	12 months	0.65% of tendered amount
5	Completion of 50% work of flooring, internal plaster and plumbing works in centenary building	15 months	0.65% of tendered amount
6	Completion of 75% work of flooring, internal plaster and plumbing works	18 months	0.65% of tendered amount
7	Supply of Furniture, AV system and PA system	21 months	0.65% of tendered amount
8	Cleaning of all external/internal area, operation of water line, sewerage line & other essential services including operation of E/M services and handing over of Centenary building	23 months	0.65% of tendered amount
9	All civil, electrical and mechanical works completed in all aspects including cleaning of all external/internal area, operation of water line, sewerage line & other essential services including operation of E/M services.	24 months	0.65% of tendered amount

Monthly recovery for delay in submission of the monthly progress report within specified period - not exceeding Rs 50,000 per month for each month default

Authorities:

(i) To take action under clause 5…… Engineer-in-Charge

PROFORMA OF SCHEDULES

Clause 5 Schedule of handing over of site

Part	**Portion of Site**	**Description**	**Time Period for handing over reckoned from date of issue of letter of intent.**
Part A	Portion without any hindrance	Entire site	Immediate
Part B	Portions with encumbrances		
Part C	Portions dependent on work of other agencies		

Schedule of issue of Designs…… **Not Applicable**

Part	**Portion of Site**	**Description**	**Time Period for issue of designreckoned from date of receiptof tenders**
Part A	Portion already included in NIT	-	-
Part B-1	Portions of Architectural Designs to be issued	-	-
Part B-2	Portions of Civil Designs to be issued	-	-
Part B-3	Portions of E&M Design to be issued	-	-

Schedule of rate of recovery for delay insubmission of the modified program in terms of delay days		**Rs. 5,000/- per day**
Authority to decide:		
(i) Extension of time		Additional chief engineer, WAPCOS Limited
(ii) Rescheduling of milestones		Additional Chief Engineer(WAPCOS Limited)
(iii) Shifting of date of start in case of delay in handing over of site		Additional Chief Engineer(WAPCOS Limited)

Clause 7		
Gross work to be done together with net payment / adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment		Rs. 12.00 crore for civil work and Rs 4.00 crorefor E&M works. But for first three months it shall be Rs. 2.00 crore for civil works.
Clause 7A Whether Clause 7A shall be applicable (No RA bill shall be paid till submission of EPFO, ESIC and BOCW Welfare Board)		Yes
Clause 8 A Authority to decide compensation on account if contractor fails to submit completion plans.		Additional Chief Engineer (WAPCOS Limited)

Clause 10A

List of minimum testing equipment to be provided by the contractor at site lab will be as belowand as per direction of Engineer-in-Charge.

1	STANDARD SIEVES (INDIAN STANDARD)	
a)	Set of sieves 450 mm internal dia (GI sheet frames) of sizes (100 mm, 80mm,63mm, 50mm, 40 mm, 25 mm, 20 mm, 12.5 mm, 10.0 mm, 6.3 mm, 1.75 mm complete with lid and pan)	2 sets
b)	Set of fine sieves 200 mm internal dia (brass frame)consisting of (2.36 mm, 1.18 mm, 600 mic, 425 microns, 300 mic, 212 microns, 150 mic, 90 microns, 75mic with lid and pan)	2 sets
c)	Motorised sieve shaker for the above sieves	3 nos.
2	Compression Testing Machine with Electricity cum manually operated	2 nos.
3	Slump test apparatus complete	3 nos.
4	Concrete cube moulds 15x15x15cm	100 nos.
5	Pruning Rods 2 kg weight length 40 cm and ramming face 25 mm2	3 nos.
6	Ultrasonic Test Equipment (Procedure as per IS 516 Part 5))	2 nos.
6a	Rebound Hammer	02 nos.
7	Mortar Cube Moulds 7.07x7.07x7.07 cm	20 nos.
8	Standard Sand Grade I,II, III	100kg each
9	Mortar Cube vibrator	1 no.
10	Vicate needle apparatus	2 nos.
11	Blaine's Apparatus	1 no.
12	Weighing platform capacity 100 kg (Digital)	1 no.
13	Weighing scale capacity 10 kg (Digital, least count 1 gram)	2 nos.
14	Hot air oven (temp range 50C to 300C, sensitivity 1 degree)	2 nos.
15	Enamel Trays	
a)	300 x 250 x 40 mm	4 nos.
b)	Circular plates of 250 mm dia	4 nos.
16	Hammer 1lb and 2 lb	2 nos. each
17	Wooden Hammer	2 nos.
18	Measuring tape 3 and 5 metre	5 nos. each
19	Depth gauge 20cm	1 no.
20	Steel Foot Plate	5 nos.
21	Vernier Caliper (Digital)	3 nos.
22	Screw gauge	2 nos.
23	Digital PH meter least count 0.01	2 nos.
24	Digital Micrometer least count. 0.01mm	2 nos.
25	Digital paint thickness meter for steel 500 microns	2 nos.
26	Distance Measuring Laser Apparatus	2 nos.
27	Measuring cylinder TPX or Poly propylene capacity 100 ml, 250 ml, 500 ml, 1000 ml	4 nos. each
28	Pyrex, corning or Borosil beakers with cover capacity 500 ml, 200 ml, 50 ml	3 nos. each
29	Thermometers 1-150 degree centigrade	5 nos.
30	Moisture Meter	1 no.
31	Dial Gauge, 25mm travel – 0.01 mm/division	2 nos.
32	Load frame – 5 tonnes capacity, electrically operated with speed	1 no.

	control	
33	Aggregate impact test apparatus as per IS 2386-Part IV-1963	1 no.
34	Compaction apparatus (Proctor) as per IS 2720-PartVII -1974	1 no.
35	Modified ASHO compaction apparatus as per IS 2720 –Part-III-1974	1 no.
36	Sand pouring cylinder with control funnel and tube complete as per IS 2720- Part XXVIII-1974	1 no.
37	Penetrometer with automatic time controller and with adjustable weight accessories and needles as per IS 1203-1958	1 no.
38	Distant reading thermometers	1 no.
39	Any other equipment for site tests as outlined in BIS codes and as directed by the Engineer-in-Charge.	

Clause 10B (ii) Whether Clause 10B (ii) shall be applicable	**Yes** The mobilization advance shall be given in four equal installments @ 2.5% of tendered amount
Clause 10B (iii) Whether Clause 10 B (iii) shall be applicable	**No**
Clause 10CC	**Applicable**
Clause 10CC to be applicable in contracts with stipulated period of completion exceeding the period shown in next column.	12 months

S. No.	Relevant component of Material /Labour for price escalation	Percentage of total value of work
1	Component of Cement.	15%
2	Component of Labour	25%
3	Civil Component of other Construction Materials	21%
4	Electrical and Mechanical (E&M) Component of Construction Materials	19%
5	Component of POL (Diesel)	NIL
6	Reinforcement steel bars/TMT bars/structural steels (including strands and cables).	20
7	Component of Bitumen	NIL
	Total	100%

Clause 11		
Specifications to be followed for execution ofwork		(1) CPWD Specifications 2019, Volume-I and II and DPAR-2021 with correction slips upto last date of submission of tender and manufacturer's specification. (2) CPWD General specification For electrical Works with correction slips up to last date of submission of tender. (i) **Part I Internal 2013** with correction slipsup to last date of submission of tender. (ii) Part II (External) 1994 (iii) Part III – Lifts & Escalators) – 2003 (iv) Part IV (Sub Station) 2013 (v) Part V (Wet Riser & Sprinkler system) 2020 **(vi)** Part VI **Fire Detection and Alarm System** 2018 (vii) Heating, Ventilation & Air Conditioning(HVAC) – 2017 (3) CPWD Green Rating Manual 2021 and GRIHA RATING 5 for buildings and GRIHA LD RATING 5 for Large Development and any similar ratings and awards. (4)CPWD Handbook on Safety, Health and Environment (5)CPWD Manual on Accessible Built Environment 2019.
Clause 12		
Deviation Limit beyond which clauses 12.2 & 12.3		Not Applicable
Clause 16 Competent authority for deciding reducedrates.		Additional Chief Engineer(WAPCOS Limited
Clause 17 Contractor liable for damages, defects during defect liability period		Defect liability period shall be **Thirty Six (36) months** after completion of the whole work.

Clause 18

List of machinery, tools & plants to be deployed by the contractor at site

Sl.No.	Equipment	Numbers (Tentative)
1.	Automatic batching Concrete Batch Plant fully Computerized (Capacitynot less than 30 cum)	2
2.	Fixed / Mobile Tower crane	1
3.	Excavator cum loaders (JCB 3D model or equivalent).	2
4.	Compressor machine minimum 200 cfm capacity.	2
5.	DG set of minimum capacity 40 KVA	3
6.	Concrete Pumps	4
7.	Needle Vibrators	25
8.	Plate Vibrators	3
9.	Dumpers	6
10	Reinforcement bending machines	4
11	Reinforcement / Steel cutting machines	4
11(a)	Coupler threading machine	1
12	Power driven earth rammers (Soil compactors).	2
13	Real Time Kinematic (RTK) / Total station with distance meter	1
14	Tractor with trolley	3
15	Water tankers (minimum capacity 5000 litre)	4
16	Welding machines 400 Ampere	4
17	Screener for Coarse Sand and Fine Sand	8
18	Centrifugal Mono Block Water Pump suitable for minimum 60 m head	3
19	Transit Mixer	6
20	Concrete Mixer	6
21	Screed leveler	2
22	Good quality Camera for taking photographs and video recording of major activities for record purpose and for quality assurance.	2
23	Steel shuttering materials with necessary props	10000 sqm
24	Double steel scaffolding and staging materials	6600 sqm
25	Road roller 8 to 10 tons	1
26	Vibratory roller	1
27	Drilling machine	5
28	Floor grinding/polishing machines	3
29	Granite cutting machine	4
30	Ceramic tile cutting machine	10
31	Granite polishing machine	4
32	Granite hand polishing machine	4
33	Concrete core cutting machine with required dia drill bits.	2
34	Any other machinery required for completion of the work as per decisionof Engineer-in-Charge.	As per Actual requirement

Note: The above list is only indicative and not exhaustive. Any other machinery/equipment desired for required progress shall be arranged by the agency as per direction of Engineer-in-Charge.

Clause 19

Authority to decide for each default	Additional Chief Engineer(WAPCOS Limited
Clause 19 C	Rs. 5,000/- each default

Clause 19 D		Rs. 5,000/- each default
Clause 19 G		Rs. 5,000/- per day for each default (subjectedto a maximum of 5% of the estimated cost put to tender)
Clause 19 K		Rs. 5,000/- per tradesman per day
Clause 25		
(i) Conciliator		Additional chief engineer,WAPCOS
(ii) Arbitrator appointing authority		As per DOP
(iii) Place of Arbitration		New Delhi

Clause 32						
Requirement of technical representative(s) and recovery rate						
Sl. No.	Minimum Qualification of Technical Representative	Designation of Technical Staff	Minimum experience (Years)	Number (of Civil + E& M)	Rate at which recovery shall be made from the contractor in the event of not fulfilling provision of clause36(i)	
					Figures	Words
1.	Graduate Engineer (Major Component)	Project Manager with Degree in major discipline of Engineering	20 and having experience of one similar nature ofwork)	1 no.	Rs. 60,000/- per month	Rs. sixty thousand per month.
2.	Graduate Engineer	Deputy Project Manager (Civil and Electrical)	12 and having experience of one similar nature of work)	2+1	Rs. 40,000/- per monthper person	Rs. forty thousand per month per person
3.	Graduate Engineer or Diploma Engineer	Project/Site Engineer	5 or 10 respectively	4+2 nos.	Rs. 25,000/- per month per person	Rs. twenty five thousand per month per person
4.	Graduate Engineer	Quality Engineer	8	1+1 nos.	Rs. 25,000/- per monthper person	Rs. twenty five thousandper month per person
5	Diploma Engineer	Surveyor	8	1	Rs.15,000/- per monthper person	Rs. fifteen thousand per month per person
6	Graduate Engineer	Project Planning/Billing Engineer	6	1+1 nos.	Rs. 20,000/- per monthper person	Rs. twenty thousand per month per person
7	Graduate	Safety Engineer	8	1 no.	Rs. 25,000/- per monthper person	Rs. twenty five thousandper month per person
8	Graduate Architect	Architect	8	1 no.	Rs. 25,000/- per monthper person	Rs. twenty five thousandper month per person

Biometric attendance system to be installed by the contractor for Engineers as per the direction of Engineer-in-Charge.

Assistant Engineers retired from Government services that are holding Diploma will be treated at par withGraduate Engineers.

Diploma holder with minimum 10 years relevant experience with a reputed construction company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

Clause 38			
(i)	(a)	Schedule/statement for determining theoretical quantity of cement & bitumen on the basis of "Delhi Schedule of Rates 2021 with upto date correction slips as on last date of submission of tender.	
(ii)		Variations permissible on theoretical quantities:	
	(a)	Cement	3% plus/ minus
	(b)	Bitumen all works	2.5% plus only and nil on minus side
	(c)	Steel reinforcement and structural steel sections for each diameter, section and category	2% plus/ minus
	(d)	All other materials.	Nil

SECTION - IX

ANNEXURES

ANNEXURE - I	**FORMAT FOR CONTRACT AGREEMENT AND LETTER OF AWARD**
ANNEXURE - II	**FORMAT FOR PERFORMANCE BANK GUARANTEE**
ANNEXURE - III	**FORMAT FOR MOBILIZATION ADVANCE PAYMENT BANK GUARANTEE**
ANNEXURE - IV	**FORMAT FOR INDENTURE FOR SECURED ADVANCES**
ANNEXURE - V	**FORMAT OF BANK GUARANTEE FOR EMD**
ANNEXURE - VI	**FORMAT FOR SEEKING EXTENSION OF TIME**
ANNEXURE – VII	**FORMAT OF GUARANTEE BOND /AFFIDAVIT FOR WORKS**
ANNEXURE - VIII	**CONTRACT FOR REMOVAL OF DEFECTS AFTER COMPLETION IN RESPECT OF WATER PROOFING WORKS**
ANNEXURE – IX	**FORMAT FOR GUARANTE BONDS FOR ANTI-TERMITE TREATMENT**
ANNEXURE – X	**SAFETY CODES**
ANNEXURE – XI	**MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS FOR WORKERS EMPLOYED BY CONTRACTORS**
ANNEXURE – XII	**CONTRACTOR'S LABOUR REGULATIONS**
ANNEXURE - XIII	**NO CLAIM CERTIFICATE**

ANNEXURE-I

(Format for "Contract" to be signed on Non-Judicial Stamp Paper of Rs. 100 by successful bidder)

CONTRACT AGREEMENT

This Contract made on the____ day of ___ 20____between WAPCOS Limited, a Company in corporate under Indian Company's Act and having its registered office at 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called "WAPCOS" of the one part) and (Name of Contractor Firm & Address)_____ (hereinafter called "Contractor" of the other part).

WHEREAS the WAPCOS is desirous that Work known as "_____". (Herein after referred to as "Work/ Project") under the Tender no._____ dated_____ should be executed by the Contractor AND WHEREAS by a Letter of Award No._____ dated _____ issued by WAPCOS Limited and accepted by the contractor. WAPCOS Limited has accepted a Bid submitted by the Contractor for the execution and completion of such Work AND WHEREAS the Contractor has agreed to undertake such Work and furnish a Performance Security_____(details) pursuant to Tender conditions.

NOW THIS AGREEMENT WITNESSETH as follows;

In this Contract words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
The following documents shall be deemed to form and be read and construed as part of this Contract, viz;

a) Tender Document no._____dtd._____
b) Letter of Award to Contractor by WAPCOS
c) Documents furnished by the Contractor during Bidding process
d) Corrigendum/Amendments, if any
e) Clarifications / Correspondences, if any
f) Any other documents as forming part of the contract

1. The aforesaid documents shall be taken as complementary and mutually explanatory of one another.

2. In consideration of the payment to be made by WAPCOS to the Contractor as indicated in this Contract, the Contractor hereby covenants with WAPCOS to execute and complete the Works in conformity, in all respects, with the provisions of the Contract.

3. WAPCOS hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the contract at the time and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with Laws of India on the day, month & year indicated above.

SIGNED, SEALED AND DELIVERED

For and on behalf of the WAPCOS	For and on behalf of the Contractor
NAME _____	NAME _____
Designation	Designation
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

NOTE: Contractor shall submit the Original Power of Attorney on Non-Judicial Stamp Paper for this particular Work / Project, in the name of Person who will sign the Contract with WAPCOS after award of Work.

Annexure – II

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR PERFORMANCE BANK GUARANTEE

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015.

In consideration of _____ (Employer's name) (hereinafter referred to as "the Employer") which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to _____ (Contractor's name & address) (hereinafter referred to as "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) a contract, by issue of Employer's Notification of Award No. _____ dt. _____ and the same having been unequivocally accepted by the Contractor, resulting into a contract valued at Rs. _____ (Rupees _____only) for "**Name of work / Project"** (hereinafter called "the contract") and the Contractor having agreed to provide a Contract Performance Security for the faithful performance of the entire contract equivalent to Rs. _____ (Rupees _____only) (5% of the said value of the Contract to the Employer).

We, _____ (name & address of bank) (hereinafter referred to as "the Bank" which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer, on demand any or, all monies payable by the Contractor to the extent of Rs. _____ (Rupees _____only) as aforesaid at any time upto _____ without any demur, reservation, contest , recourse or protest and/or without any reference to the Contractor or court. Any such demand made by the Employer on the bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantee herein contained shall continue to be enforceable till the Employer discharges this guarantee.

We the said Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said contract have been fully paid and its claims satisfied or discharged or till the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said Contractor and accordingly discharges the guarantee.

The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee, from, time to time to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor and to exercise the same at any time in any manner and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under law would but for this provision, have the effect of

relieving the Bank. The guarantee shall not be affected by a change in the constitution of the bank or of the employer.

The bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance, without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

We The Said Bank do hereby declare that we have absolute and unconditional power to issue this guarantee in your favour under the Memorandum and Articles of Association or such other constitutional documents of the Bank and the undersigned have full power to execute this guarantee under the Power of Attorney / Post Approval Authorization dated _____ of the bank granted to him / us by the Bank. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the powers of the bank or its officials and the guarantee shall be deemed to have been issued as if the bank and its officials have all the powers and authorization to give this guarantee on behalf of the bank.

We the said bank do hereby certify the genuineness and appropriateness of the Stamp paper and stamp value used for issuing the guarantee. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the stamp paper or its stamp value.

We the said bank do hereby declare that our payments hereunder shall be made to you , free and clear of and without and deduction, reduction on account of any reasons including any and all present and future taxes, levies, charges of withholding whatsoever imposed or collected with respect thereto.

Notwithstanding anything contained hereinabove our liability under this guarantee is restricted to Rs. _____ (Rupees _____ only) and it shall remain in force upto and including _____ and shall be extended from time to time for such period as may be desired by M/s WAPCOS Limited to whom this bank guarantee has been given.

Notwithstanding anything contained herein

i) Our liability under this guarantee shall not exceed Rs. _____ (Rupees_____ only);
ii) This bank guarantee shall be valid upto _____; and
iii) our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee, only and only if you serve upon us a written claim or demand in terms of the guarantee on or before _____ **(indicate a date twelve month after validity of Guarantee**)

Dated this _____day of _____ at New Delhi.

Authorized Signatory of …… Bank

Signature	**Signature**
Name…….	**Name…….**
Signature Code/ S.S no. ……	**Signature Code/ S.S no. ……**

ANNEXURE – III

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR MOBILIZATION ADVANCE PAYMENT BANK GUARANTEE

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015

In consideration of WAPCOS LTD. (hereinafter referred to as "the Employer") which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to _____ (Contractor's name) with its Registered /Head Office at _____(hereinafter referred to as "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) a contract, by issue of Employer's Notification of Award No. _____ dt. _____ and the same having been unequivocally accepted by the Contractor, resulting into a contract valued at Rs._____ (Rupees_____only) for _____ (hereinafter called "the contract") and the Employer having agreed to make an advance payment to the Contractor for performance of the above Contract amounting to Rs. _____ (Rupees _____only) as an advance against bank guarantee to be furnished by the Contractor.

We, _____ (name & address of bank) having its Head Office at _____ (hereinafter referred to as "the Bank" which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer immediately on demand any or, all monies payable by the Contractor to the extent of Rs. _____ (Rupees _____only) as aforesaid at any time upto _____ without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We agree that the Guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Employer discharges this guarantee. We further agree that no change in the constitution of the Bank or of the Employer shall affect this guarantee. The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee, from time to time, to vary the advance or to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under law would but for this provision, have the effect of relieving the Bank.

The bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the

Contractor's liabilities.

We the Said Bank do hereby declare that we have absolute and unconditional power to issue this guarantee in your favour under the Memorandum and Articles of Association or such other constitutional documents of the Bank and the undersigned have full power to execute this guarantee under the Power of Attorney/ Post Approval Authorization dated _____ of the bank granted to him / us by the Bank. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the powers of the bank or its officials and the guarantee shall be deemed to have been issued as if the bank and its officials have all the powers and authorization to give this guarantee on behalf of the bank.

We the said bank does hereby certify the genuineness and appropriateness of the Stamp paper and stamp value used for issuing the guarantee. We the said bank does hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the stamp paper or its stamp value.

We the said bank do hereby declare that our payments hereunder shall be made to you , free and clear of and without and deduction, reduction on account of any reasons including any and all present and future taxes, levies, charges of withholding whatsoever imposed or collected with respect thereto.

Notwithstanding anything contained hereinabove our liability under this guarantee is limited to Rs._____ (Rupees _____ only) and it shall remain in force upto and including _____ and shall be extended from time to time for such period (not exceeding one year), as may be desired by M/s _____ on whose behalf this bank guarantee has been given.

Notwithstanding anything contained herein

i) Our liability under this guarantee shall not exceed Rs._____(Rupees _____only);
ii) This bank guarantee shall be valid upto _____ and
iii) our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee, only and only if you serve upon us a written claim or demand in terms of the guarantee on or before _____ **(indicate a date twelve months after the validity of the guarantee).**

Dated this _____ day of _____ at……...

Authorized Signatory of …… Bank

Signature	**Signature**
Name…….	**Name…….**
Signature Code/ S.S no. ……	**Signature Code/ S.S no. ……**

ANNEXURE-IV

(On non-judicial stamp paper of Rs. 100 duly attested by Notary / Magistrate)

FORMAT FOR INDENTURE FOR SECURED ADVANCES

THIS INDENTURE made the…… day of ……..20……. BETWEEN …… (hereinafter called the Contractor which expression shall where the context so admits or implies be deemed to include his executors administrators and assigns) of the one part and the WAPCOS (hereinafter called the WAPCOS which expression shall where the context so admits or implies be deemed to include his successors in office and assigns) of the other part.

WHEREAS by an agreement dated…….. (hereinafter called the said agreement) the Contractor has agreed AND WHEREAS the Contractor has applied to the WAPCOS that he may be allowed advances on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charges) AND WHEREAS the WAPCOS has agreed to advance to the Contractor the sum of Rupees ……. on the security of materials the quantities and other particulars of which are detailed in Accounts of Secured Advances attached to the Running Account Bill for the said works signed by the Contractor on ……and the WAPCOS has reserved to himself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works. Now THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees ……on or before the execution of these presents paid to the Contractor by the WAPCOS (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid the Contractor doth hereby covenant and agree with the WAPCOS and declare as follows: -

(1) That the said sum of Rupees ……..so advanced by the WAPCOS to the Contractor as aforesaid and all or any further sum or sums advanced as aforesaid shall be employed by the Contractor in or towards expediting the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Account of Secured Advances which have been offered to and accepted by the WAPCOS as security are absolutely the Contractor's own property and free from encumbrances of any kind and the contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnifies the WAPCOS against all claims to any materials in respect of which an advance has been made to him as aforesaid.

(3) That the materials detailed in the said Account of Secured Advances and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Divisional Officer ……. Division (hereinafter called the Divisional Officer) and in the term of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and on his own responsibility and shall at all times be open to inspection by the Divisional Officer or any officer authorised by him. In the event of the said materials or any part thereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof the Contractor will forthwith replace the same

with other materials of like quality or repair and make good the same as required by the Divisional Officer.

(5) That the said materials shall not on any account be removed from the site of the said works except with the written permission of the Divisional Officer or an officer authorised by him on that behalf.

(6) That the advances shall be repayable in full when or before the Contractor receives payment from the WAPCOS of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the WAPCOS will be at liberty to make a recovery from the Contractor's bill for such payment by deducting there from the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously, the value for this purpose being determined in respect of each description of materials at the rates at which the amounts of the advances made under these presents were calculated.

(7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the WAPCOS shall immediately on the happening of such default be repayable by the Contractor to the WAPCOS together with interest thereon at twelve per cent per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs charges, damages and expenses incurred by the WAPCOS in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the WAPCOS to repay and pay the same respectively to him accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the WAPCOS of the said sum of Rupees .....and any further sum or sums advanced as aforesaid and all costs charges, damages and expenses payable under these presents PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and whenever the covenant for payment and repayment herein before contained shall become enforceable and the money owing shall not be paid in accordance therewith the WAPCOS may at any time thereafter adopt all or any of the following courses as he may deem best :-

(a) Size and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion and the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay same to the WAPCOS on demand.

b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the WAPCOS under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except in the event of such default on the part of the Contractor as aforesaid interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been herein before expressly provided for the same shall be finally resolved as per provisions of clause 25 of the contract.

In witness whereof the said Contractor and WAPCOS by the order and under the direction of the WAPCOS have hereunto set their respective hands the day and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	**For and on behalf of the WAPCOS**
NAME _____	**NAME**_____
Designation _____	**Designation**_____
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

ANNEXURE-V

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR BANK GUARANTEE OF EMD

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015.

WHEREAS, M/s …….. having their Registered/Head Office at …….. (hereinafter called "the Bidder") has submitted his Bid dated …… for the …… [hereinafter called "the Bid"] to M/s WAPCOS Limited (hereinafter called the Employer)
KNOW ALL PEOPLE by these presents that we …… (name of the Bank) having our head office at …… (hereinafter called "the Bank") are bound unto Employer in the sum of …… for which payment well and truly to be made to the Employer, the Bank binds itself, its successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this …… day of ……month…… year.

THE CONDITIONS of this obligation are:
(1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified;

OR

(2) If the Bidder having been notified of the acceptance of his bid by …… during the period of Bid Validity:

We undertake to pay to the …… up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the Bidder will note that the amount claimed by him is due to him owing to the occurrence of one or any of the above mentioned two conditions and specify the occurred condition or conditions.
This Guarantee will remain in force up to and including the date …… after the deadline for submission of Bids as is stated in the instructions to Bidders or as it may be extended by the …… notice of which extension(s) to the Bank is hereby waived and notice to the bidder would constitute sufficient notice to the Bank. Any demand in respect of this guarantee should reach the Bank not later than the above date.
Notwithstanding anything contained herein

i) Liability under this guarantee shall not exceed ……
ii) This bank guarantee shall be valid upto …… and;
iii) Our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee only and only if you serve upon us a written claim or demand in terms of the guarantee on or before …… (indicate a period twelve months after the date of issue of Bank Guarantee).

Dated this _____ day of _____ at……...
Authorized Signatory of …… Bank

Signature	**Signature**
Name…….	**Name…….**
Signature Code/ S.S no. ……	**Signature Code/ S.S no. ……**

ANNEXURE-VI

(To be submitted on Contractor's original Letter Head)

FORMAT FOR SEEKING EXTENSION OF TIME

1. Name of Contractor:
2. Name of work:
3. Agreement No. and Date:
4. Date of commencement of work as per Agreement:
5. Period and Stipulated date of completion as per Agreement:
6. Period for which extension of time already given:

Extension	Period	Reasons Stated earlier for seeking EoT
(a) 1st extension		
(b) 2nd extension		
(c) 3rd extension		
(d) 4th extension		
(e) 5th extension		

9) Reasons for present extension

10) Period for which extension is applied for

It is understood that we will not claim any additional cost due to above extension of time and also understand that WAPCOS have rights to act in accordance with provisions in relevant clauses of Contract Agreement.

Dated……..

Contractor's Signature and Stamp

Annexure – VII
(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate and will be signed by the person who sign the Original Agreement)

FORMAT FOR GUARANTE BONDS
To Be Executed by Contractor for Structural Stability, Removal of Defects after completion of work

This Supplementary Agreement made this ____ day of _____ 20___ between (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called WAPCOS of the other part) for the Work **"Name of Work / Project"** in respect of Contract Agreement (hereinafter called the "Original Agreement" signed between ……(Name of Contractor firm) and WAPCOS on…….. dated ……..), whereby the contractor interalia, under look to render the work in the said contract recited structurally stable workmanship and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said work will remain structurally stable and guarantee against faulty workmanship, manufacturing defects of materials etc.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable, for the minimum life of ten years, to be reckoned from the date of start of Defect Liability Period or Maintenance Period whichever is later, prescribed in the Contract.

The decision of the WAPCOS with regard to nature and cause of defects shall be final. During the period of guarantee the Guarantor shall make good all defects to the satisfaction of the WAPCOS calling upon him to rectify the defects, failing which the work shall be got done by the WAPCOS by some other agencies at the Guarantor's cost and risk. The decision of the WAPCOS as to the cost payable by the Guarantor shall be final and binding.

That if the Guarantor fails to make good all the defects, commits breach thereunder then the guarantor will indemnify the Principal and his successor against all loss, damage cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and / or damage and / or cost incurred by the WAPCOS the decision of the WAPCOS will be final and binding.

IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Original Contract Agreement) on behalf of .....(Name of Contractor Firm) and WAPCOS on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	For and on behalf of the WAPCOS
NAME _____	NAME _____
Designation	Designation
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

Annexure – VIII

(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate and will be signed by the person who sign the Original Agreement))

FORMAT FOR GUARANTE BONDS
To Be Executed by Contractor for Water Proofing after Completion of Work

This Supplementary Agreement made this ____ day of _____ 20___ between (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called WAPCOS of the other part) for the Work **"Name of Work / Project"** in respect of Contract Agreement (hereinafter called the "Original Agreement" signed between ……(Name of Contractor firm) and WAPCOS on…….. dated ……..), whereby the contractor interalia, under look to render the buildings and structures in the contract recited completely water and leak-proof for Toilets, Shower , Under Ground Tank, Roof, Over Head Tank, Basement and any other allied areas of building.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said structures will remain water and leak-proof for **ten years** from the date after the Defect Liability Period or Maintenance Period whichever is later, prescribed in the contract. NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be **ten years** to be reckoned from the date after the Defect Liability Period / Maintenance Period whichever is later, prescribed in the contract.

Provided that the Guarantor will not be responsible for the leakage caused by earthquake or structural defects or misuse of roof or alteration and for such purpose:

a. Misuse of roof shall mean any operation which will damage proofing treatment, like chopping of firewood and things of the same nature which might cause damage to the roof.
b. Alteration shall mean construction of an additional storey or a part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts.
c. The decision of the Principal Employer with regard to cause of leakage/seepage shall be final.

During this period of guarantee the Guarantor shall make good all defects and in case of any defect being found, render the building water proof to the satisfaction of the Principal Employer at his cost and shall commence the work for the rectification within seven days from the date of issue of the notice from the Principal Employer calling upon him to rectify the defects failing which the work shall be done by the Principal Employer by some other agency at the GUARANTOR's risk and cost. The decision of the Principal Employer as to the cost payable by the Guarantor shall be final and binding. That if Guarantor fails to make good all defects or commits breach there under then the Guarantor will indemnify the principal and his successors against all loss, damage, cost expense otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and/or damage and/or cost incurred by the Principal Employer the decision of the owner will be final and binding on the parties.

IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Contract) on behalf of .....(Name of Contractor Firm) and Principal Employer on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	For and on behalf of the Principal Employer/Employer

NAME _____
Designation

in the presence of witness:

1_____

2 _____

NAME _____
Designation

in the presence of Witness

1_____

2 _____

ANNEXURE VIII (a)

FORM OF BANK GUARANTEE BOND FOR WATER PROOFING WORK

1. In considerable of the …….(Name of Principal Employer) (hereinafter called "The Owner") having agreed to exempt..... (Hereinafter called the said contractor(s)) from the demand, under the terms and conditions of the Agreement No..... dated.....Made between ..... and ..... For the work of..... (hereinafter called "The said Agreement") security deposit for the due fulfillment by the said contractor(s) of the terms & conditions contained in the said Agreements for the work of Anti water proofing work on production of an irrevocable Bank Guarantee for Rs. 10 Lakhs for ten years we ..... (Indicate the name of the bank) (Hereinafter referred to as "the Bank) hereby undertake to pay to the Owner an amount not exceeding Rs. ……(Rupees ……only) on demand by the Owner

2. We..... (indicate the name of the bank) do hereby undertake to pay the amounts due and payable under this Guarantee without any demure, merely on a demand from Principal Employer stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the bank under the Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. ……(Rupees ……only).

3. We..... (indicate the name of the bank) further undertake to pay to Principal Employer any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.
The payment so made by as under this bond shall be a valid discharge of our liability for payment there under and the contractor(s) shall have no claim against us for making such payment.

4. We..... (indicate the name of the Bank) further agree that the guarantee hereinafter contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of Principal Employer under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Principal Employer certified that the terms and condition of the said agreement have been fully and properly carried out by the said contractor(s) and accordingly discharges this guarantee.

5. We…….. (indicate name of the bank) further agree with Principal Employer that Principal Employer shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by Principal Employer against the said contractor(s) and to for bear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractors(s) or for any bearance, act of commission of the part of Principal Employer or any indulgence by Principal Employer to the said contractor(s) or by any such matter of thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of Bank or the contractor(s).

7. We…… (indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of Principal Employer in writing

8. This guarantee shall be valid upto ..... unless extended on demand by Principal Employer. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs. ……(Rupees ……only) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged

Dated this _____ day of _____ at……...

Authorized Signatory of …… Bank

Signature **Signature**

Name…….. **Name……..**

Signature Code/ S.S no. …… **Signature Code/ S.S no. ……**

Annexure – IX

(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate)

FORMAT FOR GUARANTE BONDS FOR ANTI-TERMITE TREATMENT
To Be Executed by Contractor for Anti Termite Treatment after Completion of Work

This Agreement made on this ____ day of _____ 20___ between_____ (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the _____(hereinafter called Principal Employer/Employer of the other part) for Anti Termite Treatment Works for **"Name of Work / Project"**

WHEREAS This Agreement is Supplementary, to a Contract (hereinafter called the Contract) Contract no._____ dated _____and made between the _____ (Name of Contractor) and WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi, whereby the contractor, inter alia, undertook to render the wooden work in the said contract recited completely Termite proof.

THE GUARANTOR hereby guarantee that the anti-termite treatment given by him will render the wooden works completely Termite proof and the minimum life of such Anti-Termite treatment shall be five years to be reckoned from the from the date after the Defect Liability Period or Maintenance Period whichever is later, prescribed in the contract.
During the period of guarantee the Guarantor shall make good all defects and in case of any defects being found render the wooden works termite proof to the satisfaction of the Principal Employer at his cost and shall commence the work for such rectification within seven days from the date of issue of notice from the Principal Employer calling upon him to rectify the defects, failing which the work shall be got done by the Principal Employer through some other Agency at the Guarantor's cost and risk. The decision of the Principal Employer as to the cost payable by the Guarantor shall be final and binding.
That if the guarantor fails to execute the Anti-termite works, or commits breach thereunder then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and / or cost incurred by the Principal Employer on the decision of the Principal Employer will be final and binding.
IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Contract) on behalf of .....(Name of Contractor Firm) and Principal Employer on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	**For and on behalf of the Principal Employer/Employer**
NAME _____ Designation	NAME _____ Designation
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

ANNEXURE-X

UNDERTAKING REGARDING ELECTRICAL LICENSE

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015.

Subject: "Name of Work / Project"

Sir,

Having examined the details given in bid document for the above work, I/we hereby submit the following:

"I / We hereby certify that I / we will either obtain valid electrical license at the time of execution of electrical work or associate Contractor having valid electrical license of eligible class."

Seal of bidder

Signature of bidder(s)

Name……..

Date

ANNEXURE - XI

SAFETY CODES

1. Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and hand-hold shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1(¼ horizontal and 1 vertical).

2. Scaffolding of staging more than 3.6 m (12ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3ft.) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12ft.) above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in (2) above.

4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. (3ft.).

5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30ft.) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (11½") for ladder upto and including 3 m. (10 ft.) in length. For longer ladders, this width should be increased at least ¼" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit; action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person

6. (a) Excavation and Trenching - All trenches 1.2 m. (4ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100ft.) in length or fraction thereof, Ladder shall extend from bottom of the trench to at least 90 cm. (3ft.) above the surface of the ground. The side of the trenches which are 1.5 m. (5ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5ft.) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done.

   (b) Safety Measures for digging bore holes:-

      i. If the bore well is successful, it should be safely capped to avoid caving and collapse of the bore well. The failed and the abandoned ones should be completely refilled to avoid caving and collapse;

ii. During drilling, Sign boards should be erected near the site with the address of the drilling contractor and the Engineer-in-charge of the work;
iii. Suitable fencing should be erected around the well during the drilling and after the installation of the rig on the point of drilling, flags shall be put 50m all-round the point of drilling to avoid entry of people;
iv. After drilling the borewell, a cement platform (0.50m x 0.50m x 1.20m) 0.60m above ground level and 0.60m below ground level should be constructed around the well casing;
v. After the completion of the borewell, the contractor should cap the bore well properly by welding steel plate, cover the bore well with the drilled wet soil and fix thorny shrubs over the soil. This should be done even while reparing the pump;
vi. After the borewell is drilled the entire site should be brought to the ground level.

7. Demolition - Before any demolition work is commenced and also during the progress of the work,
   (i) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
   (ii) No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.
   (iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

8. All necessary personal safety equipment as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned. The following safety equipment shall invariably be provided.
   (i) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.
   (ii) Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes, shall be provided with protective goggles.
   (iii) Those engaged in welding works shall be provided with welder's protective eyeshields.
   (iv) Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
   (v) When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public. In addition, the contractor shall ensure that the following safety measure are adhered to :-
      (a) Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.
      (b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.
      (c) Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.
      (d) Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.
      (e) Safety belt with rope should be provided to the workers. While working inside the manholes, such rope should be handled by two men standing outside to enable him to be pulled out during emergency.
      (f) The area should be barricaded or cordoned of by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public

whenever cleaning works are undertaken during night or day.

(g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.

(h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

(i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-in-Charge may decide the time up to which a worker may be allowed to work continuously inside the manhole.

(j) Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

(k) Air-blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

(l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing to work in the manhole.

(m) The workers shall be provided with Gumboots or non sparking shoes bump helmets and gloves non sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

(n) Workmen descending a manhole shall try each ladder stop or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

(o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

(p) The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:-

(a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

(b) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

(c) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

9. The Contractor shall not employ women and men below the age of 18 on the work of painting with product containing lead in any form, wherever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use :

(i) White lead, sulphate of lead or product containing these pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.

(ii) Measures shall be taken, wherever required in order to prevent danger arising from the application of a paint in the form of spray.

(iii) Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing down and scraping.

(iv) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

(v) Overall shall be worn by working painters during the whole of working period.

(vi) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.

(vii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man.

(viii) WAPCOS may require, when necessary medical examination of workers.

(ix) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

10. When the work is done near any place where there is risk of drowning, all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision, should be made for prompt first aid treatment of all injuries likely to be obtained during the course of the work.

11. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions :-

(i) (a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and in good working order.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

(ii) Every crane driver or hoisting appliance operator, shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

(iii) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(iv) In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in-Charge. As regards contractor's machines the contractors shall notify the safe working load of the machine to the Engineer-in-Charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.

12. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

13. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

14. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

15. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer or Engineer-in-Charge of the department or their representatives.

16. Notwithstanding the above clauses from (1) to (15), there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

ANNEXURE – XII

MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS

FOR WORKERS EMPLOYED BY CONTRACTORS

1. APPLICATION

These rules shall apply to all buildings and construction works in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. DEFINITION

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST-AID FACILITIES

(i) At every work place, there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed.

(ii) The first-aid box shall be distinctly marked with a red cross on white back ground and shall contain the following equipment:-

(a) For work places in which the number of contract labour employed does not exceed 50- Each first-aid box shall contain the following equipments :-

1) 6 small sterilised dressings.
2) 3 medium size sterilised dressings.
3) 3 large size sterilised dressings.
4) 3 large sterilised burn dressings.
5) 1 (30 ml.) bottle containing a two per cent alcoholic solution of iodine.
6) 1 (30 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
7) 1 snakebite lancet.
8) 1 (30 gms.) bottle of potassium permanganate crystals.
9) 1 pair scissors.
10) 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
11) 1 bottle containing 100 tablets (each of 5 gms.) of aspirin.
12) Ointment for burns.
13) A bottle of suitable surgical antiseptic solution

(b) For work places in which the number of contract labour exceed 50. Each first-aid box shall contain the following equipments.

1) 12 small sterilised dressings.
2) 6 medium size sterilised dressings.
3) 6 large size sterilised dressings.
4) 6 large size sterilised burn dressings.
5) 6 (15 gms.) packets sterilised cotton wool.
6) 6.1 (60 ml.) bottle containing a two per cent alcoholic solution iodine.
7) 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label
8) 1 roll of adhesive plaster.
9) 1 snake bite lancet.

10) 1 (30 gms.) bottle of potassium permanganate crystals.
11) 1 pair scissors.
12) 1 copy of the first-aid leaflet issued by the Director General Factory Advice Service and Labour Institutes / Government of India.
13) A bottle containing 100 tablets (each of 5 gms.) of aspirin.
14) Ointment for burns.
15) A bottle of suitable surgical antiseptic solution.

(iii) Adequate arrangements shall be made for immediate recoupment of the equipment when necessary

(iv) Nothing except the prescribed contents shall be kept in the First-aid box.

(v) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

(vi) A person in charge of the First-aid box shall be a person trained in First-aid treatment in the work places where the number of contract labour employed is 150 or more.

(vii) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.

(viii) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4. DRINKING WATER

(i) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

(ii) Where drinking water is obtained from an Intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

(iii) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and waterproof.

(iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

(i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.

(ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.

(iii) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

(ii) Latrines shall be provided in every work place on the following scale namely :-

(a) Where female are employed, there shall be at least one latrine for every 25 females.

(b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that, where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be upto the first 100, and one for every 50 thereafter.

(iii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

(iv) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting nonabsorbent materials and shall be cement washed inside and outside at least once a year, Latrines shall not be of a standard lower than borehole system.

(v) (a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers "For Men only" or "For Women Only" as the case may be.
(b) The notice shall also bear the figure of a man or of a woman, as the case may be.

(vi) There shall be at least one urinal for male workers upto 50 and one for female workers upto fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females upto the first 500 and one for every 100 or part thereafter.

(vii) (a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.
(b) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

(viii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

(ix) Disposal of excreta: - Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure).

(x) The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the contractor's workmen or employees on the site. The contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10 ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sqm (6 sft) per head.
Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. CRECHES

(i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H (ii) a,b & c.

(ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

(iii) The contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bed room.

(iv) The contractor shall provide one ayaa to look after the children in the creche when the number of women workers does not exceed 50 and two when the number of women workers exceed 50.

(v) The use of the rooms earmarked as creches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS

a. In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the contractor for the use of such contract labour.

b. The canteen shall be maintained by the contractor in an efficient manner.

c. The canteen shall consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils.

d. The canteen shall be sufficiently lighted at all times when any person has access to it.

e. The floor shall be made of smooth and impervious materials and inside walls shall be limewashed or colour washed at least once in each year.
Provided that the inside walls of the kitchen shall be lime-washed every four months.

f. The premises of the canteen shall be maintained in a clean and sanitary condition.

g. Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.

h. Suitable arrangements shall be made for the collection and disposal of garbage.

i. The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time.

j. The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square metre (10 sft) per diner to be accommodated as prescribed in sub-Rule 9.

k. (a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.
(b) Washing places for women shall be separate and screened to secure privacy.

l. Sufficient tables stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9.

m. (a) 1. There shall be provided and maintained sufficient utensils crockery, furniture and any other equipments necessary for the efficient running of the canteen.
2. The furniture utensils and other equipment shall be maintained in a clean and hygienic condition.
(b) 1. Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.
2. A service counter, if provided, shall have top of smooth and impervious material.
3. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipments.

n. The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.

o. The charges for food stuffs, beverages and any other items served in the canteen shall be based on 'No profit, No loss' and shall be conspicuously displayed in the canteen.

p. In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be taken into consideration as expenditure namely:-
(a) The rent of land and building.
(b) The depreciation and maintenance charges for the building and equipment provided for the canteen.
(c) The cost of purchase, repairs and replacement of equipment including furniture, crockery, cutlery and utensils.
(d) The water charges and other charges incurred for lighting and ventilation
(e) The interest and amounts spent on the provision and maintenance of equipment provided for the canteen.

q. The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. AMENDMENTS

Government may, from time to time, add to or amend these rules and issue directions - it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.

ANNEXURE-XIII

Contractor's Labour Regulations

1. **GENERAL**

These Labour regulations shall be followed by the Contractor.

2. **DEFINITIONS**

(i) Workman means any person employed by contractor directly or indirectly through a subcontractor with or without the knowledge of the WAPCOS to do any skilled, semiskilled or unskilled manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment are expressed or implied but does not include any person :-

(a) Who is employed mainly in a managerial or administrative capacity: or

(b) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of powers vested in him, functions mainly of managerial nature: or

(c) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the Employer/ Principal Employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the Employer/ Principal Employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer.

(i) No person below the age of 14 years shall be employed to act as a workman.

(ii) Fair Wages means wages whether for time or piece work fixed and notified under the provisions of the Minimum Wages Act from time to time.

(iii) Contractors shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor.

(iv) Wages shall have the same meaning as defined in the Payment of Wages Act.

3. (i) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

(ii) When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week, he shall be paid over time for the extra hours put in by him at double the ordinary rate of wages.

(iii) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time irrespective of whether such worker is governed by the Minimum Wages Act or not.

(iv) Where the minimum wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages at the rate applicable to the next preceding day,

(iv) provided he has worked under the same contractor for a continuous period of not less than 6 days.

(v) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day on one of the five days immediately before or after the normal weekly holiday and pay wages to such worker for the work performed on the normal weekly holiday at overtime rate.

4. **DISPLAY OF NOTICE REGARDING WAGES ETC.**

The contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clear and legible condition in conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers giving the minimum rates of wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix 'III'.

5. **PAYMENT OF WAGES**

(i) The contractor shall fix wage periods in respect of which wages shall be payable.
(ii) No wage period shall exceed one month.
(iii) The wages of every person employed as contract labour in an establishment or by a contractor where less than one thousand such persons are employed shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.
(iv) Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.
(v) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.
(vi) Wages due to every worker shall be paid to him direct by contractor through Bank or ECS or online transfer to his bank account.
(vii) All wages shall be paid through Bank or ECS or online transfer.
(viii) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.
(ix) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgment.
(x) It shall be the duty of the contractor to ensure the disbursement of wages through bank account of labour.
(xi) The contractor shall obtain from the Junior Engineer or any other authorised representative of the Engineer- in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage-cum-Muster Roll" as the case may be in the following form:-

6. **FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES**

i) The wages of a worker shall be paid to him without any deduction of any kind except the following:-
   a. Fines
   b. Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

c. Deduction for damage to or loss of goods expressly entrusted to the employed person for custody or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.
d. Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register.
e. Any other deduction which the Central Government may from time to time allow.

ii) No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved of by the Chief Labour Commissioner.
Note :- An approved list of Acts and Omissions for which fines can be imposed is enclosed at Appendix-X

iii) No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

iv) The total amount of fine which may be imposed in any one wage period on a worker shall not exceed an amount equal to three paise in a rupee of the total wages, payable to him in respect of that wage period.

v) No fine imposed on any worker shall be recovered from him by instalment, or after the expiry of sixty days from the date on which it was imposed.

vi) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

7. LABOUR RECORDS

i) The contractor shall maintain a Register of persons employed on work on contract in Form XIII of the CL (R&A) Central Rules 1971 (Appendix IV)

ii) The contractor shall maintain a Muster Roll register in respect of all workmen employed by him on the work under Contract in Form XVI of the CL (R&A) Rules 1971 (Appendix V).

iii) The contractor shall maintain a Wage Register in respect of all workmen employed by him on the work under contract in Form XVII of the CL (R&A) Rules 1971 (Appendix VI).

iv) Register of accident - The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:
a. Full particulars of the labourers who met with accident.
b. Rate of Wages.
c. Sex
d. Age
e. Nature of accident and cause of accident.
f. Time and date of accident.
g. Date and time when admitted in Hospital,
h. Date of discharge from the Hospital.
i. Period of treatment and result of treatment.
j. Percentage of loss of earning capacity and disability as assessed by Medical Officer.
k. Claim required to be paid under Workmen's Compensation Act.
l. Date of payment of compensation.
m. Amount paid with details of the person to whom the same was paid.
n. Authority by whom the compensation was assessed.
o. Remarks

v) The contractor shall maintain a Register of Fines in the Form XII of the CL (R&A) Rules 1971 (Appendix-XI) The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omissions for which fines can be imposed (Appendix-X)

vi) The contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix-XII)

vii) The contractor shall maintain a Register of Advances in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIII)

viii) The contractor shall maintain a Register of Overtime in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV)

8. **ATTENDANCE CARD-CUM-WAGE SLIP**

i) The contractor shall issue an Attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-VII)

ii) The card shall be valid for each wage period.

iii) The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.

iv) The card shall remain in possession of the worker during the wage period under reference.

v) The contractor shall complete the wage slip portion on the reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.

vi) The contractor shall obtain the signature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

9. **EMPLOYMENT CARD**

The contractor shall issue an Employment Card in Form XIV of the CL (R&A) Central Rules 1971 to each worker within three days of the employment of the worker (Appendix-VIII).

10. **SERVICE CERTIFICATE**

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a Service certificate in Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX)

11. **PRESERVATION OF LABOUR RECORDS**

All records required to be maintained under Regulations Nos. 6 & 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorised by the Ministry of Urban Development in this behalf.

12. **POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY**

The Labour Officer or any person authorised by Central Government on their behalf shall have power to make enquires with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and the Provisions of these Regulations. He shall investigate into any complaint regarding the default made by the contractor or subcontractor in regard to such provision.

13. **REPORT OF LABOUR OFFICER**

The Labour Officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer-in-charge concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under Clause 13 of these regulations, actual payment to labourers will be made by the Engineer-in-charge after the Competent Authority of WAPCOS has given his decision on such appeal.

(i) The Engineer-in-charge shall arrange payments to the labour concerned within 45 days from the receipt of the report form the Labour Officer as the case may be.

14. **APPEAL AGAINST THE DECISION OF LABOUR OFFICER**

Any person aggrieved by the decision and recommendations of the Labour Officer or other person so authorised may appeal against such decision to the Engineer-in-charge concerned within 30 days from the date of decision, forwarding simultaneously a copy of his appeal to the Engineer-in-charge concerned but subject to such appeal, the decision of the officer shall be final and binding upon the contractor.

15. **PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER**

(i) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by:-
   a. An officer of a registered trade union of which he is a member.
   b. An officer of a federation of trade unions to which the trade union referred to in clause (a) is affiliated.
   c. Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed.

(ii) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by :-
   a. An officer of an association of employers of which he is a member.
   b. An officer of a federation of associations of employers to which association referred to in clause (a) is affiliated.
   c. Where the employers is not a member of any association of employers, by an officer of association of employer connected with the industry in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged.

(iii) No party shall be entitled to be represented by a legal practitioner in any investigation or enquiry under these regulations.

16. **INSPECTION OF BOOKS AND SLIPS**

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorised by the Central Government on his behalf.

17. **SUBMISSIONS OF RETURNS**

The contractor shall submit periodical returns as may be specified from time to time.

18. **AMENDMENTS**

The Central Government may from time to time add to or amend the regulations and on any question as to the application/Interpretation or effect of those regulations the decision of the Engineer-in-charge concerned shall be final.

NOTE: ***APPENDICES*** *mentioned in above "Contractor's Labour Regulation" will be as per the General Conditions of Contract-2020 – Construction Works of CPWD.*

ANNEXURE – XIV

NO CLAIM CERTIFICATE

Address to :
The Engineer- in-Charge
WAPCOS Ltd.,

Sub: "Name of work / Project": Reg. No Claim Certificate

Ref: 1. Work Order no.:-
2. Contract Agreement no.:-

Sir,

We have submitted ----------nos. of bills including final bill total gross amounting for the subjected project of Rs. ----------/- (Rupees ---------- only).

However, following payment are due with Employer:

1. Balance Net amount (if any) of Rs. ----------/- against RA Bill No.----------
2. Balance GST (if any) of Rs. ----------/- against RA Bill No.----------
3. Performance Guarantee no. ----------dated ---------- amounting to Rs.----------/- issued by --------Bank which will be released by Employer as per tender conditions.
4. Security Deposit amounting to Rs.----------/- which will be released by Employer as per tender conditions

We declare unequivocally that the above payments are full and final amount for execution of subjected works against referred Contract Agreement with WAPCOS. We will not raise any further claim and have no dispute of any description whatsoever, regarding the amounts worked out as payable to us and that we shall continue to be bound by the terms and conditions of the Contract Agreement, as regards Performance of the Contract.

Yours faithfully,

Date:

(Signature, name and designation of the Authorized signatory)

Place:

Name and seal of Bidder

SECTION - X

SCOPE OF WORK

SECTION X

SCOPE OF WORK

Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.

1.0 The project site is in Dhanbad district of Jharkhand which is basically a chota nagapur plateu, located approx. 3 km from Dhanbad Railway Station and approx. 85 km from Kazi Nazul islam Airport , Durgapur & 140 Km from Birsa Munda Airport , Ranchi.

3.0 The details of buildings and approximate plinth area are described in Table-'A' below. The conceptual drawing as per EPC Mode-1 and Master Plan of the Campus are prepared by the consultant appointed by the IIT(ISM) Dhanbad. The bidder shall engage a consultant/ consultants who shall provide preliminary architectural drawings, detailed working drawings, structural drawings & service drawings for all buildings and development works & services and any other drawings required for completing the project. The drawings and schemes shall be got approved by WAPCOS / Client Authorities. The execution shall be done based on the approved working & structural drawings. CPWD Specifications, relevant IS codes, National Building Code 2016, ECBC 2017 and other standard specifications shall be followed in general except otherwise mentioned in bid document. Samples of the materials of approved make or otherwise shall be got approved from the Engineer-in-Charge before use in the work. The buildings are to be planned and designed as a GRIHA RATING 5 for buildings and GRIHA LD RATING 5 for Large Development and any similar ratings and awards.The work is to be executed on ENGINEERING, PROCUREMENT AND CONSTRUCTION (EPC) Mode-1 basis.

TABLE - A

Sl. No.	Building	Approximate Plinth Area (in sqm)
1	**Construction of centenary building (lecture hall and auditorium)**	
A	**Auditorium**	**9623.36**
B	**Lecture Hall**	**9085.29**
	TOTAL	**18708.65**
	Say	**18709**

BRIEF SCOPE OF WORK:

The scope of work includes-

(i) Statutory Approvals:

The status of statutory approvals is as below:

1. The Contractor will take required approval before start of work from Dhanbad Local bodies and statutory fee if any will be reimbursed by IIT(ISM) Dhanbad on actual basis.

2. NOC from Airport Authority (if required), NOC from Fire Department and tree cutting permission (if required) shall be obtained by contractor on reimbursement basis of actual statutory fees only.

3. Removals of tree roots are in the scope of EPC contractor.

4. Monthly monitoring report for EIA compliances to be submitted formally by contractor at required stages of execution as per guidelines.

After completion of work all necessary required approval such as occupancy certificate from local body, NOC from fire department, sub-station, lift inspector (if any) and any other statutory approval related to building for handing over the assets shall be taken by the EPC contractor. Contractor shall take all necessary measures required to be taken to remove any live or dead service lines running through the plot area without any extra cost.

(ii) Topographic Survey:

Contractor is advised to conduct topographical survey of the entire area land where building and all other services like roads, paths, cycle track, drains, and water bodies are located / passes out. Cost of topographic survey is included in the work and nothing

extra is to be paid for it. No claim about the change in site condition shall be entertained in future.

(iii) Soil Investigation:

The contractor has to carry out the soil investigation for finding out characteristics of soils of the campus, safe bearing capacity of soil, foundation design of buildings and retaining walls etc. Investigation of soil is to be done minimum upto 10 metre below ground / expected foundation level. Bores are to be done for each block, static and dynamic underground tanks and at locations of retaining walls in consultation with Engineer-in-Charge. Minimum nos. bores to be done for soil investigation as per IS code 1892 – code of practice for subsurface investigation for foundation. Contractor also carries out the CBR test for road design. 3 nos. CBR test / other tests are to be done, it is assumed that soil strata are uniform in the campus. If soil strata are not found uniform the CBR test is to be conducted at every 750 metre. First test is to be done at 100 metre from start of the road. Contractor is also advised to engage a geologist for finding out any fractured rock line in the area and submit his reportto the Engineer-in-Charge.

The final designs are to be done based on approved Geotechnical Investigation Report submitted by the EPC contractor.

(iv) Preparation of Drawings:

Contractor shall engage architectural consultant(s), structural and MEP services consultants. The contractor shall prepare following drawings and schemes but essence of Master Plan and Conceptual architectural drawings cannot be changed without approval of the client IIT (ISM) Dhanbad/WAPCOS.

(a) Preparation of good for construction drawings. These drawings shall be prepared in consultation with WAPCOS and client department. Architectural Consultant shall incorporate all the suggestions and modification as directed.

(b) Structural design and drawings of buildings (Structural design shall be done on the basis of considering campus of IIT(ISM) Dhanbad falls in Seismic Zone IV). Prepared structural drawings shall be got vetted from IIT's .

(c) Design and scheme of plumbing and water supply system

(d) Design and scheme of sewage drainage and storm water drain system

(e) Design and scheme of roads, footpaths and cycle track

(f) Design of retaining walls, if any

(g) Design and scheme of soil stabilization, if required

(h) Design and scheme of internal electrical installation, compound and street lighting

(i) Design and scheme of HVAC

(j) Design and scheme of firefighting including sprinkler systems and zoning, addressable fire alarmsystem, PA and evacuation system

(k) Design and scheme of CAT 6A based LAN system and CCTV system.

(l) Façade lighting

(m) Design and scheme of Electrical Substation consisting of HT Panel, Transformers, TTA MV Panel, APFC Panel, Rising Mains and bus trunking, MRL Lifts, UPS, provision for LT panels / feeder pillars, cabling work, emergency lighting, water supply pumping system etc complete as required for modern Institution Building.

(n) Design of service trenches, rain water collection ponds etc as per scope of work.

(v) Other Works:

Apart from above mentioned works following works are also in the scope of work

(a) Providing and erecting 6.00 metre high temporary barricading as per direction of Engineer-in-Charge.

(b) Provision shall be made to make buildings barrier free as per CPWD Manual 2019 on Accessible Built Environment.

(c) Appointment of BIM consultant for 3D-BIM modelling etc. as per scope of work defined in additional conditions.

(d) Submission of measurements, for record and other purposes.

(e) After completion of the work contractor shall submit as built drawings of all services in Auto CAD including five sets of colored drawings on A0 size.

(f) The EPC contractor shall submit structural stability & safety certificate. However, vetting of design/drawings from IIT's shall not absolve the Agency from the responsibilities of any failure in the structural design and RCC design during construction as well as during the specified life period of the structures.

(g) The EPC contractor shall submit life cycle cost analysis of buildings, other equipments and analysis as per direction of Engineer-in-Charge.

(h) The contractor shall provide good quality camera and take photographs and video recording of major activities for record purpose and for quality assurance as per direction of Engineer- in-Charge.

(vi) Construction of Civil, Electrical and MEP works:

A. Building

Earthquake resistant RCC framed structure buildings are to be constructed along with their mandatory services (e.g. internal electrification, fire services, lifts, water supply, sewerage etc). The approximate plinth area details of building are as below:

AREA STATEMENT FOR IIT DHANBAD AUDITORIUM			
FLOORS	**SPACES**	**ROOM HEIGHT IN (M)**	**CONSTRUCTION AREA IN SQ.M**
GROUND FLOOR			
	AUDITORIUM	19.5	945.73
	Rest of GF	4.5	1791.75
		Sub -total GF	**2737.48**
FIRST FLOOR		4.5	**968.03**
SECOND FLOOR			
	AUDITORIUM	15.5	410.00
	Rest of SF	4.5	2023.75
		Sub -total SF	**2433.75**
THIRD FLOOR		4.5	**1623.75**
FOURTH FLOOR		4.5	**1860.35**
TOTAL	**AUDITORIUM**		**9623**

AREA STATEMENT FOR IIT DHANBAD LECTURE HALL BUILDING			
FLOORS	**SPACES**	**ROOM HEIGHT IN (M)**	**CONSTRUCTION AREA IN SQ.M**
GROUND FLOOR			
	CANTEEN	6	296.72
	STAIRCASE AND ESCALATORS	6	114.30
	CIRCULATION AREA	6	498.85
	Rest of GF	3	416.22
			1326.09
FIRST FLOOR		3.8	**1384.74**

SECOND FLOOR		3.8	**2126.16**
THIRD FLOOR		3.8	**2124.15**
FOURTH FLOOR		3.8	**2124.15**
TOTAL			**9085**

Scope of works for construction works shall be as per Annexure "A"

Note: 1. The areas shown are indicative only and EPC contractor can make minor changes while makingdetailed working drawings in consultation with WAPCOS.

2. Minimum plinth height of each building shall be 600 mm from nearest road level or formation ground level around building whichever is higher.

Note:

Ramps:

a) All ramps with handrails on both sides shall be as per "CPWD Manual on Accessible BuiltEnvironment" issued in 2019.

Refuge Area:

For buildings exceeding 15 metre in height, refuge area shall be provided as as follows.

a)For floors above 15m and upto 24m – one refuge area on the floor immediately above 18m.

b)For floors above 24m and upto 36m - one refuge area on the floor immediately above 24m.

Refuge area shall be provided on the external walls as cantilever projections or in any other manner(which will not be covered in FAR) with a minimum area of 15 sqm and to be calculated as per norms.

Plinth Area Calculation:

The total plinth area of a building shall be calculated as per PAR -2021.

B. Electrical Works

Brief Scope of E & M works are given in Annexure A.

		Annexure A
Construction of Auditorium of Centenary Building at IIT (ISM) Dhanbad		
A	**CIVIL WORKS**	
	RCC framed structure	
	Fire Fighting	
	Downcomer System	
	with wet riser and sprinkler system	
	Fire Alarm System	
	Automatic Fire Alarm System	
	RCC Water Tank	
	Over head Tank without independent staging for fire	20000 litre
B	**Services**	
	Internal Water Supply & Sanitary Installations	
	External Service Connection	
	Electrical External Service Connections	
	Civil External Service Connections	
	Internal electric installations	
	Extra for Power wiring and plugs	
	Lightning conductors	
	Telephone conduits	
C	**LIFTS with power operated centre opening doors and AC variable voltage & variable frequency controls**	
	Passenger lifts	
	Passenger lift for 16 persons with speed 1.5m/s, G+5	3 Nos.
D	**Specialised E&M Works**	
	Sub-Station Equipment	
	Supply, installation, testing and commisioning of 11Kv/415V substation equiment compraising HT panel, dry type/Oil type trasformer, HT cable, BUS truking from Trasformeer to LT panel, LT panels, Automatic Power factor correction panel, active harmonic filter, TVSS, SPD (Surge protection System) Essential Panel, earthing, required inter connections, sub station safety equipment including LT cabling from Substation to the buildings fed by the substation.	800 KVA
	Generating Sets	
	Supplying, installation, testing and commissioning of DG sets, AMF panel, bus ducting/ cables from DG sets to essential panel, DG set enclosure room sound insulation/ventilation/smoke exhaust as required, earthing of DG set system, control cabling, fuel tank/piping, DG set exhaust piping/ exhaust chimney as per CPCB norms, civil works connected with DG sets including foundation as required.	800 KVA
	Uninterrupted Power Supply	

	Supplying, installation, testing and commissioning of online 3 phase UPS system with 30 minutes back up including batteries, interconnecting cables, battery racks etc.	80 KVA
	Central AC Plant	
	Supply, installation, testing and commisioning of energy efficient central AC plant including low side works	90.38 TR
	Extra for stand-by chilling units high side	90.38 TR
	CCTV	
	Supplying, installation, testing and commissioning of IP based CCTV system for building security comprising of PTZ I fixed camera, cabling, digital recording, HD display system with minimum display of 5" × 8" per camera and hard ware software support - for indoors only {Rate applicable on total plinth area but CCTV coverage shall be limited to 15% of the total plinth area as per requirement}	2737.48 sqm
	For external surveillance (Rate applicable on total plot area minus plinth area at ground floor)	3262.52 sqm
	Access Control System Supplying, installation, testing and commissioning of access control system for building security comprising of controller, E&M locks, reader, smart cards, cabling, recording, display system, hardware and software support as required (Rate applicable only on plinth area of high security area in the building)	2737.48 sqm
	IBMS: Integrated Building Management System	
	Supplying, installation, testing and commissioning of integrated building management system for digital/electronic display and monitoring of all E&M systems like substation, DG sets, UPS, solar power, lifts, AC plants, ventilation systems, fire protection systems, pumps etc. to include cabling, monitors, recording, display system, hardware, software support (upto 10,000 sqm) (Rate applicable on total plinth area)	2737.48 sqm
	Add extra for built up area above 10,000 sqm (Rate applicable on total plinth area)	2737.48 sqm
	Hydropneumatic Water Supply System	
	Supply, installation, testing and commisioning of hydro pneumatic water supply system consisting of pumps, pneumatic tank, microprocessor based control panel, VFD, inter connecting pipes, valves, cabling, switchgear etc. as required	375 LPM
	Lighting Automation Including Occupancy Sensors	
	Supplying, installation, testing and commissioning of lighting automation including occupancy sensors (Rate applicable on area to be specified by client)	9623.36 sqm
	LAN System	

	Supply, installation, testing and commisioning of LAN System compraising of core switches and L2 switches with 10G, 10Giga SFP modules Wifi access point, Wfi Controller, Network management software, racks, CAT 6A Cable, Patch panels, OFC etc.	9623.36 sqm
	Street Lighting With LED	
	Supplying, Installation Testing & commissioning LED Street/ Compound/ High mast/ Pathway/ Landscape Lighting for entire Campus	6000 sqm
	Emergency Light & Illuminated Signages	
	Illuminated signages (Rate applicable on total plinth area)	2737.48 sqm
E	**Finishing**	
	Providing & fixing false ceiling at all heights with GRG (Glass Fibre Reinforced Gypsum) false ceiling tiles of Size 595x595 mm of approved texture, design and patterns having moisture content less than 2%, humidity resistance of 99%, NRC 0.50 to 0.75 as per IS 8225:1987, Non combustible as per BS 476 (part 4)-1970 and light reflectance of 85% (minimum) to be laid in true horizontal level suspended on interlocking metal T-Grid of hot dipped galvanised iron section of 0.33mm thick (galvanized @ 120 grams per sqm including both sides) comprising of main-T runners of size 15x32 mm of length 3000 mm, cross - T of size 15x32 mm of length 1200 mm and secondary intermediate cross-T of size 15x32 mm of length 600mm to form grid module of size 600 x 600 mm, suspended from ceiling using galvanised mild steel items (galvanizing @ 80 grams per sqm) i.e. 50 mm long, 8 mm outer diameter M-6 dash fasteners, 6 mm dia fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 85x25x2 mm. Galvanised iron perimeter wall angle of size 24x24x0.40 mm of length 3000 mm to be fixed on periphery wall / partition with the help of plastic rawl plugs at 450 mm center to center and 40 mm longdry wall wood screws. The work shall be carried out as per specifications, drawing and as per directions of the Engineer-in-Charge.	
	With semi perforated 12 mm thick micro tegular edged GRG false ceiling tiles.	7953.01 sqm
F	**Development at site:**	
	Semi Compact/Semi scattered side compraisaing of Few blocks of Mid rise (Between 6 -12 Stories) building in a gated compound	AS per 2.2 of PAR 2021 , page No.-7
	Horticulture Works	
	Horticulture operation including 300mm earth filling, grassing, tree plantation/shrubs and potted plants etc.	4000 sqm

	Unfiltered water supply distribution lines	150 metre
G	**Furniture**	
H	**Public Announcement (PA) System**	
I	**Audio Visual (AV) System**	

Construction of Lecture Hall of Centenary Building at IIT (ISM) Dhanbad		
A	**CIVIL WORKS**	
	RCC framed structure	
	Fire Fighting	
	Downcomer System	
	with wet riser and sprinkler system	
	Fire Alarm System	
	Automatic Fire Alarm System	
	RCC Water Tank	
	Over head Tank without independent staging	Composite quatity for complete building Considered in Auditorium
B	**Services**	
	Internal Water Supply & Sanitary Installations	
	External Service Connection	
	Electrical External Service Connections	
	Civil External Service Connections	
	Internal electric installations	
	Extra for:	
	Extra for Power wiring and plugs	
	Lightning conductors	
	Telephone conduits	
	LIFTS with power operated centre opening doors and AC variable voltage & variable frequency controls	
	Passenger lifts	
	Passenger lift for 16 persons with speed 1.5m/s, G+5	3 Nos.

	Specialised E&M Works	
	Sub-Station Equipment	
	Supply, installation, testing and commisioning of 11Kv/415V substation equiment compraising HT panel, dry type/Oil type trasformer, HT cable, BUS truking from Trasformeer to LT panel, LT panels, Automatic Power factor correction panel, active harmonic filter, TVSS, SPD (Surge protection System) Essential Panel, earthing, required inter connections, sub station safety equipment including LT cabling from Substation to the buildings fed by the substation.	700 KVA
	Generating Sets	
	Supplying, installation, testing and commissioning of DG sets, AMF panel, bus ducting/ cables from DG sets to essential panel, DG set enclosure room sound insulation/ventilation/smoke exhaust as required, earthing of DG set system, control cabling, fuel tank/piping, DG set exhaust piping/ exhaust chimney as per CPCB norms, civil works connected with DG sets including foundation as required.	700 KVA
	Uninterrupted Power Supply	
	Supplying, installation, testing and commissioning of online 3 phase UPS system with 30 minutes back up including batteries, interconnecting cables, battery racks etc.	70 KVA
	Central AC Plant	
	Supply, installation, testing and commisioning of energy efficient central AC plant including low side works	265.28 TR
	Extra for stand-by chilling units high side	265.28 TR
	CCTV	
	Supplying, installation, testing and commissioning of IP based CCTV system for building security comprising of PTZ I fixed camera, cabling, digital recording, HD display system with minimum display of 5" × 8" per camera and hard ware software support - for indoors only {Rate applicable on total plinth area but CCTV coverage shall be limited to 15% of the total plinth area as per requirement}	1326.09 sqm
	For external surveillance (Rate applicable on total plot area minus plinth area at ground floor)	2673.91 sqm
	Access Control System Supplying, installation, testing and commissioning of access control system for building security comprising of controller, E&M locks, reader, smart cards, cabling, recording, display system, hardware and software support as required (Rate applicable only on plinth area of high security area in the building)	1326.09 sqm
	IBMS: Integrated Building Management System	

	Supplying, installation, testing and commissioning of integrated building management system for digital/electronic display and monitoring of all E&M systems like substation, DG sets, UPS, solar power, lifts, AC plants, ventilation systems, fire protection systems, pumps etc. to include cabling, monitors, recording, display system, hardware, software support (upto 10,000 sqm) (Rate applicable on total plinth area)	1326.09 sqm
	Add extra for built up area above 10,000 sqm (Rate applicable on total plinth area)	1326.09 sqm
	Hydropneumatic Water Supply System	
	Supply, installation, testing and commisioning of hydro pneumatic water supply system consisting of pumps, pneumatic tank, microprocessor based control panel, VFD, inter connecting pipes, valves, cabling, switchgear etc. as required	468.75 LPM
	Lighting Automation Including Occupancy Sensors	
	Supplying, installation, testing and commissioning of lighting automation including occupancy sensors (Rate applicable on area to be specified by client)	9085.29 sqm
	LAN System	
	Supply, installation, testing and commisioning of LAN System compraising of core switches and L2 switches with 10G, 10Giga SFP modules Wifi access point, Wfi Controller, Network management software, racks, CAT 6A Cable, Patch panels, OFC etc.	9085.29 sqm
	Street Lighting With LED	
	Supplying, Installation Testing & commissioning LED Street/ Compound/ High mast/ Pathway/ Landscape Lighting for entire Campus	4000 sqm
	Emergency Light & Illuminated Signages	
	Illuminated signages (Rate applicable on total plinth area)	1326.09 sqm

C	**Finishing**	
	Providing & fixing false ceiling at all heights with GRG (Glass Fibre Reinforced Gypsum) false ceiling tiles of Size 595x595 mm of approved texture, design and patterns having moisture content less than 2%, humidity resistance of 99%, NRC 0.50 to 0.75 as per IS 8225:1987, Non combustible as per BS 476 (part 4)-1970 and light reflectance of 85% (minimum) to be laid in true horizontal level suspended on interlocking metal T-Grid of hot dipped galvanised iron section of 0.33mm thick (galvanized @ 120 grams per sqm including both sides) comprising of main-T runners of size 15x32 mm of length 3000 mm, cross - T of size 15x32 mm of length 1200 mm and secondary intermediate cross-T of size 15x32 mm of length 600mm to form grid module of size 600 x 600 mm, suspended from ceiling using galvanised mild steel items (galvanizing @ 80 grams per sqm) i.e. 50 mm long, 8 mm outer diameter M-6 dash fasteners, 6 mm dia fully threaded hanger rod upto 1000 mm length and L-shape level adjuster of size 85x25x2 mm. Galvanised iron perimeter wall angle of size 24x24x0.40 mm of length 3000 mm to be fixed on periphery wall / partition with the help of plastic rawl plugs at 450 mm center to center and 40 mm longdry wall wood screws. The work shall be carried out as per specifications, drawing and as per directions of the Engineer-in-Charge.	
	With semi perforated 12 mm thick micro tegular edged GRG false ceiling tiles.	7313.22 sqm
D	**Development at site:**	
	Semi Compact/Semi scattered side compraisaing of Few blocks of Mid rise (Between 6 -12 Stories) building in a gated compound	
	Horticulture Works	
	Horticulture operation including 300mm earth filling, grassing, tree plantation/shrubs and potted plants etc.	2000 sqm
	Unfiltered water supply distribution lines	150 metre
G	**Furniture**	
H	**Public Announcement (PA) System**	
I	**Audio Visual (AV) System**	

NOTE:

1. **<u>The contractor shall made arrangement for fixing of solar panels and their frames at terrace level of each building as per direction of Engineer-in-Charge. Solar panels andtheir frames are not in the scope of work.</u>**

2. **<u>The mode of tender is EPC mode 1 and as per scope of work the bidder should also consider the Plinth area of the building and other relevant parts of the tender document for calculating remaining qty of items which are not categorically listed in ANNEXURE A.</u>**

PART - B

CIVIL WORKS

ARCHITECHTURAL CONSULTANCY

General Conditions for Planning & Design

1.0 The bidder should engage a reputed Firm / Consultant (whether titled as an Architectural firm or Engineering firm) to prepare architectural designs, structural designs, service drawings for all internal and external services comprising civil, electrical and mechanical components to be approved by WAPCOS/ IIT (ISM) Dhanbad. The consultant shall also prepare and submit Design Basis Report for Civil works, structural design and MEP services. The minimum eligibility criteria for the consultant are as below.

"The main contractor should associate with a consultancy firm headed by an architect who should possess Masters Degree in Town Planning / Master Degree in Urban Planning / Master Degree in Architecture and Bachelors degree in Architecture, registered with council of architecture with minimum 15 years of experience in the field of planning and architecture. Further, the firm should possess experience of having satisfactorily completed, as mentioned below, during the last 7 (seven) years ending previous day of last date of submission of bids."

One major academic institutional campus having built-up area not less than 80% of built-up area in sqm

OR

Two major institutional campuses each having built-up area not less than 50% built-up area in sqm

OR

Three major institutional campuses each having built-up area not less than 40% built-up area in sqm

All cost / fee regarding preparation of model, traveling & lodging cost, honorarium etc. to be paid to the consultants shall be borne by the firm / contractor. The department will have the intellectual right on conceptual plan, model etc. and will have the right to use some of the concepts or features from drawings submitted.

The Consultant shall be associated till completion of the project i.e. till occupancy certificate obtained from the concerned local body.

1.1 Consultant shall provide:

a. Comprehensive consultancy services in Project by the way of preparation of modified master plan after incorporating changes desired by local authorities in the Master Plan and drawings submitted to local bodies by the consultant appointed by the IIT.
b. Detailed architectural drawings with artistic features including designing and detailing of all services, external development works, landscaping, etc for the scope of work.

c. Structural drawings to WAPCOS along with structural design & analysis duly vetted by IIT's (Delhi/ Roorkee/ Madras/ Bombay) before the same are released for execution.

d. Consultant shall also prepare and supply all the coordinated "GOOD FOR CONSTRUCTION" drawings as per approved drawings.

1.2 In case in house personnel of required experience is not available with the contractors or with the associated architectural/ Engineering firms, the main contractor shall have to enter into agreement with consultant for design of E&M subheads. Copy of such agreement shall be submitted to Engineer-in-Charge. In case of change of associate consultant, the main contractor has to enter into agreement with the new consultant to be associated by him. Agreement should be drawn as per Proforma for agreement between associate electrical contractor and main contractor after suitably modifying the proforma for consultancy work.

If the performance of the consultant(s) is not of satisfactory qualities and standard or they fail to adhere to the timeline specified in the bid document, the main contractor will take timely suitable necessary action against the consultant(s) as per the terms and conditions of agreement between them. However this will not absolve the main contractor from the levy of liquidated damage due to delay in the project and department will be free to take action as per relevant clauses of agreement. In the case of termination of the contract with the consultant(s) by the main contractor, the process of selection of new consultants(s) will be same as provided in the bidding document. All additional cost associated with this shall be borne by the contractor. They will not be eligible for any extra time/ extension of time for delay in this process. Any loss of time in the process shall be made good within the milestones fixed in the bidding document.

2. ROLE OF THE CONSULTANT

The Role of the Consultant is to provide consultancy services for Construction of Buildings for

Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad as defined in scope of works.

2.1 The details of the scope of the work involved mentioned in this Bid Document are broad and suggestive. Notwithstanding the details of the scope of the work and role of agency mentioned elsewhere in this Bid Document, the agency is required to provide drawing and design on all aspects of the work for complete comprehensive planning and designing for proposed construction of buildings of Phase 1 for IIT (ISM) Dhanbad.

2.2 The statutory approvals shall include obtaining Fire Clearance from CFO after completion of the work and completion certificate for the completed building from the local bodies.

2.3 The consultant and his sub consultant shall have constant and regular interaction with the WAPCOS for formulating the design philosophy and parameters, designs / drawings and specifications.

2.4 The consultant or contractor shall have to carry out detailed topographical survey and the survey of all existing services and other constraints existing in and around the site for proper design of all the services.

2.5 The Consultant shall have to perform in an efficient, orderly and professional manner and shall deploy necessary qualified and skilled persons according to the requirement.

2.6 The Consultant and the Sub-Consultants shall visit the works during execution stage at regular interval but not more than 30 days and to ensure that the works are being executed as per approved scheme and render appropriate advice and carry out all site related modifications in the designs and drawings.

2.7 The Consultant shall co-ordinate regularly with the WAPCOS and structural / services consultants for developing structural drawings, detailed working drawings, MEP services and development works drawings, specifications etc.

2.8 The consultant shall prepare the completion drawing after incorporating the suggestions/ modifications and shall obtain completion/ occupancy certificate from local bodies.

2.9 The consultant/contractor shall have to get the structural analysis/design and design of services and drawings and get vetted at his own cost and nothing extra shall be paid. The detailed design notes shall be submitted along with design philosophy to Engineer-in-Charge.

2.10 The Consultant shall comply with all applicable laws, bye-laws, and statutory provisions, codes and specifications etc. in the performance of the consultancy assignment and in the execution of the project.

2.11 The Consultant shall comply with the applicable norms of local as well as Central Govt. Bodies.

2.12 The consultancy services shall be provided through a Team Leader supported by experienced professionals. The Consultant shall deploy adequate number of professionals and other staff to deliver the requisite services as per time schedule. The Consultant shall have to submit an Organogram giving details of proposed team detailing the roles/work to be performed by each personnel, their tentative duration, inter-relationships of each personnel etc. The consultant shall deploy one graduate architect of minimum 8 years' experience. Details of key personnel to be deployed by the consultant shall be as per clause 32 of Operative schedule.

2.13 The Consultant shall get the approval of the WAPCOS through presentations, physical models etc. The comments and suggestions or observations of the WAPCOS shall be evaluated and suitably incorporated till the working drawing / design is accepted and frozen.

2.14 The Consultant shall develop the good for construction drawings for each building after incorporating changes as suggested by the statutory authorities/bodies.

2.15 The Consultant shall ensure that the various building/engineering services are designed without any discrepancies between the structure, services and finishes.

2.16 The Consultant shall ensure that the nature, position, and appearance of all controls of piped services and electrical installation satisfy user and aesthetic requirements in a coordinated manner.

2.17 The Consultant shall have to co-ordinate with the department and attend meetings with the department as and when required along with the main agency.

2.18 The consultant shall obtain fire clearance from CFO on completion of the construction work after incorporating the modifications in the drawing and services as suggested by them.

3.0 SCOPE OF SERVICES

3.1 The consultant shall provide Comprehensive Consultancy Services in the following.

a) All Architectural Services including building plans/ all hard and soft Landscaping / signage, AV equipment design.
b) All Quantity Surveying Services
c) All Civil & Structural Engineering Services including all proof checking work.
d) All Electrical Engineering Services i/c all proof checking works.
e) All Mechanical Engineering Services i/c all proof checking works.
f) All Public Health Engineering Services i/c all proof checking works.
g) All Waste Water treatment and Management System i/c all proof checking works.
h) All furniture /equipments/fixtures/fittings for all buildings.
i) All interiors and all acoustical treatments.
j) All art work and signage.
k) All water supply & drainage system.
l) All I.T. Service.
m) Any other services which are required but not specifically indicated.
n) Vetting of structural drawings from IIT Delhi / Roorkee / Madras / Bombay.

3.1.1 The consultant shall provide comprehensive consultancy services broadly described herein after. However, it should be clearly understood that the description of services is only indicative and the Consultant shall be required to all services which may be required for completion of the project complete in all respects whether or not expressly mentioned hereinafter in this contract document of this work

3.1.2 The Consultant(s) shall perform all the Architectural, Structural design work design of services, landscaping works by utilizing the most economical, effective and widely accepted engineering concepts/practices and shall at all times show a high degree of professionalism in his work.

3.1.3 The Consultant will be fully responsible for the design of all the civil, electrical and structural engineering (if applicable) works including landscaping services. The services to be provided by the Consultant shall include but not be limited to the following:

(i) Buildings & services in the scope of this tender as mentioned in the chapter Brief Particulars of Works.

Details of services (Civil, Electrical and other miscellaneous works) are given in under Brief Particulars of works.

3.2 Preliminary Stage

3.2.1 Carry out topographical survey and the survey of all existing services and other constraints existing in and around the site.

3.2.2 Carry out soil investigation of the site, for each block to establish the soil characteristics and other parameters required for the foundation design of buildings. Types of investigation/test and their qualities shall be got approved from Engineer-in-Charge. Soil investigation agency should be experienced, specialized and should be got approved from Engineer-in-Charge.

3.2.3 The contractor / consultant shall also get ascertained the liquefaction potential of soil at required depths using modern methodology such as Spectral Analysis of Surface Waves (SASW) test or any other method and combination of tests approved by Engineer-in- Charge

and suggest remedial measures and account for same while suggesting the foundation system and suggesting bearing capacity/load carrying capacity.

3.2.4 The soil report shall be got vetted / proof checked from the Institute of repute such as IIT (D), IIT (Roorkee), IIT Madras, IIT Bombay or CBRI Roorkee.

3.3 Tender drawings for all buildings under phase1 uploaded by WAPCOS.

3.4.1 Modifications of the tender drawings taking into account the comments, suggestions etc. of the client and WAPCOS.

3.4.2 Obtaining approval on the tender drawings from the WAPCOS/ Client i.e. IIT (ISM) Dhanbad Authorities.

3.4.3 Submission of the final designs along with models, photographs and as per the requirement of norms etc. The cost of such models, photographs, etc. shall be borne by the consultant/ Agency.

3.5 Charges to be payable to local bodies: The charges to local bodies will be payable by the WAPCOS.

3.6 Preparation of shop drawings: The consultant shall prepare and submit shop drawings for various item of works e.g. uPVC windows, frameless glass doors, aluminium works, plumbing works, structural glazing, bridge, gantry girders, signages and any other works required shop drawings for approval before start of work. Shop drawing shall incorporate

a) All proposed structural supports/ hanging / laying and jointing details

b) Plumbing layout plan including details of toilets and fixtures

3.7 DETAILED DESIGN STAGE

3.7.1 ARCHITECTURAL DRAWINGS & SERVICES

3.7.1.1 The drawings & documents shall include detailed site plan, detailed drawings for each building including floor plans, elevations, sections, doors & windows schedules, services, finishing schedules, wall profiles, Staircases, ramp and lift details, details of important building parts / areas, landscape details etc. Description, Standard & specifications of materials to be used shall be mentioned rather than specific products or brand names.

3.7.1.2 Prepare and issue “Good for Construction” drawings. Drawings shall be adequately detailed and shall contain enough information.

3.7.1.3 The working drawings shall include Layout Plan showing:
All proposed buildings, play fields, green area, location of Under Ground Sump, STP, ETP, Rain Water Collection Pond, Elect. Sub-Station, Roads, Bridge, Culverts, Service Trench, Cycle Tracks, Footpath etc. Blow up of road junction / parking area and other such area as required and Coordinated External services.

3.7.1.4 Detailed drawings shall include showing:
All proposed buildings, play fields, green area, location of Under Ground Sump, STP, ETP, Rain

Water Collection Pond, Electric Sub-stations, Roads, Bridge, Culverts, Service Trench, Cycle Tracks, Footpath etc. Blow up of road junction / parking area and other such area as required and Coordinated External services.

- Floor plans, fully coordinated with all services/disciplines
- Elevations
- Sections
- Wall profiles
- Doors & Window details
- Stairs/Ramps/Lifts details
- Details of building parts, areas, critical special treatments
- Toilet details
- Flooring pattern and details
- Dado details
- Roof flow, drainage system including rain water harvesting system consisting of pits, recharge of aquifer through bores, creation of natural water bodies etc; all interlinked with proper drawings • Detailed drawings showing furniture layout
- Detailed drawings of artwork
- Interior design including design of furniture & furnishing etc. for all buildings
- Landscape i/c water bodies works of whole campus including around the buildings
- Drawings of landscape including blow up of critical areas / landscapes / plant scapes in detailed coordination with all external services
- Checking and certifying the Architectural drawings, technical specifications, services and all other drawings to ensure their completeness/correctness
- Finalizing finishing schedule, elevation treatment, fixtures, colour scheme of all buildings.
- Any other details as required by the Engineer-in-Charge.

3.7.1.5 Integration of design with the existing landscape including water bodies and suggest modification if any.

3.7.1.6 Any other details required for completion of the buildings/services.

3.7.1.7 Inspect the works and attend meetings during execution to give clarifications, if any, and to modify the drawings as per the site/construction requirements.

3.7.2 CIVIL AND STRUCTURAL ENGINEERING SERVICES

3.7.2.1 Design Basis

i. Conduct surveys, tests and other investigations including geotechnical investigations as per latest IS 1892 with upto date amendments, as required to determine the basis to accomplish designs as per latest specifications &codes.

ii. Planning for the structural arrangements with the architectural design i.e. structural arrangement should be compatible with architectural drawings.

iii. The Building shall be analysed as a Space Frame. The building shall be modeled using structural engineering latest software package with upto date amendments ETABS/STRAP/STAAD Pro V8ior any other standard proven software. SI units should be followed for entire analysis and design. The modelled space frame should be analyzed for all possible various loads as per IS codes i.e. 875 etc for example Dead Loads (DL), Live Loads (LL),

Wind Loads (WL), Earthquake Loads(EQ), and their combinations as per clause 6.3.2 and clause 6.3.4 of IS: 1893-2016 (Part-1).

The proposed model shall be analysed for seismic zone V using dynamic analysis and other IS EQ codal provisions.

The Building should also be checked for storey drift as per clause 7.11 of IS 1893:2016 and torsion as per clause 7.8 of IS 1893:2016. Check should also be applied for clause 7.1.1, clause 7.2, clause 7.5, clause 8 etc of IS 13920: 2016. All supports (foundations) of the Building columns and shear walls shall be considered as fixed joints for analysis. Effective length of columns shall be considered as per the standard codes of practice. All expansion joints shall be designed as seismic joint. This structure should be designed and detailed as per Indian codes of practice. All disaster managements practices as specified in NBC to be followed.

iv. The structural members should be designed by using minimum grade of design mix concrete as M 25 and will be designated based on the principles given in IS 456. 10262 and SP 23 with upto date amendments.

v. The grade of steel shall be minimum Fe 500D and confirming to latest IS:1786-2008 with upto date amendments. vi. Co-ordination & finalization of structural arrangement

- Foundation system
- Beam & Column location
- Beam & Column size finalization
- Slab profiles
- All other detailing required for the finalization of design

vii. Finalization of design basis & structural systems

viii. For solar panels, load 50 kg/sqm shall be taken for load calculation besides other imposed and dead loads on terrace.

ix. The consultant shall submit to WAPCOS vetted structural drawings & design details including input / output data for approval. These structural drawings shall be vetted from IIT (Delhi, Roorkee, Madras, Bombay).

3.7.2.2 Drawing Stage

- Foundation plans & details
- Column, walls and beam layout plans
- Floor framing plans, fully coordinated with all disciplines Floor slab structural details
- Column & beam structural details
- Staircases, ramps, lifts shafts and machine room details, rain water harvesting chamber.
- Requirement of Green Building Concept
- All other details and sketches required for proper execution of the works.

3.8 ELECTRICAL ENGINEERING SERVICES

1 A. General

The services to be provided by Consultant shall include (Schedule of Quantities of various items involved in this work, Design, Drawings, Vetting and shop drawings)

1. Design for internal and external electrical installations including all electrical fittings/fixtures, fans, water supply pumps, de-watering pumps etc. as necessary.
2. Design of Power supply and distribution system of HT and LT including emergency and DG supply, sub station, DG set with PLC based AMF panel, HT panel (RMU), LT panel, feeder pillars etc.
3. IP based Telephone system, Intercom communication facilities, data networking system.
4. Cable TV/dish antenna system.
5. Lightening protection and earthing system.
6. LED based External lightning.
7. Building wise UPS backup supply system for computer points, DATA & CCTV racks, Fire Alarm & PA system, BMS, Control system, Access control system.
8. Design of SCADA system for HT supply network.
9. MRL Lifts.
10. Building Management system controlling all essential services.
11. Fire fighting, fire detection and Alarm system and PA system design.
12. Any other services required but not specifically indicated.
13. Proper coordination with Civil Engineering/Mechanical Engineering features/services.
14. Liaisonig of other statutory agencies like, Municipal corporation, govt. fire services agencies , CEA, Lift inspector for obtaining the pre construction and post construction clearances. The statutory payment to these agencies however will be reimbursed on actual basis.
15. HVAC system for all buildings.
16. Street light design with Time control panel.
17. Advanced CCTV & Entrance security system and equipments.
18. Audio, Visual system & equipments in conference hall, meeting hall, lecture hall, class rooms and seminar halls etc.
19. Water treatment plant and STP.
20. Façade lighting.

B. Services

1. Carry out basic and detailed designs of comprehensive electrical power distribution scheme, indoor and outdoor lighting, lightning protection and earthing systems of all the buildings in accordance with the relevant Indian regulations and Standards. The work shall include, but not limited to the following services:
2. Design and draw up preliminary schemes on the electrical requirements.
3. Design the distribution systems and prepare single line diagrams with details of accessories and equipment.
4. Specify the details and capacities of HT panels, Transformers, LT panels, standby diesel generators and fuel intake, and to specify the type of supply arrangement for incoming power supply, interlocking arrangement between HT panel, transformer, L T panel & DG sets.
5. Design the Sub-station comprising of the HT panel room, transformer room, L T panels room, generator room and to specify the necessary switchgear and control 'Changeover panels, capacitor banks, bus duct, essential and non essential panels as necessary with the appropriate load shedding.

6. Make detailed specifications of all electrical items, essential and non-essential panels, power control centers, capacitor panels.
7. Design and prepare detailed layout drawings for the individual power. Indoor and outdoor lighting, lighting protection and earthing system as required.

2 Telephone, Intercom & Communication System

Telephone layout and telephone equipment including conduit and accessories layout for the telephone system and any protective devices battery back-up required.

Design the EPABX room. Prepare conduit layout of cables and terminals inclusive of a fiber optic or other special data transmission cables for system required.

Intercom layout and intercom equipment including conduit and accessories layout for the intercom system and any protective devices required.

Prepare the specifications.

Integrate the drawings/documents/ specifications of supplier's / manufacturer's of approved items with other services and working drawings.

3 Lightning Protection and Earthing System

Lightning protection system shall be an advanced integrated lightning protection system. The work shall include, but not limited to the following

Survey and investigation of ground resistivity of sub-soil at different depths.

Prepare plans showing internal/external earth grid, earth electrodes and lightning protection with size of conductors and details of each electrical and lightning arrestors along-with details of earthing pits.

Design of earthing system shall be based on survey, investigation data, load and as per relevant Indian Standards and Indian Electricity rules.

4 External Lighting

Assess the external lighting requirement for parking, buildings etc.

Prepare plans indicating the road lighting with circuit details, typical pole detail with type of fixture, cabling, earthing etc.

Prepare the specifications;

Submission of detailed drawings of the suppliers/ manufacturers to WAPCOS for approval.

5 UPS back-ups

Prepare the plan indicating the locations of UPS rooms in the buildings, UPS room layout, Single line diagram/Power flow diagram.

Prepare specifications;

Submission of detailed drawings of the suppliers / manufacturers to WAPCOS for approval.

6 Solar water Heating

Planning and installation of Solar Heating System.

Prepare specification.

Submission of detailed drawings of the suppliers / manufacturers to WAPCOS for approval.

7 Planning & Designing C.C.TV, EPABX System, LAN, Wi-Fi Networking system & BMS System, D.G.

Set & Air Conditioning and other services.

Prepare the plan indicating the locations of system/ service layout, Single line diagram/Power flow diagram.

Prepare specifications;

Submission of detailed drawings of the suppliers / manufacturers to WAPCOS for approval.

3.9 MECHANICAL ENGINEERING SERVICES

3.9.1 General

The services to be provided by Consultant shall include.

(i) Fire detection, Fire fighting system and automatic fire alarm system.

(ii) Lifts, escalators, water pumps etc.

(iii) Substation building and equipment and related external cabling work.

(iv) DG sets.

(v) HVAC.

(vi) Audio visual equipments and services.

(vii) Solar heating system.

(viii) Others services as specified in bidding documents.

(ix) Propercoordinationwithcivil/electricalengineeringfeatures/services.

3.9.2 Services

To carry out basic and detailed design of the required Heating, Ventilation & Air conditioning system. This shall include amongst others the following services:

3.9.2.1 Fire Detection &Alarm System Design the FDA Control Room layout.

Prepare working drawings (Floor wise) indicating the zones, location of the fire alarm sensors, Response Indicator, Manual call points, Hooters, their conduits and wiring and location/details of FDA control panels.

Vetting of drawings from local fire authority

3.9.2.2 Lifts, Escalators

Specify the capacity and type of lifts/escalators to be provided. Minimum capacity is indicated in the contract document. Prepare layout for the necessary machine areas and associated fittings and services.

Finalize the design for lifts and escalators installation as per the Statutory/local regulations. Prepare specifications.

Check and approve the suppliers'/ manufacturers drawings/ documents and incorporate necessary changes in architectural /working drawings.

Vetting of design and drawings by WAPCOS.

3.9.2.3 Water Pumps

Specify the type of pumps for water supply &de-watering purpose.
Prepare specifications.
Check and approve the suppliers'/ manufacturers drawings/ documents and incorporating in service drawings.
Vetting of design and drawings by WAPCOS.

3.9.2.4 Ventilators system (as required)

Design and estimation of proper ventilation system from user comfort as specified in relevant codes, specifications and also from fire safety point of view. Vetting of design and drawings by WAPCOS.

3.9.2.5 Fire Fighting & Fire Suppression System

Design and prepare working drawings for internal and external fire protection and suppression system including hydrant, sprinkler system, CO^2 flooding system, pressurization system, fire extinguisher system, UG tanks, fire pump rooms etc. in line with the statutory requirements.
Size all equipment required and prepares detailed specifications.
Obtain necessary license/permissions from the statutory/local fire authority /bodies etc. as required.
Check and approve detailed drawings and data sheet of suppliers/ manufacturers and incorporation of modification of any working /architectural /structural drawings.

3.9.2.6 DG sets.

3.10.0 PUBLIC HEALTH ENGINEERING

3.10.1 All the design and drawings should be well coordinated with Architecture, structure and other services drawings.

3.10.2 All designs shall be as per the latest Indian Standards, Local bye-laws and Statutory norms/regulation.

3.10.3 Design of Public Health & Engineering services taking into account various topographical, meteorological, Hydrological etc. reports, identify the source and quality of water, conduct survey of existing water supply system, Sewerage system, Drainage system, Fire-fighting system, other site development works etc. for planning of services.

3.10.4 The services shall include following major components:

Water Supply System including underground water tanks and pumps.
Sewerage System including sewerage treatment plant.
Drainage System i/c water harvesting, absorption trenches etc.
Fire Fighting & Fire Suppression System with peripheral grid around each building connected with fire main grid.

Dual plumbing system i/c water supply system from STP for horticultural operations, flushings, HVAC etc;
Solid waste management.

3.11.0 Services

3.11.1 Water Supply System

Calculation of water requirements for residential, non-residential and other services.

Design and prepare working drawings of internal and external dual water supply system including Underground tank, Overhead tank, Water treatment plant, Pumping stations, rising mains, distribution system and internal plumbing, recycling of treated waste water etc.

Untreated water supply system for horticultural works i/c design of sprinkler and drip irrigation system. If necessary the supply to be augmented.

SPECIAL CONDITIONS FOR CEMENT AND STEEL

CONDITIONS FOR CEMENT

a) Cement required for the work shall be procured by the contractor.

b) The contractor shall procure PPC conforming to IS: 1489 (Part-I) / OPC conforming to IS:8112 as per List of Preferred Makes for Civil Works.

c) The supply of cement shall be taken in 50 kg bags / or in bulk for storage in cement silos for batching plant bearing manufacturer's name and ISI marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-inCharge to do so. Supply of cement shall be taken in 50 kg bags bearing manufacturer's name, or his registered trade marks if any and grade and type of cement as well as ISI marking. The packing of the cement bags shall be as per CPWD specifications 2019 with correction slips upto last date of submission of bid.

d) The cement shall be brought at site in bulk supply of approximately 50 tonnes or more as decided by the Engineer-in- Charge.

e) The 2 nos. cement godowns, each of the capacity to store a minimum of 5000 bags of cement shall be constructed by the contractor at site of batching plant for which no extra payment shall be made. In addition 2 nos. cement godown of required capacity (minimum 2000 bags) has to be constructed at site to take care of day to day requirement.

f) Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the keys of the other lock shall remain with the contractor. The contractor shall be responsible for the watch and ward and safety of the cement go down. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at anytime.

g) The cement shall be got tested by the Engineer-in-Charge and shall be used on the work only after satisfactory test results have been received. The contractor shall supply free of cost the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the contractor.

h) The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 38 of the General Condition of Contract 2019 for EPC projects and shall be governed by conditions laid there in. In case the cement consumption is less than theoretical consumption including permissible variation, work shall liable to be rejected. In case of excess consumption no adjustment need to made.

i) The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in-Charge.

j) The damaged cement shall be removed from the site immediately by the contractor on receipt of a notice in writing from the Engineer-in-Charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in-Charge shall get it removed at the cost of the contractor.

k) In case cement is brought at site/cement store in a lot of lesser quantity of 50 MT, testing charges shall be borne by the contractor even if cement passes in test results.

CONDITIONS FOR STEEL REINFORCEMENT

1. The contractor shall procure ISI marked TMT Bars of Fe 500D grade from the steel manufacturer such as SAIL, TISCON, RINL, Jindal Steel & Power Ltd. and JSW Steel Ltd. or their authorized dealer having valid BIS License for IS 1786-2008 (Amended – November 2012). If TMT bars of any dia of above mentioned make is not available in market at any time then the contractor on producing non availability certificate from the manufacturers may procured TMT bars of that dia from Steel manufacture as per the following guidelines:

   Credentials for eligibility criteria & other technical parameters for steel manufacturer:

   The manufacturer should meet the following eligibility criteria:

   a) The Steel manufacture should have following documentary evidence:
      i. Certificate of incorporation
      ii. Memorandum of articles of Association
      iii. Credit rating of the company from CARE/CRISIL/ICRA (the grading should not be C/D grade for minimum last 3 years)
   b) The Steel manufacturer must have following licenses and certificates:
      i. ISI certificate for billets (IS 2830:2012)
      ii. ISI certificate for TMT Bars (IS 1786:2008 (Amendment -1 November 2012)
   c) The Steel manufacturer should also preferably have the following licenses:
      i. ISO 9001:2015
      ii. ISO 14001:2015
      iii. OHSAS 18001:2007
   d) The steel manufacturer should be using iron ore as the basic raw material. The entire gamut of iron and steel production is owned by the same company or oits subsidiary company (ies) and the iron making capacity is sufficient matching the steel making capacity, adopting any of the refining technologies for manufacturing steel & TMT Bars as given under are eligible: i. BF-BOF route
      ii. COREX-BOF Route
      iii. DRI-EAF Route (Each Electric Arc Furnace should be 100 MT or more)
   e) Billets produced must be ISI marked (IS 2830:2012)
   f) The TMT bars produced must be ISI marked (IS 1786:2008)
   g) The steel manufacturer should have the following in house testing facilities (NABL Accredited):

i. Computerized Universal Testing Machine
ii. Spectrometer
iii. Bend Re-bend facility as per IS : 1786:2008 (Amendment-1 November 2012)
iv. Raw material laboratory: Arrangement for testing Carbon, Sulphur & Phosphorous etc.
v. Other testing facilities as specified in IS : 1786:2008 & IS : 2830:2012

2. Samples shall also be taken and got tested by the Engineer-in-Charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time or written orders from the Engineerin-Charge to do so.

3. The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, or as decided by the Engineer-in-Charge.

4. The steel reinforcement bars shall be stored by the contractor at site of work in such away as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

5. For checking nominal mass, tensile strength, bend test & re-bend test etc. specimen of sufficient length shall be cut from each size of the bar at random at frequency not less than the specified below:

Size of bar	For consignment below 100 tones	For consignment above 100 tonnes
Under 10 mm dia bars	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes or part thereof
10mm to 16mm dia bars	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16mm dia bars	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

6. The contractor shall supply free of charge the required steel bars for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor.

7. The actual issue and consumption of steel on work shall be regulated and proper accounts maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in clause 38 of the contract and shall be governed by conditions laid therein. In case the consumption is less then theoretical consumption including permissible variations leading to under designing of the structure, the work shall be summarily rejected, otherwise recovery at rate so prescribed shall be made

after ensuring structural soundness and stability. In case of excess consumption no adjustment need to be made.

8. Steel brought to site and remaining unused shall not be removed from site without the written permission of Engineer- in-Charge.

9. The standard sectional weights referred to shall be as given in Table 5.4 in para 5.3.4 in CPWD Specification 2019 Vol.-I and will be considered for conversion of length of various sizes of TMT Bars in to standard weight. Record of actual sectional weights shall also be kept dia. And lot wise. The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The decision of the Engineer-in-Charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute one single lot for the purpose. The weight of steel by conversion of length of various sizes of bars based on the actual weighted average sectional weight shall be terms as Derived Actual Weight.

a) If the derived weight is less than the standard weight, then the Derived Actual Weight shall be accepted if it is within the following tolerances specified in IS:1786-2008, otherwise whole lot will be rejected. However, deductions shall be made for the difference in derived actual weight and standard weight at the rate mentioned in clause 10CA for TMT-500D reinforcement bars.

Tolerances on Nominal Mass

Nominal Size in mm	Tolerance on Nominal mass Percent			
	Batch		Individual Sample*	Individual sample for coil**
a) Upto and including10	±7	-8	±8	
b) Over 10 upto and i/c 16	±5	-6	±6	
c) Over 16	±3	-4	±4	

* For individual sample plus tolerance is not specified.

**For coils batch tolerance is not specified.

b) If the derived actual weight is found more than the standard weight, then nothing shall be paid extra for the difference in derived actual weight and standard weight.

12. The contractor shall submit original vouchers from the manufacturer for the total quantity of steel supplied under each consignment to be used in the work. All consignment received at the work site shall be inspected by the Site staff along with the relevant documents before acceptance. The contractor shall obtain Original Vouchers and Test Certificates and furnish the same to the Engineerin-Charge in respect of all the lots of steel brought by him from approved supplier to the site of work. The original vouchers and test certificates shall be defaced by the Site staff and kept on record in the site office.

General Specification:

1. Earth Work in excavation, filling, banking, disposal of surplus earth etc shall be applicable for all leads and lifts. It also includes carrying out work in or under water or liquid mud, or in foul conditions, pumping out, including bailing out water as per specification. The surplus excavated earth (which is not required at site either for filling or raising the ground to achieve desired formation level as per architectural drawings) shall be disposed of inside the campus as per direction of Engineer-inCharge. Nothing extra shall be paid on these accounts. No extra payment for double handling of earth will be made.

2. Temporary barricading: Contractor shall provide and erect 6 metre high temporary barricading to separate construction site from the running campus of IIT. He shall use pre-coated galvanized iron profile sheets of minimum thickness 0.50 mm with adequate frame work. The work shall be executed as per approved drawing and direction of Engineer-in-Charge which includes writing and painting, arrangement for traffic diversion such as traffic signals during construction at site for day and night, glow lamps, reflective signs, marking, flags, and caution tape.

   The barricading shall be retained in position at site continuously i/c shifting of barricading from one location to another location as many times as required during the execution of the entire work till its completion. The barricading shall not be removed without prior approval of Engineer-in-Charge.

3. The embankment and subgrade shall be compacted to satisfy the minimum compaction requirements. For embankment work relative compaction shall not be less than 95% of maximum laboratory dry density conducted as per IS:2720 (Part 8) and for subgrade & earthen shoulders work relative compaction should not be less than 97% of maximum laboratory dry density. Side slopes shall not be steeper than 2H: 1V unless soil is retained by suitable soil retaining structures.

4. Anti termite treatment works to be done by diluting and injecting chemical emulsion for Pre Constructional antitermite treatment and creating a chemical barrier under and all round the column pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall and floor, along the external perimeter of building, expansion joints, surrounding of pipes and conduits etc. (excluding the cost of chemical emulsion) (Note-for payment purpose only plinth Area to be measured).

5. All buildings shall be earthquake resistant, RCC framed structure with suitable foundation system as per the detailed soil investigation report and design. RCC structures shall be designed conforming to latest amendments of IS: 875, IS: 456, IS: 1893, IS: 13920, SP 34 and other relevant IS Code Provision and standard sound Engineering practices. However, foundation for all those buildings having Ground / Stilt / Basement + 4 storied shall be either raft foundation or pile foundation. The grade of RCC design mix shall be minimum

M25 and TMT reinforcement bars shall be Fe-500D or more to be used. For all water retaining structures and shear walls for development of buildings, the grade of RCC design mix shall be minimum M30.

6. Providing and fixing parallel threaded couplers conforming to IS code for bar dia 16 mm and above on "Reinforcement Couplers for Mechanical Splices of Bars for Concrete Reinforcement - Specification", to reinforcement bars including threading, enlargement at connection by forging, protecting the prepared reinforcement bars and related operations as required to complete the works per direction of Engineer-in-Charge. (The length of the bars in which coupler is to be provided should not be less than 4 metre, no deduction for labour and binding wire saved for not providing lap length shall be made)

7. (i) Providing and fixing floor, wall and roof joint gap with expansion joint system as per DSR 2021

(ii) Waffle slab/ coffered slab centering shall be with form finished shuttering / FRP shuttering to get the required finish.

(iii) GI coated metal sleeves of required dia. shall be provided in RCC shear walls/ beams in all floors as shown in drawings for taking service lines.

8. All super structure external and internal walls shall be 230 mm thick FPS Fly ash bricks (non modular) of class designation 7.5 except wet area.

9. Brick work with burnt clay F.P.S. (non modular) of class designation 7.5 shall be done in foundation, parapet walls of the buildings and wet areas with cement mortar.

10. 230 mm thick burnt clay brick masonry shall be done in cement mortar 1:6 (1 cement : 6 coarse sand) and half brick masonry shall be done in cement mortar 1:4 (1 cement : 4 coarse sand).

11. All outer peripheral walls shall start from top of foundation / ground level to plinth beam. Filler walls shall be provided on both sides of expansion joints.

12. Restroom cubicles shall be enclosed or corner unit type of Classique Invincible (Greenlam Sturdo) or equivalent. It shall be 18 mm thick high density board with decorative compact laminate of required colour, shade and size including stainless steel accessories (SS-316 grade) like square top rail. Front panel and divider wall with stipe shoe touching floor (No gap shall be at bottom of divider/front panel except door), knob, thumb turn and indicator, twin coat hook, door stopper, adjustable shoe, gravity hinges, locking arrangement and SS channel etc. all complete as per drawing/ direction of Engineer- in Charge.

13. All sections for aluminium doors / windows including frames shall be polyester powder coated aluminium (minimum thickness of polyester powder coating 50 micron). Single

and double rebate section aluminium door frame shall have minimum weight 1.110 kg/m and 1.800 kg/m respectively. Kiln seasoned hard wood shall be filled inside door frames on hinged side and top of frames wherever hydraulic door closers are to be provided. Frames shall be fixed with dash fastener of minimum size 10 x 100 mm as per approved shop drawings. Other sections of aluminium doors shall have minimum thickness 2.50 mm.

Gap between aluminium frame / uPVC window and adjacent RCC / masonry work shall be filled by providing weather silicon sealant over backer rod of approved quality as per direction of Engineerin-Charge.

14. Wherever mild steel / galvanized iron sections and pipes are provided in the work, priming coat of approved steel primer shall be done after removing rust from section if any and finally finished with low VOC synthetic enamel paint or as mentioned specifically in specification.

15. Monkey ladder shall be provided for over head water tanks, mumty and lift machine room doors with frame and steps of 40x40x6 mm angle iron, etc.

16. MS Structural steel support framing for stone cladding / GRC Screen works with priming coat of zinc primer and painted with two or more coats of epoxy paint as per drawing, specifications and direction by Engineer-in-Charge.

17. Corrosion resistant high grade AISI 316 stainless steel railing shall be used in the work. Railings shall be provided on both sides in staircase and ramps with double handrail for barrier free accessibility requirements. Top / side mounted square baluster with horizontal members with knock down fixing system shall be used in railing. Wall mounted handrail (knock down fixing system) may be used as per site condition / architectural requirement. Pipe dia for handrail shall not be less than 40 mm. Modular handrail and baluster system includes all type of fittings and accessories like starting pipe, end cap, connectors, different type of bends, top brackets, wall mounted brackets / flange / cover cap for hand rails; baluster base and base cover cap; end cap and bends for horizontal members.

18. Knock down stainless steel railing shall also be provided in balconies, parapets and similar location as per approved architectural drawings. Top of railings at these locations shall not be less than 1200 mm.
19. Sliding door bolts of size 300 x 16 and 250 x 16 mm shall be provided wherever required in all double leaf shutter and single leaf shutter (except WC/bath door shutters) respectively. In WC and bath door shutters, sliding door bolts of size 200 x 16 mm shall be provided.

20. Wall mounted door stoppers shall be provided to protect the wall where the door handle would run into it. Wooden moulded beading of size 48 x10 mm shall be provided on all wooden door frames.

21. Three point panic touch bar with trim and 2 nos. door closers shall be provided in all double leaf fire door shutters except in AHU and electric Rooms. In AHU and electric rooms, sliding door bolts, handles 25 mm dia x 300 c/c with rose and flush bolt 300 mm shall be provided.

22. Acoustic insulation shall be done on walls (full height) in all AHU rooms. Acoustic shall be designed by taking into consideration RT 60 less than 0.5 sec., STI greater than 0.55 and NRC value greater than 80.

23. U Baffle aluminium panel ceiling in required colour and shade shall be provided as mentioned in schedule of finishes of buildings and as per approved architectural drawings. It consists of panel size 50 mm wide x 140 mm deep x 0.7 mm thick, panel length minimum 4 metre and maximum upto 6 metre. Panels shall be clipped to a baked enameled steel carrier 30 mm wide x 47 mm high x 0.5 thick, one leg of the carriers with cut outs to hold the panels in a module 150 mm and baffle can be connected with the help of aluminium splice. Panel carrier shall be suspended by means of 6mm dia threaded rod at a distance of 1.20 metre centre to centre.

24. False ceiling hanging support should not be taken from ceiling and alternative secondary system of support to be design while taking support from beam.

25. Granite / Kota stone in flooring, counters, sills etc. shall be laid over 20mm (average) thick base of cement mortar 1:4 (1 cement:4 coarse sand) and jointed with cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc complete as per approved architectural drawings. Granite stone / Digital ceramic glazed wall tiles in wall lining, dado, risers, skirting, water tank etc. shall be laid on 12 mm (average) thick cement mortar 1:3 (1 cement:3 coarse sand) and jointed with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing etc complete as per approved architectural drawings. Polished / flamed granite stone slab shall be Jet Black, Cherry Red, Elite Brown, Cat Eye or equivalent as per direction of Engineer-in-Charge.

26. All type of granite stone shall be 18 mm thick. All flamed granite stone flooring shall be leather finish.

27. Vitrified tiles in floor shall be laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS:15477, in average 6 mm thickness and with spacers having joint of 3 mm width (minimum). Grouting of joints shall be done by using

epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg) and finishing complete as per direction of Engineer-in-Charge.

28. In toilet mat finishing vitrified tile shall be laid on 20 mm thick cement mortar 1:4 (1 cement:4 coarse sand), jointing with grey cement slurry @ 3.3 kg per sqm including grouting the joints with white cement and matching pigments.

29. Wherever specification of floorings in rooms are not mentioned specifically it shall be considered as double charged vitrified tiles 600x600mm. And in other areas wherever specification of floorings are not mentioned it shall be considered as 18mm thick granite flooring.

30. All the Rain Water Pipes and balconies drainage pipes shall be 100 mm dia (minimum) Hubless centrifugally cast (spun) iron pipes epoxy coated i/c all type of fittings shall be provided and the same is to be fitted in suitable MS frame bracket to avoid dirct contact with wall suface atleast by 75 mm from wall surface. For 50 sqm roof top area minimum one rain water pipe shall be provided. Balconies drainage shall not be connected to terrace rain water pipe sand separate pipes for balconies drainage shall be provided as per direction of Engineer-in-Charge.

31. 12/15 mm cement plaster shall be done in cement mortar 1:6 (1 cement : 6 fine sand) and 6 mm cement plaster shall be done in cement mortar 1:3 (1 cement : 3 fine sand). Wherever a floating coat of neat cement on plaster is required, cement plaster shall be done in cement mortar 1:4 (1 cement: 4 coarse sand). Thickness of gypsum plaster shall be 10-12 mm.

32. Approximately 20% water closets shall be provided Indian type in Hostel. In each Type-IV S quarters, one Indian type WC shall be provided.

33. Wash basin counter shall be finished with 18mm thick granite on top and facia of RCC slab. 600 mm wide looking mirror shall be provided in full length equal to wash basin counter over marine plywood IS-710 of approved design in non-residential buildings.

34. For disable toilet: L shaped S.S 304 grab bar of size 700 x 700 mm (Right Hand/Left Hand version) dia 30 mm for W.C. U shaped movable S.S 304 grab bar of length 600mm and 38 mm dia for wash basin. S.S. 304 Support bar of length 600 mm and 38 mm dia. In toilets.

35. All quarter turn C.P. brass fittings, single lever divertor, single lever basin / sink mixers shall be of Vignette Prime Series (Jaquar) or equivalent and bath accessories (towel rail, square towel ring, soap dish holder, toilet roll holder, double coat hook) shall be of Kubix Prime Series (Jaquar) or equivalent. Bottle Trap and Health Faucet shall be of Jaquar Cat. No. ALD-769L300x190 and ALD579 or equivalent respectively. Overhead Shower shall be 150x150mm square shape single flow with rubit cleaning system of Jaquar (Cat No. OHS-35495) or equivalent. For geysers connection pipes shall be 450 mm long braided hose

with two 15 mm nuts and rubber washers without nipple (Jaquar model ALD-805B or equivalent).

36. Approved model of sanitary fittings:

I. Vitreous China Rimless wall-hung WC with soft close seat & cover, with or without cistern as per architectural drawings. shall be of approved make and model By WAPCOS/IIT (ISM) Dhanbad .

II. White vitreous china urinals with pressmatic system operated urinals shall be of make and model By WAPCOS/IIT (ISM) Dhanbad .

III. Under counter oval shape wash basins of approximate size 560 x 420 mm of make and model By WAPCOS/IIT (ISM) Dhanbad .

IV. Under counter rectangular shape wash basins of approximate size 595 x 400 x 195 mm of make and model By WAPCOS/IIT (ISM) Dhanbad.

37. Cement concrete interlocking paver blocks means factory made 80 mm thick chamfered edge cement concrete paver blocks of M-30 grade. It shall be laid in required size, shape, colour, design and pattern over 50mm thick compacted bed of sand by using plate vibrator, filling the joints with sand and cutting of paver blocks as per required size and pattern and sweeping extra sand complete. C.C. paver block shall be made by table vibratory method using PU mould.

38. Precast RCC Rectangular Covers shall be 100 mm thick factory made machine batched & machine mixed of M-25 grade. Reinforcement of 10 mm dia TMT bars of Fe 500 D grade @ maximum 100mm c/c shall be provided on both ways in precast RCC covers. Precast RCC covers shall be finished with neat cement punning on top surface, properly encased on all edges with 1.6 mm thick
and 100 mm wide MS sheet duly painted over priming coat, reinforcement to be welded at edges with MS sheet and making holes of 25 mm @ 24 holes per sqm.

39. All kerb stone shall be factory made in M 35 grade cement concrete. It shall be laid in position to the required line, level and curvature, jointed with cement mortar 1:3 (1 cement: 3 coarse sand), including making joints with or without grooves (thickness of joints except at sharp curve shall not be more than 5mm), including making drainage opening wherever required as per direction of Engineer-in-Charge. Precast kerb stone shall be rounded on top of size 300 to 600 mm (L) x 350 mm (H) x 150 mm.

40. Lift well water proofing shall be done with integral cement based treatment on horizontal and vertical surfaces at all depth below ground level as per DSR-2021 item no. 22.1 & 22.2 respectively.

41. Suitable provision shall be made for installing Split AC's in AAC block masonry in each room of residential quarters including 50 mm PVC pipe sleeves at suitable place in walls.

42. 12 mm cement plaster finished with a floating coat of need cement of mix 1:4 (1 cement:4 coarse sand) shall be done after applying crystalline slurry coating on vertical and horizontal surfaces in sunken portion and retaining walls which are part of the building.

43. Roller blinds shall be provided in Engineering Block, Lecture theatre complex and Workshop (except workshop halls). Translucent fabric roller blinds shall be provided in offices, faculty rooms and at other rooms/halls blackout fabric roller blinds.

44. For solar panels load 50 kg/sqm shall be taken for load calculation besides other imposed and dead loads on terrace.

45. Modular Kitchen cabinets and drawers shall be provided complete in all respect i.e. baskets, trolley, bottle rack etc. including hinges, channels, handles etc. as per architectural drawings/ direction of Engineer-in-Charge in Residential Units.

46. Supplying and fixing rolling shutters of approved make, made of required size M.S. laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters. 80x1.25 mm M.S. laths with 1.25 mm thick top cover including providing and fixing ball bearing for rolling shutters.

47. 62 mm thick cement concrete flooring with concrete hardener topping under layer 50 mm thick cement concrete 1:2:4 (1 Cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) and top layer 12 mm thick Hardcrete cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone
aggregate 6mm nominal size) by volume hardening compound is mixed @ 2 litre per 50 kg of cement or as per manufacturers specificationss. This includeds cost of cement slurry, glass strips etc.complete. the work should be executed by strictly following the CPWD specification.

PARTICULAR SPECIFICATIONS

1.0 EARTHWORK:

1.1 The work shall be done in accordance with CPWD Specifications – 2019 – Volume-I & II and National Building Code 2016 with upto date correction slips upto last date of submission of bids.

1.2 Excavation shall be undertaken to the width of the Basement / Retaining wall footing including necessary margins for construction operation as per drawing or directed otherwise. Where the nature of soil or the depth of the trench and season of the year, do not permit vertical sides, the contractor at his own expense shall put up the necessary shoring, strutting and planking or cut slopes with or without steps, to a safer angle or both with due regard to the safety of personnel and works and to the satisfaction of the Engineer-in-Charge.

1.3 The contractor shall make at his own cost all necessary arrangements for maintaining water level, in the area where works are under execution low enough so as not to cause any harm to the works or problems in carrying out with the execution and the rates of work shall be considered as inclusive of pumping out or bailing out water, if required, for which no extra payment shall be made. This will include water coming from any source, such as rains, accumulated rain water, floods, leakages from sewer and water mains, subsoil water table being high or due to any other cause whatsoever. The contractor shall make necessary provision of pumping, dredging, and bailing out water coming from all above sources and excavation and other works shall be kept free of water by providing suitable system approved by the Engineerin-Charge.

1.4 Natural ground water table is very deep. However, the water level may rise in localized pockets due to rainy season or due to water currents under sub-soil being a hilly area. In order to avoid possibility of basement floor / lower floors of building being getting uplifted/damaged due to water pressure, the contractor shall make arrangement for lowering the ground water table below the proposed foundation level as approved by Engineer-in-Charge. Sub-soil water table shall be maintained at least 50 cm below the P.C.C. level during laying of P.C.C., water proofing treatment, laying of basement raft and beams including filling of earth/sand under the basement floor. The water table shall not be allowed to rise above base of raft level until completion of outer retaining walls including water proofing of vertical surface of walls and back filling along the walls up to ground level and until the structure attains such height to counter balance the uplift pressure. However, the contractor should inspect the site and make his own assessment about sub-soil water level likely to be encountered at the time of execution and quote his rates accordingly. Rate of all items are inclusive of pumping out or bailing out water, if required. Nothing extra on this account whatsoever shall be paid to him unless otherwise specified. The sequence of construction shall be got approved by the Engineer-in-Charge.

1.5 All the major excavation shall be carried out by mechanical excavator. No extra payment shall be made for that.

1.6 The rates are inclusive for all depths & nothing extra shall be paid for additional lift etc.

1.7 The soil under the area has a tendency to slide, if deep cuts are made in rainy season. Additional precautions are required if cutting of soil is being done specially during rainy season. No extra time or hindrance of any kind is permissible on this account.

1.8 The surplus excavated earth (which is not required at site either for filling or raising the ground to achieve desired formation level as per approved architectural drawings) shall be disposed of inside the campus as per direction of Engineer-in-Charge and nothing extra shall be paid on this account.

2.0 CEMENT CONCRETE

The work shall be done in general as per CPWD Specifications 2019, Volume-I & II with date correction slip issued upto last date of submission of bid.

3.0 R.C.C./C.C WORK (DESIGN MIX CONCRETE):

3.1 The RCC work shall be done with Design Mix Concrete. Wherever letter M has been indicated, the same shall imply for the Design Mix Concrete. The Design Mix Concrete will be designated based on the principles given in the latest IS: 456, 10262 & SP 23. The condition and specifications stated herein shall have precedence overall conditions and specifications stated in relevant I.S. codes/CPWD specifications. The concrete mix shall be designed for specified target mean compressive strength in order to ensure that the work test results do not fall below the acceptance criteria specified for the concrete mix. The Contractor shall design mixes for each class of concrete indicating that the concrete ingredients and proportions will result in concrete mix meeting requirements specified. The mix shall be designed with quantities of admixture / plasticizer proposed to achieve required workability & strength. The specifications mentioned here in below shall be followed for Design Mix Concrete.

The sources of coarse aggregate, fine aggregate & water to be used in concrete work shall be identified by the contractor & he will satisfy himself regarding their conforming to the relevant specification & their availability before getting the same approved by the Engineer-in-Charge.

3.2 Coarse Aggregate: As per CPWD Specifications 2019 – Volume-I & II with upto date correction slips upto last date of submission of bids.

3.3 Fine Aggregate: As per CPWD Specifications 2019 – Volume I & Vol. II with upto date correction slips upto last date of submission of bids.

3.4 Water: It shall confirm to requirements laid down in IS:456-2000 / CPWD Specifications 2019 – Volume I & Vol. II with upto date correction slips upto last date of submission of bids.

3.5 Cement: PPC shall be used for design mix concrete and shall conform to IS-1489 (Part I). However, if OPC / higher grade of cement is used by the contractor nothing extra shall be paid on this account.

3.6 Admixtures / Plasticizers: - The admixture shall confirm to IS: 9103, wherein required, the admixture of approved quality and approved make only shall be used to attain the required workability. Nothing extra shall be paid for use of admixtures.

3.8 Grade of Concrete: The compressive strength of various grades of concrete shall be given as below

Grade Designation	Compressive strength on 15 cm cubes minimum 7 days (N/mm^2)	Specified Characteristic Compressive Strength at 28 days (N/mm^2)	Maximum Water Cement Ratio	Minimum Cement to be used in (kg per cum)
M-10	As per design	10	0.50	220
M-15	As per design	15	0.50	240
M-20	As per design	20	0.50	300
M-25	As per design	25	0.50	330
M-30	As per design	30	0.45	340
M-35	As per design	35	0.45	350
M-40	As per design	40	0.45	360
M-50	As per design	50	0.40	380

NOTE: In the designation of a concrete mix letter M refers to the mix and the number of the specified characteristic compressive strength of 15 cm – cube at 28 days expressed in N/mm^2.

3.9 The contractor shall engage one of the following approved laboratories/ test house at their own expenses for designing the concrete mix in accordance with relevant IS Codes and to conduct laboratory test to ensure the target strength and workability criteria for a given grade of concrete.

a) IIT Kharagpur
b) IIT Patna
c) IIT BHU
d) IIT Delhi

e) IIT Kanpur

f) NIT Jamshedpur

g) NIT Durgapur

3.10 The various ingredients for mix design / laboratory tests shall be sent to the lab / test houses through the Engineer-in-Charge and the samples of such aggregates sent shall be preserved at site.

3.11 The contractor shall submit the report on design mix from any of above approved laboratories for approval of Engineer-in-Charge within 30 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the design mix is approved.

3.12 In case of change of source or characteristic properties of the ingredients used in the concrete mix during the work, a revised laboratory mix design report conducted at laboratory established at site shall be submitted by the contractor as per the direction of the Engineer-in-Charge.

3.13 Trial Batches

3.13.1 The designed mix proportion shall be checked for target mean compressive strength by means of trial batches.

3.13.2 The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability tests.

3.13.3 The workability of Trial Mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required changes in the workability.

3.13.4 With the modified water content, the mix pro-portions shall be recalculated by keeping with water cement ratio unchanged. The mix proportions, as modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

3.13.5 In addition, Trial Mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio $\pm$ 10 percent of the specified value and tested for their design characteristics.

3.14 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the contractor including redesigning of the concrete mix wherever required and directed by Engineer-in-Charge.

3.15 APPROVAL OF DESIGN MIX:

The mix design for a specified grade of concrete shall be done for a target mean compressive strength $T_{ck} = F_{ck} + 1.65\ S$ or $F_{ck} + X$, whichever is higher

Where,

F_{ck} = Characteristic compressive strength at 28 days.

S = Standard deviation which depends on degree of quality control.

X = factor based on the grade of concrete, as per Table 1(IS:10262-2019

The degree of quality control for this work is "good" for which the standard deviation (s) obtained for different grades of concrete shall be as follows:

GRADE OF CONCRETE	STANDARD DEVIATION(S)
M-10	3.5
M-15	3.5
M-20	4.0
M-25	4.0
M-30	5.0
M-35	5.0
M-40	5.0
M-50	5.0

Minimum three sets of seprate preliminary test shall be carried out for each trial batch of concrete mix. Each test shall comprise six specimens and only one test set of six specimens shall be made on any particular day. Out of the six specimen of each set, three shall be tested at seven days and remaining three at 28 days. The preliminary tests at seven days are intended only to indicate the strength to be attained at 28 days. While the design mix shall be approved only on the basis of test strength of 28 days. The design mix shall be considered satisfactory and approval if at least three preliminary test- sets individually satisfy the following strength and workability criteria.

a) The average strength of each test sets is not less than the specified target means compressive strength (TCK).

b) The strength of any specimen cube is not less than $0.85T_{ck}$.

c) The concrete mix is required degree of workability and acceptance concrete finish.

3.16 All cost of mix designing and testing connected therewith including charges payable to the laboratory shall be borne by the Contractor.

3.17 WORK STRENGTH TEST:

Test Specimen

Work strength test shall be conducted in accordance with IS:516 on random sampling. Each test shall be conducted on six specimens, three of which shall be tested at 7 days and remaining three at 28days.

Test Result of Samples

The test results of the sample shall be the average of the strength of three specimens. The individual variation shall not be more than + 15% percent of the average. If variation is more, the test results shall be treated as invalid. 90% of the total tests shall be done at the laboratory established at site by the contractor and remaining 10% in any laboratory mentioned in para 3.9above.

Frequency of Tests

The minimum frequency of sampling of concrete of each grade shall be one sample for every 50 cum or part thereof. At least one sample shall be taken from each shift.

3.18 STANDARD OF ACCEPTANCE:

i) In case the test results of all the samples are above the characteristic compressive strength, the concrete shall be accepted.

ii) In case the test result of one or more samples fails to meet the requirement (i) above, it shall be accepted if both the following conditions are met:
   a) Any individual test result is not less than(F_{ck}-S)N/mm^2.
   b) The mean of test results from any group of four consecutive samples is more than
   (F_{ck}+S)N/mm^2.

iii) Concrete of each grade shall be assessed separately.

iv) Concrete is liable to be rejected, if it is porous or honeycombed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met.

3.19 For cast-in-situ (if required), the contractor has to arrange at site centering and shuttering as given in Proforma of Schedule before one month from stipulated date of start of work. Only M.S. centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor as approved by the Engineer-in-Charge. No extra payment shall be made on any of these grounds

3.20 In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of

R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.

3.21 As per general engineering practice, level of floors in toilet / bath, balconies, corridors shall be kept 15 mm lower than corridor/ adjacent rooms/ general floors and shuttering should be adjusted accordingly and slabs should be laid with slope towards the drainage point. Nothing extra is payable on this account.

3.22 Production of Concrete

All concrete shall be produced using minimum 2 nos. fully automatic weigh-batching plant of suitable capacity (not less than 30 cum/hr.) conforming to IS:4925 with the arrangements for automatic dispensing of admixture and having facility of giving print out indicating weight / details of all ingredient of concrete in each lot/ batch and variations from the approved design mix if any.

The batching and mixing plants shall be dedicated plants for this project. Contractor shall make his own arrangements for the necessary infrastructure for installation of batching plant and other machineries.

Automatic batcher shall be charged by devices which when actuated by a single starter switch will automatically start the weighing operation of each material and stop automatically when the designated weight of each material is fed in the mixer. The batching plant shall have automatic arrangement for dispensing the admixture and shall be capable of discharging water in more than one stage.

A batching plant essentially shall consist of the following components:

- Separate storage bins for different sizes of aggregates, silo for cement, water storage tank.
- Batching equipment
- Mixers
- Control Panels
- Mechanical material feeding and elevating arrangements

The compartments of storage bins for aggregates shall be approximately of equal size. The cement compartment shall be centrally located in the batching plant. It shall be water tight and provided with necessary air vent, aeration fittings for proper flow of cement & emergency cut off gate. The aggregate and sand shall be charged by power operated centrally revolving chute. The entire plant from mixer floor upward shall be enclosed and insulated. The batch bins shall be constructed so as to be self-cleansing during draw-down. The batch bins shall in general conform to the requirements of IS:4925.

The batching equipment shall be capable of determining and controlling the prescribed amounts of various constituent materials for concrete accurately i.e. water, cement, sand, individual size of coarse aggregates etc. The accuracy of measuring devices shall fall within the following limits.

Measurement of Cement:	± 2% of the quantity of cement in each batch
Measurement of Water:	± 3% of the quantity of water in each batch
Measurement of Aggregate:	± 3% of the quantity of aggregate in each batch
Measurement of Admixture:	± 3% of the quantity of admixture in each batch

The batching and mixing plant shall have the provision of adjusting the plus / minus quantity of various ingredients in the next batch so that there is no variation in quantity of ingredients from design mix in a lot consisting of 5 to 6batches.

The mixer in the batching plant shall be so arranged that mixing action in the mixer can be observed from the operator's station. The mixer shall be equipped with a mechanically or electrically operated timing, signaling and metering device which will indicate and assure completion of the required mixing period. The mixer shall have all other components as specified in IS: 4925.

Land for Temporary Use

The land for labour camps and batching plant shall be arranged by the contractor outside IIT campus. The lease/rent charges shall be borne by the contractor. The Engineer-in-Charge shall extend necessary help and issue necessary recommendations etc. to the concerned department for temporary allotment of land during construction period.

3.23 TRANSPORTATION, PLACING AND COMPACTION OFCONCRETE

a. Mixed concrete from the batching plant shall be transported to the point of placement by transit mixers and placed in position through concrete pumps and/or steel closed bottom buckets capable of carrying minimum 0.6 cum concrete. In case the concrete is proposed to be transported by transit mixer, the mixing speed shall not be less than 4rev/min. of the drum nor greater than a speed resulting in a peripheral velocity of the drum 70 m/minutes at its largest diameter. The agitating speed of the agitator shall be not less than 2 rev/min nor more than 6 rev/min of the drum. The number of revolution of the mixing drum or blades at mixing speed shall be between 70 to 100 revolutions for a uniform mix, after all ingredients, have been charged

into the drum. Unless tempering water is added, all rotation after 100 revolutions shall be at agitating speed of 2 to 6 rev/min and the number of such rotations shall not exceed 250. The general construction of transit mixer and other requirement shall conform to IS: 5892.

b. In case concrete is to be transported by pumping, the conduit shall be primed by pumping a batch of mortar through the line to lubricate it. Once the pumping is started, it shall not be interrupted (if at all possible) as concrete standing idle in the line is liable to cause a plug. The operator shall ensure that some concrete is always there in the pump receiving hopper during operation. The lines shall always be maintained clean and shall be free of dents at all stages. Special precaution shall be taken that surrounding temperature during concreting shall not exceed 30 degree centigrade.

c. Except where otherwise agreed to by the Engineer-in-Charge, concrete shall be deposited in horizontal layers to a compacted depth of not more than 450 mm. Unless agreed to by the Engineer- in-Charge, concrete shall not be dropped into place from a height exceeding 1.5metre. In order to avoid such situations chutes, tremie pipe or closed bottom buckets shall be used. These shall be kept clean and used in such a way as to avoid segregation. Slope of the chute shall be so adjusted that concrete flows without the use of excessive quantity of water. The delivery end of chute shall be as close as possible to the point of deposit. The chute shall be thoroughly flushed with water before and after each working period and the water used for this purpose shall be discharged outside the form work. The concrete shall be compacted by using immersion type vibrators. When the concrete is being continuously deposited to a uniform depth along a member, vibrator shall not be operated within one meter of free end of the advancing concrete. Every effort shall be made to keep the surface of the previously placed layer of concrete alive so that the succeeding layer can be amalgamated with it by the vibration process. In case the concrete in underlying layer has hardened to such an extent that it cannot be penetrated by the vibrator but is still fresh (that is, just after initial set), un imposed bond shall be achieved between the top and underlying layer by first scarifying the lower layer before the new concrete is placed by systematically and thoroughly vibrating the new concrete. The points of insertion of vibrator in the concrete shall be so spaced that the range of action overlap to some extent and the freshly filled concrete is sufficiently consolidated at all locations. The spacing between the dipping positions of vibrator shall be maintained uniformly throughout the surface of concrete so that concrete is uniformly vibrated. The vibrating head shall be regularly and uniformly inserted in the concrete

so that it penetrates of its own accord and shall be withdrawn slowly whilst running so as to allow redistribution of concrete in its way and allow the concrete to flow back into the hole behind the vibrator. The vibrator head shall be kept in one position till the concrete within its influence is completely consolidated. Vibration shall be continued until the coarse aggregate particle have blended into the surface but have not disappeared. The contractor shall keep at least one additional vibrator in serviceable condition to be used in the event of breakdowns and maintenance problems.

d. The vibrator head shall not be brought more than 200 mm near to the formwork as this may cause formation of water stagnations. The formwork shall be strong and great care shall be exercised in its assembly. It shall be designed to take up increased pressure of concrete and pressure variations caused in the neighborhood of vibrating head, which may result in excessive local stress on the formwork. The joints of the formwork shall be made and maintained tight and close enough to prevent the squeezing out slurry or sucking in of air during vibration. The formwork to receive concrete shall be cleaned and made free from standing water, dust, etc. The contractor shall keep provision for screed and shutter vibrators at site.

e. No concrete shall be placed in any part of the structure until the approval of Engineer-in-Charge has been obtained. If concreting is not started within 24 hours of the approval being given, it shall have to be obtained again from the Engineer-in-Charge. Concreting shall be done continuously over the area between construction joints. Fresh concrete shall not be placed against concrete which has been in position for more than 30 minutes unless a proper construction joint is formed. When concreting has to be resumed on a surface which has hardened, it shall be roughened, swept, clean, thoroughly wetted and covered with a 13 mm thick layer of mortar composed of cement and sand in the same ratio as in the concrete mix itself. The 13 mm layer of mortar shall be freshly mixed and placed immediately before placing of new concrete.

f. Where concrete is not fully hardened, all latency shall be removed by scrubbing the wet surface with wire or bristle brushes. Care shall be taken to avoid dislodgement of particles of coarse aggregate. The surface shall then be thoroughly wetted, all free water removed and then coated with neat cement grout. Particular attention shall be given to corners and close spots.

3.24 In case of rejection of concrete on account of unacceptable compressive strength, governed by para “Standard of Acceptance” as above, the work for

which samples have failed shall be redone at the cost of contractor. However, the Engineer-in-Charge may order for additional tests (like cutting cores, ultrasonic pulse velocity test, load test on structure on part of structure, etc) to be carried out at the cost of contractor to ascertain if the portion of structure wherein concrete represented by the sample has been used, can be retained on the basis of results of individual or combination of these tests. The Contractor shall take remedial measures necessary
to retain the structure as approved by the Engineer- in-Charge without any extra cost. However, for payment, the basis of rate payable to contractor shall be governed by the 28 days cube test results and reduced rates.

4.0 EXPANSION JOINT SYSTEM

4.1 Floor Joint

General requirement of material
The expansion joint system will be of extruded aluminum base members, self aligning /self centering arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor/ floor to wall expansion control system for various vertical locations in load application areas that accommodate multi directional seismic movement without stress to its components. The system shall consist of metal profiles with universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self centering arrangement that freely rotates/ moves in all directions. The self-centering arrangements shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement. The scope of work includes all labour, materials, equipments and services and performs all operations required for complete installation of expansion joint system.
Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.
Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

4.2 Wall Joint

General requirement of material

The expansion joint system related with wall joint (internal/ external) shall be of extruded aluminum base members, self aligning / centering arrangement and support plates as per ASTM B221-02. The material shall be such that it provides an Expansion joints systems suitable for vertical wall to wall/ wall to corner application, both new and existing construction in office buildings & complexes with no slipping down tendency amongst the components of the joint system. The Joint System shall utilize light weight aluminum profiles exhibiting minimal exposed aluminum surfaces mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to ASTM 6063)

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

4.3 Roof Joint

General requirement of material

The expansion joint system for various roof locations shall be of extruded aluminum base members with, self aligning and self centering arrangement support plates as per ASTM B221-02. The system shall be such that provides that is capable to accommodating multidirectional seismic movement without stress to its components. System shall consist of metal profile that incorporates a universal aluminum base member designed to accommodate various project conditions and roof treatments. The cover plate shall be designed of width and thickness required to satisfy movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates/ moves in all directions. The self centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexures in all directions including vertical displacement. The joint system shall

resists damage or deterioration from the impact of allying ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement.

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

5.0 SHUTTERING / FORM WORK:

a) The work shall be done in general as per CPWD Specifications 2019, Volume-I & II with date correction slip issued upto last date of submission of bid.

b) Only M.S. centering / shuttering and scaffolding material unless & otherwise specified shall be used for all R.C.C. work to give an even finish of concrete surface. However, marine-ply shuttering in exceptional cases as per site requirement may be used on specific request from contractor to be approved by the Engineer-in-Charge.

c) Double steel scaffolding having two sets of vertical supports shall be provided for external wall finish, cladding etc. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding platform shall be fixed. Scaffolding shall have steel staircase for inspection of works at upper levels.

d) Nothing extra shall be paid for the centering and shuttering, circular in shape whenever the form work is having a mean radius exceeding 6m in plan.

e) In order to keep the floor finish as per architectural drawings and to provide required thickness of the flooring as per specifications, the level of top surface of R.C.C. shall be accordingly adjusted at the time of its centering, shuttering and casting for which nothing extra shall be paid to the Contractor.

f) As per general engineering practice, level of floors in toilet / bath, balconies, shall be kept minimum 15 mm lower than general floors as required. Shuttering should be adjusted accordingly. Nothing extra is payable on this account. Steel shuttering as approved by the Engineer-in-Charge shall be used by the contractor. Minimum size of shuttering plates shall be 600mm x 900mm except for the case when closing pieces required completing the

shuttering panels. Dented, broken, cracked, twisted or rusted shuttering plates shall not be allowed to be used on the work.

g) The shuttering plates shall be cleaned properly with electrically driven sanders to remove any cement slurry or cement mortar or rust. Proper shuttering oil or de-bonding compound shall be applied on the surface of the shuttering plates in the requisite quantity before assembly of steel reinforcement.

h) For the execution of centering and shuttering, the contractor shall use propriety Reebole Chemical Mould release agent of FOSROC or equivalent as shuttering oil as approved by Engineer-inCharge and nothing extra shall be paid on this account.

i) Concreting of upper floor shall not be done until concrete of lower floor has set at least for 10 days but form work and reinforcement can be taken up after the concrete has set at least for three days.

j) All existing formwork that fail to meet the specifications mentioned above or do not qualify to meet the minimum standards in the view of Engineer-in-Charge shall have to removed and stacked.

6.0 REINFORCEMENT:

a) The reinforcement shall be done as per CPWD Specifications 2019, Volume-I & II with correction slip upto last date of submission of bid.

b) The rate of item of reinforcement of RCC work includes all operations including straightening, cutting, bending, welding, binding with annealed steel or welding and placing in position at all the floors with all leads and lift complete as per CPWD Specifications 2019, Vol.-I &Vol.-II with correction slip upto last date of submission of bid.

c) The contractor shall provide approved type of support for maintaining the bars in position and ensuring required spacing and correct cover of concrete to reinforcement as called for in the drawings, spacer blocks of required shape and size. Chairs and spacer bars shall be used in order to ensure accurate positioning of reinforcement. To ensure proper cover, factory made round / rectangular type cover blocks will be used to avoid displacement of bars in any direction and nothing extra will be paid for that.

d) Reinforcement TMT bars of grade Fe 500D or more to be used in this work.

e) Bar Bending Schedule

The agency shall prepare bar bending schedule drawings as per approved structural drawings and submit to Engineer-in-Charge in advance for approval. The bar bending schedule shall conform to Indian Standard IS 2502-Code of Practice for Bending and Fixing of bars for Concrete Reinforcement. Before execution of work, five copies of these drawings each including for revision will be submitted to Engineer-in-Charge for approval. Keeping in view the quantum of the work, the BBS shall preferably be prepared with software and

one person acquainted with preparing BBS with software shall be deputed at site to speed up the work. One software shall also be installed in the office.

7.0 MASONARY WORK:

a) The masonry shall be done as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid.

b) Brick masonry with burnt clay F.P.S. (non modular) of class designation 7.5 shall be done in foundation, wet areas and parapet walls with cement mortar.

8.0 STEEL WORK:

Steel work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid.

Stainless steel generally shall be Grade 1.4301 (SS 304) or 1.4401 (SS 316). Lower grades shall not be used. Surface finish of all the stainless steel materials will be in 240 grit satin finish / matt finish. All stainless steel material will have to be coated by a solution of Inox to avoid finger in prints and avoidance of settlement of environment / atmospheric dust.

Stainless steel railing, both sides in staircase and ramp with double handrail shall be used for barrier free accessibility requirements with adequate SS balusters, runners etc as per approved architectural drawing.

Stainless steel railing in balconies, parapets etc. of height not less than 1200 mm shall be used with adequate SS balusters, runners etc. as per approved architectural drawing.

Fixing shall be done by stainless steel expansion bolts of approved size and make as per Engineer-inCharge and welding to be done by using organ welding rods and the surface being duly finished and cleaned by K2 passivation, which is nitric acid plus floric acid solution treatment by which the chances of corrosion will be eliminated and any burn out makes on the metal will also be eliminated.

Stainless steel grade 304 wire gauge with wire of dia 0.50 mm and average width of aperture 1.4 mm in both directions shall be used in wire gauge shutters for doors and windows.

Wherever M.S. grill provided in window, weight of grill in each window should not be less than 12 kg/sqm.

9.0 WOOD WORK

The wood work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid.

The samples of species of timber to be used shall be deposited by the contractor with the Engineer in-Charge before commencement of the work. The contractor shall produce cash vouchers and certificates from standard kiln seasoning plant operator about the timber to be used on the work having been kiln seasoned by them, failing which it would not be accepted as kiln seasoned.

Specified timber shall be of good quality and well-seasoned. It shall have uniform colour, reasonably straight grains and shall be free from dead knots, cracks and sapwood.

Wood work shall not be painted, oiled or otherwise treated before it has been approved by the Engineer-in-Charge.

All portion of timber including architrave abutting against masonry concrete stone or embedded in ground shall be painted with approved wood preservative or with boiling coal tar as per item.

All fittings and fixtures shall be got approved from the Engineer-in-Charge before procurement well in advance and the approved samples shall be kept at site till completion of the work.

Wardrobes

Built in wardrobes up to ceiling height with shelves and drawers consisting rear side made of 6mm thick both side laminated BWR grade plywood (IS: 303) and all other sides, partitions, drawers will be of 19mm thick both side laminated BWR plywood. The shutters of cupboard shall be factory made 27 (1+25+1) mm thick flush door shutters with decorative lamination on exposed side & balancing lamination on other side and with stainless steel auto sensys hinges. All exposed edges of sides, partitions, flush door shall be provided with 5mm thick pre polished 2^{nd} class teak wood lipping and all lamination shall be 1 mm thick high pressed. Each ward robe is to be provided with heavy-duty stainless-steel grade 304 hanger rod with stainless steel brackets, decorative handles and locks.

10.0 uPVC DOORS, WINDOWS& VENTILATORS:

All the work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid. Windows to be designed with integrated MS safety grill provision with wiremesh. uPVC windows shall be of a company who has own production facilities from extrusion to installation at site.

For Casement Window: Profile frame of high impact modified grade uPVC of 65mm x 50mm (outer Frame two track Slider type) & 118mmx50mm (outer frame 3-track slider) and Sash of 45mmx60mm (Two track Slider type) & 45mmx74mm (3-track Slider type), wall thickness of profile must be minimum 1.8±0.3mm, which shall be manufactured from Tropicalized Blend with TiO2 and required additives. Profile must be colorfast and conform to standard EN12608. The profile sections should have multi hollow (min 2 to 3) chamber to include GI reinforcement with 120 GSM zinc coated, fitted in continuous length, in closed chamber. The thickness of GI should be selected to meet the wind load requirement as per IS 875-Part III on sash/mullion. Supplier should be submitting wind load calculation & validation complying with IS-875-III before material supply. Minimum steel reinforcement thickness shall be 1.2mm to 2.5mm. UPVC Windows must be fabricated with fusion welded corners & must conform to the strength requirements based on wind load as per IS 875-Part III. All hardware fitted should be Non-SS, except handles to be of zinc/Al. alloy casted with powder coated.

The uPVC profiles manufacturer shall provide warranty of 10 years for colour fastness and any manufacturing defects in respect of uPVC profiles as well as water and air tightness in case of casement uPVC door/window unit. uPVC door/windows hardware and fittings manufacturer shall provide warranty of 10 years for any manufacturing defects.

Guarantee Bond: Ten (10) years guarantee bond in prescribed proforma shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liabilities under the guarantee bond. However, the sole responsibility about efficiency of UPVC Door and Window work shall rest with the building contractor.

Additional security deposit amounting to Rs. 35.00 lakh shall be retained and the amount so withheld would be released after ten years from the date of completion of whole work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended

within the specified period, the same will be got done from other agency at the risk and cost of contractor.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form. Additional security deposit can be released against bank guarantee issued by a scheduled bank.

11.0 FIRE CHECK DOOR

CPWD Specification 2019 Vol. I & II with correction slips upto last date of submission of bid and NBC Code 2016 and manufacturer's specification will be followed to meet the criteria.

Fire Check doors shall be provided in buildings wherever necessary and required as per National Building Code 2016 and as per approved architectural drawing. All fire doors should be rated for 120 minute. Fire Check Doors shall be carried out through the Specialized Agencies having sufficient work experience in the same field and shall be got approved from the Engineer-in-Charge well in advance.

Frame:

Fire resistant doors frame of section 143x 57mm having built in rebate made out of 1.6 mm thick G.I. sheet (zinc coating not less then 120 gm per sqm), suitable for mounting 120 minutes fire rated door shutters. The profile has to be fixed to the supporting construction by means of anchor fasteners of size M10 x 100, every 150 mm from the edges and every 500 mm (approx) c/c. The frame shall be filled with mineral wool insulation of density min 96 kg/m^3 and finished with an approved fire resistant primer or powder coating of not less than 30 micron in desired shade as per the directions of Engineer-in-Charge. Frames shall also be provided with 10 x 4 mm intumescent fire seal.

Shutters:

Factory made single/ double leaf steel door shutter of thickness 46 mm thick of 120 minute fire rating fabricated with 1.20 mm thick galvanised sheet with infill of mineral wool insulation of density min 96 kg/m^3 or fire rated paper honey comb both faces of sheet with lock seam joints at stile edges and internal reinforcement at top, bottom and stile edges for fire rating. Door shutters shall be finished with an approved fire resistant primer or powder coating of not less than 30 micron in desired shade as per the directions of Engineer-in-Charge. The shutter shall be mounted with stainless steel ball bearing hinges of size 100 x 75 x 3.00 mm. Minimum 10 mm thick 120 minute fire rated toughened, inter

layered, non-wired glass shall also be provided for view panel (approximate size 300 x 450 mm). Fire doors are governed by following specifications.

BS: 476Part-20 & 22	:	Fire Test on Building and Material Structures.
ISO:834	:	Fire Resistance Test Elements of Building Construction
ISO:3008	:	Fire Resistance test on doors and shutters.
IS:3809	:	Fire Resistance Test on Structures.
IS:3614, Part –II	:	Metallic and Non-metallic Fire check doors. Resistance test
IS: 3614:2021	:	Fire doors and door sets – specification (first revision)

Performance criteria:

Stability: The Fire Door should not collapse during the rated period of the fire under specified fire conditions

Integrity: The fire door should not allow the passage of hot gases or the flames through the rebate or the gap between the door frame and shutter. The integrity or smoke sealing function is achieved by Fire Door by incorporating an "Intumescent Seal". This Intumescent Seal in the form of a strip, which under fire conditions expands many times its original size and forms a hard char which has high insulation properties and does not permit the smoke or flames to escape through the gap between the shutter and frame.

Observation, if any, made by the fire officer on the fire proof shutter, shall be incorporated suitably. The contractor shall bear all incidental charges for cartage, storage and safe custody of material and shall construct suitable godowns yards at the site of work for storing material to protect against damage by, sun, rain, fire or theft etc. and employ necessary watch and ward establishment for the purpose at his own cost.

The work shall be carried out through an approved specialized firm, who shall furnish all materials, labour, accessories, equipment, tool and plant and incidentals required for providing and installing the fire resistance and smoke check doors and other items as per architectural drawings and decision of Engineer-in-Charge. Contractor has to select one specialized agency from list of approved brands and specialized agencies. The architectural drawings and specifications cover the major requirements and are for guidance only. Required fastenings, accessories, features and all other items, which are not mentioned specifically therein, but are necessary to make a complete installation shall be provided by contractor the cost of which is deemed to be included in the rate.

Fire resistance and smoke check doors shall have made of proper sizes and section as per the available opening at the site. The details shown on the

drawings indicate generally the sizes of components parts and general standards. These may be varied slightly to suit the standard adopted by the manufactures. Before proceeding with manufacturing, the contractor shall prepare and submit complete manufacture and installation drawing for approval of the Engineer-in-Charge and no work shall be performed until the approval of these drawings is obtained.

Doors will be approved only after door passes the required tests from fire testing lab approved by the Engineer-in-Charge.

Doors shall be fabricated to size in factory. Fabricated material shall be protected against any damage during transportation. Loading and unloading shall be carried out with utmost care. On receipt of material at site it shall be carefully examined to detect any damaged units/members. Arrangements shall be made for expeditious replacement of damage units or members. Materials found acceptable on inspection shall be repacked in crates and stored safely.

Just prior to installation, the doors shall be uncarted and stacked on edge on level bars and supported evenly. The frame shall be fixed into position true to line and level using adequate number of fastener of approved size and manufacture and in an approved manner. The holes in concrete /masonry member for housing anchor bolts shall be drilled with an electric drilling machine only.

Stainless steel ball bearing hinges 4 nos. per leaf, panic touch bars, door trims, fire rated hydraulic door closers, handles, tower bolts, lock and other fittings shall be of approved quality and shall be got approved from Engineer-in-Charge.

Rate shall include the cost of all the above operation, labour, and material including frame work and cost of providing and fixing vision panel of 2 hrs. fire rating required for the work.

The design of fire checks doors and material to be used in their construction have to be such that the doors shall be capable of providing an effective barrier of desired rating.

Minimum one sample shutter from each lot shall be picked up at random for testing as per relevant codes/specifications by the Engineer-in-Charge in presence of contractor from the whole lot. The sample(s) shall be sent for testing in the approved laboratory as per the decision of Engineer-incharge.

The cost of sample shutters, packing charges, transportation charge, testing charges, and other expenses involved in the testing of the sample shall be borne by the contractor and nothing extra shall be paid on this account. In case of non-conforming of samples to the required standard, the whole lot shall stand rejected.

Guarantee Bond: Ten (10) years guarantee bond in prescribed proforma shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liabilities under the guarantee bond. However, the sole responsibility about efficiency of fire check door shall rest with the building contractor.

Additional security deposit amounting to Rs. 15.00 lakh shall be retained and the amount so withheld would be released after ten years from the date of completion of whole work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended within the specified period, the same will be got done from other agency at the risk and cost of contractor.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form. Additional security deposit can be released against bank guarantee issued by a scheduled bank.

12.0 FLOORING, MARBLE, CLADDING WORK:

All the working eneral shall be carried out as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid.

The tiles / stones shall be as specified in the schedule of finishes and approved by the Engineer-inCharge. The tiles / stones shall be of approved colours and shades and will be laid in pattern as per approved architectural drawings. Nothing extra shall be paid for laying tiles / different stones in specific pattern. The tiles shall be of first quality of approved make and nothing extra shall be paid for use of cut/sawn tiles in the work.

Proper gradient shall be given to flooring for toilets, verandah, kitchen, courtyard etc. so that the wash water flows towards the direction of floor trap. Any reverse slop if found, these shall be made good by the contractor by ripping open the floor/grading concrete and nothing shall be paid for such rectifications.

The flooring and skirting will be executed as per pattern shown in the architectural drawings. Skirting height shall be 100-150 mm except staircase portion. Skirting height at staircase will be executed as per approved architectural drawings.

Samples of flooring material are to be deposited well in advance to the Engineer-in-Charge for approval. Approved samples should be kept at site with the Engineer-in-Charge and the same shall not be removed except with the written permission of Engineer-in-Charge. No payment whatsoever will be made for these samples.

One piece Granite stone for treads / risers in staircase shall be used including rounding of nose and nothing extra shall be paid on this account.

POP protection layer shall be laid on all finished floors for protection from damage during execution of other items of work in that area which shall be removed and cleaned just before handing over of the premises for which nothing extra shall be paid.

Rates shall be inclusive of all operations including labour, material, T & P, scaffolding etc. complete. Nothing extra shall be payable on any account.

13.0 SANITARY INSTALLATIONS AND WATER SUPPLY

All the work in general shall be carried out as per CPWD Specifications 2019, Volume-I & II with correction slips upto last date of submission of bid. The work shall be in conformity with the Byelaws, Regulations and Standards of the local authorities concerned

The contractor shall be responsible for the protection of the sanitary and water supply fittings, other fittings and fixtures against pilferage and breakage during the period of installation and thereafter until the building is handed over.

The Plumbing / Sanitary System shall comprise of following: a) Sanitary pipes, fittings and fixtures.

b) Internal and external water supply.
c) Internal and external drainage.
d) Approval from local authorities.
e) Balancing, testing & commissioning.
f) Test reports and completion drawings.

Sanitary Pipes and fittings

It shall be designed on the basis of two pipe system as recommended in code of practice. Soil and waste Hubless centrifugally cast (spun) iron pipes epoxy coated inside and outside as per IS:15905 including all type of fittings. Soil pipes shall carry the waste from WC's and urinals etc. Soil pipes shall be connected directly to the 1st manhole outside the building. Waste pipes shall carry the waste from

waste appliances (lavatory basins, kitchen, sinks etc. Waste stacks shall first connect to gully traps outside the buildings and then shall be connected to external manholes. All pipes and fittings dia. shall be 100 mm or more. To avoid joints or cutting slab inside the toilet, long arm trap upto 90 cm length shall be used for connection of floor trap / WC trap to vertical stack for soil / waste pipes in shaft wherever possible. Vertical stacks for WC's and urinals should be separate.

All vertical stacks will terminate as vent pipes at parapet level. All vertical stacks shall be installed in shafts as per approved architectural drawings. These pipes must be camouflaged aesthetically above terrace level. All shafts shall be provided with suitable accessible platforms at each floor level. All those shaft openings shall be casted after pipes are laid wherever required as per fire requirement.

The pipes and fittings shall be jointed with SS 304 grade coupling with EPDM rubber gasket as per requirement and specifications. Provision has to be made for providing access door fittings for maintenance purpose wherever necessary and required.

Wherever possible disposal system shall be directly from sanitary fixtures to pipes in shaft without any joints in between. Internal buildings sanitary disposal system would be under the slab by core cutting RCC slab and suspended at bottom. Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps of approved design. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them and are properly secured. Contractor shall provide all nuts, bolts, welding material and paint the clamps with one coat of red oxide and two or more coats of black enamel paint.

Quoted Rates are inclusive of cutting hole in RCC slabs/beams/deck slabs/GI sheets by diamond core cutting machine and making good the same as per satisfaction of Engineer-in-Charge for which nothing extra shall be paid. Agency shall provide suitable size sleeves for fixing of pipes & fixtures.

Sanitary fixtures

Porcelain sanitary ware shall be glazed vitreous china of first quality free from warps, cracks and glazing defects and shall conform to relevant BIS codes. Colour of sanitary ware, shall be specified or as selected by the Engineer-in-Charge. Nothing extra shall be payable on this account.

Vitreous China Rimless wall-hung WC with soft close seat & cover, with or without cistern / Orissa pattern water closet squatting pan (Indian type W.C.

pan) with low volume vitreous china dual flushing cistern, under counter rectangular / oval shape wash basins of approximate size 595 x 400 x 195 mm, White vitreous china urinals with pressmatic system operated urinals, SS 314 urinal partition of required size shall be provided as per approved architectural drawings.

Water Supply Pipes

For internal concealed pipe work stainless steel pipe and fittings of grade A ISI 304 as per JIS standard 3448 with press type fittings shall be used. For external work and exposed on wall work of water supply pipe line upto 80mm dia., GI pipes i/c all fittings, unions, air valves, ball valves shall be provided. For grid network or where pipe dia. Requirement is greater than 80mm, S & S Centrifugally Cast (Spun) / Ductile Iron Pipes conforming to IS:8329 and suitable for Push-onjointing shall be used. When there is any change in direction (bends, tees) or any change of diameter (tapers, valves) or any pipe line end restrained joint push-on type shall be provided. Ductile Iron fittings and specials of Class K-12 suitable for push-on jointing as per IS: 9523 shall be used as per requirement.

Enclosed type water meter (bulk type) conforming to IS: 2373 along with C.I. dirt box strainer (bulk type) and butterfly valve shall be provided in municipal board supply line. Water meters shall also be provided in each quarter of residence blocks.

In water supply line unions, ball valves, butterfly valves, air valves, ball cock etc would be provided as per design and direction of Engineer-in-Charge. Wherever required suitable size chambers shall be made for valves. Nothing extra shall be payable on any account. Ball valves shall be forged brass valve of approved quality as per CPWD specifications. Valves 50 mm dia and below shall be screwed type ball valves. Butterfly Valves of 65mm dia and above shall be cast iron butterfly valves with hand lever operation and conforming to IS:13095. Butterfly Valves shall be provided with matching flanges and operating pressure shall not be less than 16 kg/cm^2. Non return valves shall be of gun metal and conforming to IS:5312. Non return valves 50 mm dia and below shall be screwed type and 65 mm and above shall be flanged type. Air valve shall be of cast iron. All valves shall be installed with bolts, nuts, rubber insertions, tail pieces, tapers etc as required.

14.0 MODULAR KITCHEN

Specification – CPWD Specification 2019 Volume I & II with correction slips upto last date of submission of bid and manufacturer's specification will be followed to meet the criteria mentioned in item or code.

Carcass 300mm deep (above work top)

Factory made carcass of BWR (Boiled Water Resistance) Ply of approved make consisting rear side of carcass made of 6 mm thick ply both side laminated and all other sides, partitions and shutters will be made of 18 mm thick BWR Ply both side laminated. All the board members shall be fixed with each other with the help of Minni Fix (Hettich or equivalent) after application of adhesive etc. All edges of carcass will be covered with 0.8 mm thick machine pressed PVC edge bending tape of (Rehau or equivalent). The exposed surface of shutter and exposed visible sides of carcass will be covered with 1 mm thick laminate of approved make, shade and finish and mechanically pressed after applying a layer of adhesive. The edges of shutters will be covered with 1.2 mm to 2 mm thick machine pressed PVC edge bending tape. The carcass will be fixed to walls with the help of required number of Wall Hanging Brackets (minimum 2 nos.) of Hilti or equivalent make. The entire work will be executed as per drawings and directions of Engineer-in-Charge. Fittings like hinges, handles, glass shelves etc. shall be provided for the functioning of carcass shutters.

Carcass 560 – 580 mm deep (below work top)

Factory made carcass of BWR (Boiled Water Resistance) Ply of approved make, consisting rear side of carcass made of 6 mm thick BWR Ply both side laminated and all other sides, partitions, drawers front panel and shutter will be of 18 mm thick BWR Ply both side laminated. All the board members shall be fixed with each other with the help of Minni Fix (Hettich or equivalent) after application of adhesive etc. All edges of carcass will be covered with 0.8 mm thick machine pressed PVC edge bending tape. The exposed surface of shutter and face of drawers etc. will be covered with 1 mm thick laminated finish of approved make, shade and finish mechanically pressed after application of a layer of adhesive. The edges of shutters and sides of drawer front panel will be covered with 1.2 to 2.0 mm thick machine pressed PVC edge bending tape. The carcass will be fixed to walls with the help of required nos. of SS expandable dash fastener of size 100 x 10 mm of Hilti or equivalent make. The entire work will be executed as per drawings and directions of Engineer-in-Charge. Fittings like hinges, handles, baskets, quadro channels etc. shall be provided for the functioning of carcass shutters& drawers etc.

Pantry unit of size 900 x 2100 shall be provided in each quarters of Type V with 8 mm thick toughened glass shelves, Inno Tech or equivalent Plain Drawer and Plain Pot & Pan Drawer with full extension silent system Inno Tech Channels with a load capacity of 30kg with screw etc. shall be provided along with 16mm thick BWR Ply both side 0.8mm thick laminated base and back. Specification of pantry unit shall be same as Carcass 560 – 580 mm deep (below work top).

Inno Tech or equivalent Plain Drawer of required size along with PVC Cutlery Tray of required size with full extension silent system Inno Tech Channels with a load capacity of 30kg with screw etc. shall be provided along with 16mm thick BWR Ply both side 0.8mm

thick laminated base and back in each kitchen as per approved architectural drawings and design of modular kitchen.

Double walled Inno Tech or equivalent Plain Drawer of size 70 x 470 mm with full extension silent system Inno Tech or equivalent Channels with a load capacity of 30 kg with screw etc. shall be provided along with 16mm thick BWR Ply both side 0.8mm thick laminated base and back as per requirement in each kitchen as per approved architectural drawings and design of modular kitchen.

Double walled Inno Tech or equivalent Plain Pot & Pan Drawer of size 144 x 470 mm with full extension silent system Inno Tech or equivalent Channels with a load capacity of 30 kg with screw etc. shall be provided along with 16mm thick BWR PLY both side 0.8mm thick laminated base and back as per requirement in each kitchen as per approved architectural drawings and design of modular kitchen.
8 mm thick toughened glass shelf for top carcass cabinet with grinded edges fixed with the help of nickel plated die casted brackets with stainless steels crews shall be provided as per requirement for horizontal partition of carcass in each kitchen as per approved architectural drawings and design of modular kitchen.

Stainless steel dish rack drainer set with PVC collecting tray of 900 mm size, stainless steel wire basket Spice Pull Out – three tier shelf of carcass size 200 mm, stainless steel waste bin holder, stainless steel Detergent holder shall be provided in each kitchen.

Stainless steel auto closed Sensys Hinges with built in Silent System (110^0, 45^0 or blind Corner type Hinge) and SS handles shall be provided as per requirement in each kitchen.

Guarantee Bond: Five (5) years guarantee bond in prescribed proforma shall be submitted by the contractor for wooden part of modular kitchen and five (5) years guarantee bond for hardware component of modular kitchen which shall also be signed by both the specialized agency and the contractor to meet their liabilities under the guarantee bond. However, the sole responsibility of Modular Kitchen work shall rest with the building contractor.

Additional security deposit amounting to Rs. 15.00 lakh and the amount so with held would be released after five years from the date of completion of whole work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended within the specified period, the same will be got done from other agency at the risk and cost of contractor.

All the hardware and fittings used by the agency in modular kitchen will not be affected by rusting, if rusting is observed it should be replaced by agency at his own cost.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form. Additional security deposit can be released against bank guarantee issued by a scheduled bank.

16 WATER PROOFING

The work shall be carried out as per CPWD specifications 2019 Volume I & II with upto date correction slips upto last date of submission of bid.

a) The work of water proofing will be carried out by a specialized agency approved by Engineerin-Charge.

b) The specialized agency will submit detail of chemicals to be used, detail methodology, test certificate as per relevant code before start of work.

c) Total quantity of the water proofing compound required shall be arranged only after obtaining the prior approval of the make by Engineer-in-Charge in writing. Materials shall be kept under double lock and key and proper account of the water proofing compound used in the work shall be maintained. It shall be ensured that the consumption of the compound is as per specified requirements.

d) The finished surface after water proofing treatment shall have adequate smooth slope as per the direction of the Engineer-in-Charge.

e) Before commencement of treatment on any surface, it shall be ensured that the outlet drainpipes / spouts have been fixed and the spout openings have been eased and rounded off properly for easy flow of water.

Guarantee Bond: Ten (10) years guarantee bond in prescribed proforma shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liabilities under the guarantee bond. However, the sole responsibility about efficiency of water proofing treatment shall rest with the building contractor.

Additional security deposit amounting to Rs. 55.00 lakh would be released after ten years from the date of completion of whole work under the agreement, if the performance of the work done is found satisfactory. If any defect is noticed during the guarantee period, it shall be rectified by the contractor within seven days of receipt of intimation of defects in the work. If the defects pointed out are not attended within the specified period, the same will be got done from other agency at the risk and cost of contractor.

The security deposit against this item of work shall be in addition to the security deposit mentioned elsewhere in contract form. Additional security deposit can be released against bank guarantee issued by a scheduled bank.

17.0 TOILET CUBICLES

Restroom cubicles (enclosed/corner unit) shall be made from 12 mm thick multi-layer high pressure Compact Laminate and 12 mm stainless steel shoes box up at the bottom with stainless steel top rail arrangement. Top rail shall be fixed with stainless steel wall fixing rose and corner connectors. All pilasters are supported by L-bracket with floor anchor bolt. The L-bracket is concealed with stainless steel flat box up of up to 100 mm height. The divider panels are fixed onto the wall with stainless steel U-channel section and SS screw inserts. Further all pilasters are fixed with a stainless steel top rail at the top and doors are incorporated with the noise deafenin tape to reduce the noise effect. Rest of the hardware like gravity hinges, coat hook cum door stopper, door knobs, alloy privacy thumb turn with indicator locks are also provided in stainless steel. All stainless steel shall be Grade 304. Dimension details of cubicles are as under:-

Standard Dimensions	General (mm)	Physically Challenged (mm)
Width of cubicle	1000	1500
Depth of cubicle	1500	1750
Height of entire cubicle	2100	2100
Width of door	600	900
Height of door (But top of door shall match with top of cubicle)	1710 (minimum)	1710 (minimum)
Ground clearance	110	110

18.0 ROLLER BLINDS

Roller Blinds with powder coated plain cassette shall be in white colour made of extruded non rusting aluminium alloy 1.25 mm thick; with 1.5 mm thick internal tube of 38 mm OD made of non rusting aluminium with a pocket to insert the fabric inside of it with end plugs & operating mechanism made up of ABS plastic with ball chain of 1.50 mm thick for lowering or raising the blind and can be positioned on right or left part of blind. The Ball Chain shall be minimum 1.5 mm diameter cord with 4.5mm diameter acetal balls moulded co-axially to it on 6mm pitch to form an endless ball chain. The brackets should be zinc plated / powder coated mild steel. Bottom rail shall be 1.50 mm thick of non rusting aluminium alloy in round / pentagon shape with powder coating of matching colour nearest to the colour of the fabric.

Translucent Fabric: The translucent fabric shall be 100% polyster, weight 270g/sqm (± 5%), 0.50 mm (± 0.05) thickness with excellent hanging and tearing strength of approved colour.

Blackout Fabric: The blackout fabric shall be 100% polyster, weight 335g/sqm (± 5%), 0.53 mm (±
0.05) thickness with excellent hanging and tearing strength of approved colour.

19.0 STRUCTURAL GLAZING

The frame work for structural glazing shall be of Aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved shop drawings. The aluminium quality shall be 6063 T5 or T6 grade as per BS 1474 including anodizing in approved colour to a minimum thickness of 20 microns or shall be PVDF coil / spray coated in approved colour and shade with metallic colours to a minimum thickness of 35 microns. The colour and the finish shall be uniform and free of streaks. The aluminium sections, before coating, shall be suitably cleaned, rinsed, buffed properly and sealed and protected after anodizing / PVDF coating, till the completion of the work.

Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels including:

a) Structural analysis, design and preparation of shop drawings for the specified design loads conforming to IS 875 Part III (the system must passed the proof test at 1.5 times design with pressure without any failure including functional design of the aluminium sections for fixing glazing panels of various thickness, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc. structural and weather silicone sealants, flashings, fire stop (barrier)-cum smoke seats, microwave cured EPDM gaskets for water tightness, pressure equalization & drainage and protection against fire hazard.

b) Fabricating and supplying serrated M.S. hot dip galvanized/ aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 dimensional movement for achieving perfect vertically and proper fixing of structural glazing system with the RCC/masonry/structural steel framework of building structure using stainless steel anchor fasteners /bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers. The mass of the zinc coating to be not less than 610 gm. Per sqm of steel area to be galvanized.

c) The Structural sealant shall be two part pump-filled silicone sealant DC 983 of Dow Corning or equivalent recommended by manufacturer and the weather silicone sealant shall be one-part silicone sealant DC 795 of Dow Corning or equivalent of other

approved brand as per the list of approved materials. All the sealing shall be done in a clean and controlled environment as specified by the silicone sealant manufacturer including double sided spacer tape, setting blocks and backer
rod, all of approved grade brand and manufacturer, as per the approved sealant design, within and all around the perimeter for holding glass.

d) All sealants must be non-staining and compatible with adjoining sealants, backup materials, substrate materials and their respective finishes and/or applied colour coatings. Care shall be taken to ensure that two different types of sealant should not come in contact with each other unless compatibility is satisfied as per manufacturer's specifications.

e) Providing and fixing in position flashings of solid aluminium sheet 1mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it water tight.

f) Making provision for drainage of moisture/water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete.

Note:

1- The extruded aluminium frames, shadow boxes, fire stop (barrier)-cum-smoke seals, extruded aluminium section capping for fixing in the grooves of the curtain glazing and vermin proof stainless steel wire mesh shall be provided as per GFC drawing.

2- The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 sqm from the certified laboratories accredited by NABL(National Accreditation Board for Testing and Calibration laboratories) Department of Science & Technologies, India. The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work.

Performance Testing of Structural glazing system: Tests to be conducted in the NABL certified laboratories

1- Performance laboratory Test for air Leakage Test (-50pa to 300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1to 200mVhr"l.
2- Static Water Penetration Test (50pa to 1500pa) as per ASTM E-331-09 testing method for a range upto 2000ml"
3- Dynamic Water penetration (50pa to 1500pa) as per AAMA 501.01-05 testing method for a range upto 2000ml

4- Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTM E-330-10 testing method for a range upto 50mm"
5- Seismic Movement Test (Upto 30mm) as per AAMA 501.4-09 testing method for Qualitative test;
6- On site Test for Water leakage for a pressure range 50 kpa to 240kpa (35psi) upto 2000ml'

Note: The Contractor shall bear all the testing charges and nothing extra will be paid.

Glazing

Vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 12mm wide, desiccants', including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor.
(i) Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 35 to 45 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 1.6 to 1.8 W/m2 degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.

20.0 ACOUSTIC WALL PANELLING

Acoustic work

1. **Acoustic Doors Acoustic Door [2000 (W) x 2400 (H)]** : Providing and fixing of teakwood door double leaf door (nominal) along with fire and smoke Intumescent seal strip of size 12mm x 4mm for 120 minutes fire rated and Rw rating acoustic door with minimum 90mm thickness having infill of 45mm thick resin bonded fibreglass of 48 kg/m3 density sandwiched by two 12mm thick non- combustible fire rated boards (edge to edge on internal hardwood frame) and cladded with 6mm thick commercial ply facing and 3mm sheet rubber interlayer and finished with 1mm thick laminate/as per architect. All material to be approved by the Acoustic Consultant prior to installation. The board shall be Resistant to vermin, mould growth, minor impact, abrasion and short term water attack and shall be off-white in color with a smooth surface suitable to receive most forms of decoration. The door closer and coordinator shall be as per architect both for single and double doors. Includes external Automatic Drop down seals & perimeter seals.

OR

Acoustic Door [1500 (W) x 2400 (H)] : Providing and fixing of teakwood double leaf (nominal) along with fire and smoke Intumescent seal strip of size 12mm x 4mm for 120 minutes fire rated and Rw rating acoustic door with minimum 90mm thickness having infill of 45mm thick resin bonded fibreglass of 48 kg/m3 density sandwiched by two 12mm thick non- combustible fire rated boards (edge to edge on internal hardwood frame) and cladded with 6mm thick commercial ply facing and 3mm sheet rubber interlayer and finished with 1mm thick laminate/as per drawings. All material to be approved by the Engineer in Charge prior to installation. The board shall be Resistant to vermin, mould growth, minor impact, abrasion and short term water attack and shall be off-white in color with a smooth surface suitable to receive most forms of decoration. The door closer and coordinator shall be as per drawings both for single and double doors. Includes external Automatic Drop down seals & perimeter seals.

2. GI Metal Ceiling Lay in perforated Tegular edge global white color tiles of size 595x595 mm and 0.5 mm thick with 8 mm drop; made of GI sheet having galvanizing of 100 gms/sqm (both sides inclusive) and 20% perforation area with 1.8 mm dia holes and having NRC (Noise Reduction Coefficient) of 0.5, electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending and perforation, and backed with a black Glass fiber acoustical fleece. Or Sl. No 49

3. **Walls Treatment Acoustic Treatment for Low Frequency Absorption for Walls**: Providing and Fixing Channeled Magnesium Board Grooved Panel of width 133mm, thickness of 18mm and length 2440 mm or as required by the Architect/acoustic consultant, made of Magnesium board surface finish by high pressure Laminate as per the approved shade/ species & finish and a melamine balancing layer on the reverse side. The boards shall have a special perforation pattern 13/3 (12.8% perforation rate). The panels shall provide a minimum sag resistance of RH90 and a fire rating 0.85 NRC. The edges of the panels shall be“tongue-and-grooved” to receive special clips for installation. Installation of panels on GI Channels of section 50mm x 50mm on 40 X 40 X 5mm GI angle Supports Fixed to solid wall having 50 mm air gap. GI panels fixed horizontally at spacing of 600mm center to centre and screwed aluminum extruded keel for channeled wood works with 50mm thick thermal banded polyester non-woven wadding fiber of 1000 gm/sqm. The fiber to be held in position with chicken wire mesh. The final color of the material and design horizontal or vertical to be approved by the consultant and the architect both to ensure the final looks of the installation is as per the design intended for, before start of work. The panels shall be mounted on special aluminum splines using clips. Item includes cost of necessary scaffolding as required.

4. **Acoustic Diffusion for side walls**: Providing and fixing MLS design Diffusion panels of width 600 mm, length 1200mm and thicknes 38mm, made of Rubber solid wood, density

board,finish with original wood texture/ required color, frequency range 500Hz- 4000Hz, Environmental performance grade: E1(GB). Installation of MLS Diffusion panels on GI Channels of section 50mm x 50mm on 40 X 40 X 5mm GI angle Supports Fixed to solid wall having air gap. GI panels fixed horizontally at spacing of 600mm center to centre and screwed aluminum extruded keel for channeled wood works with 50mm thick thermal banded polyester non-woven wadding fiber (oceanz acoustics H.K) of 1000 gm/sqm. The fiber to be held in position with chicken wire mesh. The final color of the material and design horizontal or vertical to be approved by Engineer in charge to ensure the final looks of the installation is as per the design intended for , before start of work . The panels shall be mounted on special aluminum splines using clips. All Makes and models of all items/samples should be approved by Engineer in charge prior to the installation. including cost of necessary scaffolding as required.

5. **Acoustic Treatment for Mid & High Frequency Absorption for Walls:** Providing & fixing in position, Stretch fabric (Oceanz Acoustics H.K) by using FR grade acoustically transparent fabric of size approx 1200mm width, abrasion & flame resistant as per approved color. Fabric shall be stretched by using wooden base 10mm thick, rigid vinyl Stretch tracks half wrap/ full wrap 12.5mm and Midseam 12.5mm, chicken mesh as required, fibre polyester wadding (Oceanz Acoustics H.K) required GSM infill with requisite accessories & tools. All material to be approved by the Engineer in Charge prior to installation. Wooden base 10mm to be installed first on the wall along the marking lines with metal fasteners at 300mm centers. The system to be mounted on 50 x 50mm GI frame. Tracks to be installed on wooden base, by first applying stick adhesive on both surfaces for a true and continuous secure grip, and heavy-duty fasteners at 15mm centers on one/ both sides of Stretch Tracks. NRC better than 0.8. including cost of necessary scaffolding as required.

6. **Acoustic Treatment for Stage walls:** Providing and fixing of magnesite bonded woodwool panels made with superfine wood fibres & gypsum, patented with magnesite cement, edge profiles consisting of Radius, Chamfer, Tongue-Groove & H-Spline groove, having density 400kg/m3, Acoustic NRC upto 0.90, eco-friendly, Fire Ratings - Non-combustibility at 750 degree C, Thermal Resistance, Water Vapour Diffusion Resistant, size 600 x 600/ 1200/ 2400 x 25mm installed on Strut Csystem requires unfastening and refastening of fasteners . All material to be approved by the Engineer prior to installation. The Strut C-System framework consisting of Channels fixed at 600mm centres, Long edges chamfer and kerfed for H-Spline; Thickness 38 mm installed on Strut C-system with HSpline. including cost of necessary scaffolding as required.

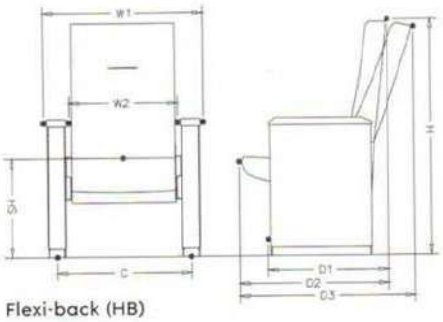
7. **Flooring : Floor Impact Isolation treatment:** Providing and fixing under the screed, PU bonded rubber fibre upper side laminated with aluminum foil, size 1,200 x 1,000 x 17 mm thick, Temperature resistance from –20 °C to +80 °C, Thermal conductivity _ = 0.08 W/mK,Thermal resistance R = 0.2162 m^2K/W, Fire classification - B2 / Class E, rot-,

moisture-, age- and deformation-resistant, permanently elastic. 0.5 mm thick PE Foil on the top of PU bonded rubber fibre.

8. **Ceiling Treatment:** Acoustic Treatment for Ceiling Providing and Fixing in position, micro perforated ceiling panel of size 585 x 585mm have NRC better than 0.80, install with grid Lay-in-system. All material to be approved by the Acoustic Consultant prior to installation. including cost of necessary scaffolding as required.

21.0 FURNITURES

In Lecture hall and auditorium chairs shall be provided. These chairs shall be fixed in position in floors of seminar hall. The seat assembly of chair is made of polyurethane foam moulded with M.S. E.R.W. tubular frame insert of dia. 19 ± 2 mm and 1.6 ± 0.13 mm thicknesses or seat plywood of 15 mm thick high pressure & induction heated manufactured with hardwood veneers upholstered with fire retardant fabric with 4mm PU lamination and of approved colour and shade. E.R.W. round tube with flexible support straps running across the length and width of the frame or Plywood support for the foam cushion. The Seat has an auto-tip up feature making it stay in upright position when not in use enabling clear row passage. Seat Size (approximate) shall be 455 mm (W) x 465 mm (D). The backrest assembly of chairs shall have a flexi back mechanism (back push mechanism). Back made of polyurethane foam moulded over M.S. ERW tubular frame insert of dia 19 ± 2 mm and 1.6 ± 0.13 mm thickness or 12 mm thick high pressure & induction heated plywood with hardwood veneers which is upholstered with fire retardant fabric laminated with 4mm PU foam and has a plastic back cover. Back Size (approximate): 455 mm (W) x 820 mm (D). The chair shall have high density and high resilience premium molded PU foam of 50 to 55 kg/cum density. The chair rests on the ground on two side panel frames fabricated from 1.2 ± 0.20 mm thick CR steel sheet which is cladded with fire retardant fabric 4 mm foam cladded upholstery. The side panel frame shall be grouted to the floor using 2 nos. of anchors for each panel through 3.0 ± 0.50 mm thick HR steel base plates or 5.0 ± 0.50 mm thick HR steel base plates. The armrest is made up of beach wood with melamine finish. The armrest is fitted with side panel through a concealed powder coated/zinc plated hinge. The desklet shall be 18 ± 0.50 mm thick pre-laminated particle board with in-situ injection moulded polypropylene edging all around. Desklet Top is mounted on High pressure die-cast aluminium arm through metal bracket 2.0 ± 0.50 mm thick. The assembly is mounted on side panel through Desklet arm connector made up of glass filled nylon (PA6+30°/0GF). Desklet Outer Dimension (approx.) shall be 270 (W) x 320 (D) or the desklet made out of Aluminum High pressure Die casting. The desklet fixed to the Aluminum die casted T Hinge connected with the side box made of 2mm HR Sheet of the chair by Screw rod made out of EN08 Steel. Outer Dimension (approx.) of the size – 320 x 220 (+/- 2mm) and thickness 10mm (+/- 1 mm). The type of desklet will be approved by WAPCOS/IIT (ISM) Dhanbad before execution based on the samples provided at site. All steel components shall be epoxy polyester powder coated (DFT 60-80 microns).



Flexi-back (HB)

Office Furniture as per approved Architectural OEM of offer product should have ISO 9000 series certification, Green guard certification and BIFMA certification

22.0 ROAD

The work shall be done in general as per CPWD Specifications 2019, Volume-I & II with date correction slip issued upto last date of submission of bid.

23.0 Automatic Fire Curtain

Supply installation testing and commissioning of Fire Curtains with Galvanized MS powder coated head top box of suitable size, Powder coated side guides (100mm x 50 mm) and bottom bars with Gravity fail safe DC motors one per roller for curtain up operation with standard battery back-up fixed into 76/88 mm steel rollers with FAB690PU fabric must be according to DIN EN 13501-1 and stainless steel reinforced glass fibre with fire-retardant aluminum pigmented polyurethane coating, with its control panel and all installation assemblies & accessories required to complete the installation. The operation shall be suitable for dedicated 230 volts UPS, 50 Hz AC supply. Complete system tested in accordance with EN 1634-1 and EN 12101-1 (foar minimum 120 minutes integrity & tested at 1000°C) with CE certificate from European Notified Body. Both test reports EN 1634-1 & EN 12101-1 must be according to the requirement of particular project, if single roller curtain is there then single roller certificates and double roller curtain is there than double roller certificates must be submitted accordingly. The fire curtain must be according to Classification of Fire Resistance Performance in Accordance with EN 13501-2: 2016. The manufacturer's valid EN certification for oversized fire

curtains according to EN 15269-11 covering the sizes of offered fire curtains as per approved Architectural drawing. Each Fire Curtain shall have independent control Panel suitable for 230V AC supply, provision to integrate with Fire signal, and battery backup. The emergency retract switch shall be provided on both sides of curtain. The Fire curtain shall reset automatically when fire control panel is reset. Fabric and all components sourced from the original manufacturer who has valid type test certificate of the fire curtain and third-party quality surveillance audit as per above standards including oversize certification according to applicable EN standards. The work includes fabrication, supply and installation of closed MS sections corner supports for fixing side channels, design suitable for stability and integrity with two hours fire rating, wherever required for full height of Fire curtain, as per approved design, duly finished with powder coating of finish matching to side channels of fire curtains. All the required test / certificates must be less than 5 Years validity. No mirror certificates allowed.
Installation: The fire curtain has fixing options to suit all types of ceiling configurations and can be integrated into either a suspended or a solid ceiling. It remains hidden until required. Upon receiving a signal from the fire detection system or on loss of power with the gravity fail safe system, the curtain automatically unwinds to its operational position.

Centenary Building		
SL. No.	Description	Specification
	FOUNDATION AND SUPER STRUCTURE	
	Foundation and Super Structure	As per General Specification 5 to 7.
	Plinth filling i) Sand filling under floor ii) Concrete under floor / footings	100 mm thick sand filling under floor / stitching slab at GF. At least 100 mm thick lean concrete below footing and under floor in M10. At least 100 mm thick RCC stitching/grade slab of grade M25 shall be laid under flooring work at ground floor with minimum reinforcement 8 mm dia @ 200 mm c/c both ways.
	Anti termite treatment	Anti termite treatment works to be done by diluting and injecting chemical emulsion for Pre Constructional asper CPWD specification.
	Masonry Work	As per General Specification 8 to 11.
	Wood Work	
	Door and fanlight frames	(i) Factory made 2nd class kiln seasoned and chemically treated teak wood single rebate section of frame of size 100 x 60 mm for room doors. (ii) Cubicals as per general specification 12 design and patteren asper approved sample.
	Door shutters	(i) All door shutters (except main entrance and Auditorium) shall be factory made hot pressed pre laminated flush door shutter37 (1+35+1) mm thick, with 1 mm thick decorative lamination on both side and 5 mm thick pre polished 2nd class teak wood lipping on all edges of shutters including S.S ball bearing butt hinges with vision panel. (ii) Main entrance door and frame as per approved Architectural drawings. Preferably Main entrance door should be Aluminium glazed. (iii) Auditorium door will be Acoustic Door for 120 minutes fire rated and Rw rating acoustic door with minimum 90mm with

		fire rated fiiting asper approved architectural drawing. (iv) Aluminium louvered door shutters with aluminium frame work including all stainless steel fittings and fixtures as per CPWD specifications in shafts doors.
	Mumty Door	i. M.S. angle door frame of size 45x45x6mm. ii. 1 mm thick M.S. sheet door with angle iron frame of 40x40x6 mm using flats 30x6 mm for diagonal braces and for lock rail 2nos. 40x40x6mm angle iron back to back with all required fittings / fixtures.
	Door Fittings	i. Stainless steel (Grade 304) fittings in satin / matt finish e.g. sliding door bolts (250 x 16mm), tower bolts (250x10mm), handles, hanging floor door stopper, etc. in laminated flush door shutter as per CPWD specification in all doors except WC doors. ii. Heavy duty hydraulic door closure. **<u>For WC and Bath Doors.(Except cubical)</u>** iii. Stainless steel (Grade 304) satin / matt finish sliding door bolts (200 x 16 mm), handles (19 mm x 250 c/c), tower bolts (250x10mm), and other fittings as per CPWD specification. iv. Heavy duty hydraulic door closure entrance door. v. Stainless steel (Grade 304) satin / matt finish sliding door bolts (200 x 16 mm), handles (19 mm x 250 c/c), tower bolts (250x10mm), and other fittings as per CPWD specification.
	Fire check door shutters, frames and fittings	Metal fire check door frames and shutters with vision panels shall be rated for 120 minutes. (Fire escape location as standerd, ABU, Electrical Panel

		Room)
	uPVC windows	(i) UPVC window in rooms with integrated MS safety grill with matching colour having glazed and wire mesh panels with double glazed hermetically sealed glazing with 6 mm thick toughened glass inside and 6 mm thick PLTG / Green Essence or equivalent toughened glass outside having 12 mm air gap. (ii) Fixed / casement / casement cum fixed glazed windows / ventilators with frosted glazing in toilets.
	Cup-boards	Cup-board upto ceiling height in Office room, Green room including magnetic catchers, tower bolt (250 x 10 mm) from inside, cup-board lock, drawer provision with lock. Cup-board shall be made as per details given in particular specification.
	Roller blind	Translucent fabric roller blinds shall be provided in offices, faculty rooms and at other rooms/halls blackout fabric roller blinds.
	STEEL WORK	
	Railing in staircase / balconies / ramps	i. Stainless steel grade 304 double handrail railing of height 960 mm (barrier free accessibility requirements) as per approved architectural drawing in staircase and ramp railings. ii. SS grade 316, single handrail railing of height not less than 1200 mm as per approved architectural drawing in balconies corridors at court yard side, parapet, over retaining walls for developing terraces of buildings.
	Miscellaneous steel work	i. M.S. grill in each window having weight not less than 12 kg/sqm. ii. Providing accessible platform in all shafts at each floor level. iii. Steel work in built up sections for drains,

		gratings and frames.
	FLOORING AND CLADDING WORK	
	Windows Sill and jambs	Single length 18 mm thick granite stone in window sills and jambs including edge moulding and polishing to edges.
	Flooring	(i) Auditorium: 18 mm thick polished granite stone flooring in required design and patterns in linear as well as curvilinear portions as per approved architectural drawings. (ii) Stage: 18 mm thick polished/flamed granite stone flooring in required design and patterns in linear as well as curvilinear portions as per approved architectural drawings. (iii) Rooms: Double charged vitrified floor tiles of size 600x600 mm laid with cement based high polymer modified tile adhesive and with spacers and filled the joints with epoxy grout. (iv) Entrance Lobby, Corridors, Lift lobby & all serving counters: 18 mm thick polished granite stone flooring in required design and patterns in linear as well as curvilinear portions as per approved architectural drawings. (v) Single length flamed granite stone flooring in tread of Staircase and landing. (vi) AHU room, HVAC, Electrical, Store, UPS room – Kota stone flooring (vii) Gents / ladies wash rooms, janitor rooms, PH toilets: antiskid double charged vitrified floor tiles of size 600 x 600 mm. (viii) Ramps: 18 mm thick Vitrified tiles in combination of Polished and Flamed (Inlanding flamed and in sole portion polished) (vii) Tactile tile (for vision impaired persons) as per standard, samarthanam Gudidelines and NBC norms. in Entrance, Coridor, stair and other areas.
	Skirting, dado and wall lining	(i) Entrance lobby, corridors and staircase 1200 mm high 18 mm thick Polished

		granite stone dado match with the specification of respective flooring. (ii) 18 mm thick polished granite stone for risers and wall lining in lift lobby upto ceiling height. (iii) Specifications for materials of skirting will be same as for flooring with matching joint pattern having 100 to 150 mm height at other places. (iv) 1st quality Digital ceramic glazed wall tiles of minimum size 300 x 450 mm in dados of toilets upto 2400 mm / false ceiling height. (v) Water tank 1st quality ceramic glazed wall tiles of minimum size 300 x 450 (vi) 50 mm thick GRC Jali in shaft or other places as per approved architectural drawings.
	ROOFING	
	Rain Water Pipes	All the RWP pipes shall be Hubless centrifugally cast (spun) iron pipes epoxy coated i/c all type of fittings to be executed as per CPWD specification and approved architectural drawings.
	False ceiling	i Metal clip in ceiling system of 600 x 600 mm as per DSR 2021, Item No. 12.54.1 in toilets. ii False ceiling in auditorium as defined particular specification.
	FINISHING	
	Plastering on walls (Internal & External)	(i) 12/15 mm thick cement plaster shall be done on outside face of external walls on walls of wet area after fixing chicken wire mesh on walls surface at junction of masonry work and RCC beams, columns, lintels etc as per CPWD specification. (ii) All other internal walls shall be plastered with gypsum plaster after fixing chicken wire mesh on walls surface at junction of

		masonry work and RCC works. (iii) Ceiling shall be plastered with 6 mm thick cement plaster. (iv) Necessary drip course shall be provided in chajjas, balconies, projecting roofs, beams etc.
	Internal / external finishing	(i) White cement based putty of average thickness 1 mm shall be done on cement plastered / gypsum plastered surface followed by primer (water / solvent based) on gypsum plastered surface before painting. (ii) All inside walls shall be painted with low VOC premium acrylic emulsion paint. (iii) All external walls shall be finished with textured exterior paint. (iv) Synthetic enamel paint on steel work, exposed pipes of rain water, sanitary and water supply. (v) Melamine Polish (in 3 or more coats to achieve superior finish) on teak wood & decorative veneered surfaces.
	SANITARY AND WATER SUPPLY WORK	
	Sanitary pipes &fixtures	(i) Vitreous China Rimless wall-hung WC with soft close seat & cover, with or without cistern with Pressmatic system as per architectural drawings. (ii) White vitreous china orissa pattern water closet squatting pan (Indian type W.C. pan) with dual flushing cistern as per architectural drawings. (iii) White vitreous china urinals with pressmatic system operated urinals. (iv) Stainless steel urinal partition of required size. (v) White Vitreous China under counter oval shaped wash basin with CP brass 32mm size Bottle Trap. (vi) Hubless centrifugally cast (spun) iron pipes epoxy coated i/c all type of fittings for soil, waste and vent pipes.

	Water supply pipes	i. GI pipees and fittings for concealed internal work. ii. For external pipe line, GI pipes i/c all fittings, union, ball valves, butterfly and air valves shall be provided.
	C.P. Brass fittings	(i) Quarter turn two way bib cock one no., one no. angle valve for cistern, one no. toilet paper holder in each European WC Toilet. (ii) Quarter turn bib cock one no., one no. angle valve for cistern in each Indian WC Toilet. (iii) Quarter turn concealed stop cock with each sensor based urinals. (iv) Quarter turn angle valve, pillar cock with auto closing system and soap dispenser with each wash basin. (v) Single lever wall mixer, 100 mm dia overhead shower with shower arm, One no. 600 mm long single towel rail and one dual rob hook in each bath. (vi) Quarter turn angle valves with each water coolers and RO's water system. (vii) Quarter turn long body bib cock as per requirement. (viii) One no. 600 mm long single towel rail in wash basin area of each toilet block.
	Miscellaneous fixtures	(i) Full length clear mirror over wash basin. (ii) Stainless steel grade 304 vertical grating with frame will be fixed in wall in all wet area.
	Toilet for persons with disability	One toilet shall be made as per harmonized guidelines and space standards for barrier free built environment for persons with disability and elderly persons issued by Ministry of Urban Development, Samarthaman,NBC etc.
	DRAINAGE	(i) DWC HDPE pipes for laying external sewer lines around building and connecting to

		main sewer line. (ii) Manholes of required size and depth in brick masonry with SFRC covers and frames. (iii) Orange colour safety foot rest of minimum 6mm thick plastic encapsulated complete as per IS: 10910 wherever required. RCC drain with covers as per architectural / structural drawing.
	WATER PROOFING TREATMENT	
	Terrace	Brick bat coba with top layer finished with 20 mm thick heat resisting tile (SRI > 78, solar reflection > 0.70 and initial emittance > 0.75) with XPS board sandwitch between Brick coba and Heat resitive tile having minimum 100 mm XPS insulation. XPS Insulation board having the density of 34-36 kg/m3, water absorption less than 1%, compressive strength > 350kPa and Thermal Conductivity of 0.0289W/mK (As approved by the adhesive manufacturer) over the adhesive layer
	Overhead water tank, toilet and sunken portion	(i) Integral 10 crystalline admixture (16 Bar) for water proofing treatment to RCC structures using integral crystalline admixture as recommended. (ii) Integral crystalline slurry of hydrophilic in nature for waterproofing treatment to RCC structures for coating on vertical and horizontal surfaces as recommended.
	CONNECTING PATH & PARKING	(i) 100 mm thick cement concrete pavement of mix M 25 with vacuum dewatering process in internal paths. Sub base and base course shall be laid as per design. (ii) Factory made precast kerb stone of M 35 grade cement concrete shall be provided and laid as per architectural drawing. (iii) 80 mm thick PU mould interlocking cement concrete paver block of M 30 grade laid in required colour, design and pattern over 50 mm thick compacted bed of sand and 100 mm thick plain concrete of M10 grade as per architectural drawing.
	MISCELLANEOUS	

	ACOUSTICS WORK	(ii) Acoustic Treatment for Low Frequency Absorption for Walls (iii) Acoustic Diffusion for side walls (iv) Acoustic Treatment for Mid & High Frequency Absorption for Walls (v) Acoustic Treatment for Stage walls (vi) Flooring : Floor Impact Isolation treatment (vii) Ceiling Treatment
	Temporary barricading	As per general specification at Sl. No. 2.
	Accessibility of Buildings	Building shall be accessible by differently abled persons as per norms of CPWD Green Manual 2019.
	Plinth Protection	1.00 meter wide 50 mm thick M 15 grade concrete. It shall be laid over 100 mm thick lean concrete in M-10 with edge protection.
	Terrace Tanks	RCC overhead water storage tanks if storage capacity is more than 5000 litre otherwise PVC water tanks.

NOTE: The above list is only indicative and not exhaustive. The contractor has to plan and execute all the missing fittings / fixtures / item to make the premises to the full use. Nothing extra shall be paid on this account.

TECHNICAL SPECIFICATIONS
FOR PKG-2

Brief scope of Electrical Works:

1	Internal and External Electrical Installations	Planning, Design & preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from the WAPCOS, Supply, installation, testing and commissioning of (i) Internal Electrical Installations, Power wiring, Fire Alarm & PA System, CCTV, LAN & DATA/VOICE ,Modular type PVC wall raceway / trunking, LED light Fittings, Exhaust fans, AC Ceiling fans, Switch boards, LT Panels, Rising mains, G.I. Cable trays, Smart Energy meters with meter boards , Lightening conductors, etc. (ii) UPS supply to required points, racks & control panels, required cabling, earthing etc. and (iii) Decorative Street lighting / compound lightinng, landscape lighting with LED fittings(as per NBC – 2016 and CPWD specifications as amended upto date, as described in the details of specifications.Contractor should subhmit DBR.
2.	MRL Lifts	Planning, Design & preparation of GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply,installation, testing and commissioning of MRL lifts as described in the details specifications of lift building wise in lift Sub head and as per NBC - 2016 guidelines etc. with all allied work.
3.	Fire Fighting System	Planning, Design & preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of Fire Fighting system as per the requirement of NBC 2016 with amendments, updated BIS codes, Fire bye-laws of Govt. of Jharkhand and CPWD specifications for buildings as described in the details of specifications. Contractor should submit DBR.
4.	Automatic Fire alarm system	Planning, Design & preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of Automatic Fire Alarm System, PA System and Exit signage‘s as per the requirement of NBC 2016 with amendments, updated BIS codes, Fire bye-laws of Govt. of Jharkhand and CPWD specifications for buildings as described in the details of specifications. . Contractor should submit DBR.

5.	DATA Networking system (Active and Passive Components)	Planning, Design & preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of Active and Passive LAN Networking system, Wi-Fi System, OFC backbone for the buildings(if required) and integration with existing DATA Centre of campus. . Contractor should submit DBR.
6.	UPS System	Planning, Design &preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of UPS System as per specification. Contractor should submit DBR.
7.	CCTV System	Planning, Design &preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of CCTV System for buildings internal andexternal area with Video Management system, Recording, Analytics and Failover Server, CCTV Client Workstation and Video Storage – 300 TB usable and integration with existing CCTV system as per specification. Contractor should submit DBR. .
8.	HVAC System	Planning, Design & preparation of GFC Drawings for E & M services, obtaining approvals from WAPCOS,Supply, installation, testing and commissioning of water cooled **Screw type** chilling machine / plant with standby unit, functional requirement as described in the details of specifications, and Codes. Minimum capacity: Central AC Plant – 356 TR Chiller unit. Stand by Unit - 356TR chiller Unit All air conditioned areas will be centrally heated through hot water generators from common HVAC plant room. HVAC plant room consisting of high side equipments i.e. Chillers, hot water generators, Primary & Secondary pumps complete with condenser, chilled water pipe lines (Supply & Return), and low side equipments i.e AHU‘s / FCU‘s, Hi-wall units, Air cooled Inverter type Spilt AC units, Air cooled package units, VAV boxes, tertiary pumps, electrical panels, control panels, VFD‘s, Pumps, motors, pressurization fans, toilet exhaust system, ventilation and smoke evacuation in basement as per NBC-2016 guidelines, CPWD specifications and relevant IS codes . All exit routes in the AC areas shall also have smoke extraction system with all allied work. Contractor should submit DBR.

9.	Electrical Sub-station equipments & ExternalElectrical Service connection cabling to buildings	Planning, Design & preparation of GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of minimum Capacity: 2 Nos. 11KV/0.433KV substation (700 & 800 KVA) equipments and external cabling as described in the details of specifications. Contractor should submit DBR. 2 Nos. 11KV/433V, SS (SS- 7 have 2 Nos. 800 KVA and 700 KVA dry/oil type transformer which includes Substation equipments, HT (VCB) panels, transformers, TTTA type LT Panels, bus trunking, APFC & AHF Panels, cables to all LT Panels, Feeder pillars, earthing etc. Design & Drawing, Supply, installation, testing and Commissioning of external service connections with suitable sizes of 1.1 KV grade aluminium conductor armoured cables to buildings and facilities under pkg-2 from substation(s)on G.I. Cable trays in MEP Trenches / building trenches with suitable M.S. supporting structure & Clamps, earthing etc. as described in the details of specifications.
10.	DG Sets & Fuel Storage tank	Planning, Design & preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of minimum Capacity: 1 X 800 KVA and 1x700 KVA DG sets,AMF panel, bus ducting cables from DG sets to essential panels DG set enclosure room sound insulation/ventilation/smoke exhaust as required, earthing of DG set system, control cabling, fuel tank/piping, DG set exhaust piping/exhaust chimney as per CPCB norms as per NBC - 2016 as described in the details of specifications. Contractor should submit DBR.
11.	BMS & SCADA	Planning, Design & preparation of GFC Drawings for E & M services, obtaining approvals fromWAPCOS, Supply, installation, testing and commissioning of BMS for operation &/or monitoring of complete mechanical and electrical services (except indoor lighting& Fans) i.e. Lifts, Substations, DG sets, HVAC, Fire Fighting & Fire Alarm systems, CCTV system, Access control system, water supply pump sets and SCADA System for SS and also include integration with existing SCADA / BMS systemas described in the details of specifications.
12.	Access Control System	Planning, Design &preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of Access Control System for Centenary buildings as per specification. Contractor should submit DBR.

13.	Water Supply System	Planning, Design &preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from WAPCOS, Supply, installation, testing and commissioning of Water supply pumping System for Centenary buildings & Services as specifications.
14.	Audio / Visual System & PA System	Planning, Design &preparation of Architectural and GFC Drawings for E & M services, obtaining approvals from the department, Supply, installation, testing and commissioning of Audio / Visual System for All the Lecturehall, Auditorium etc. as per the specifications. Contractor should submit DBR.

PART E- 1

INTERNAL AND EXTERNAL ELECTRICAL INSTALLATION

GENERAL COMMERCIAL & TECHNICAL CONDITIONS FOR INTERNAL AND EXTERNAL ELECTRICAL WORKS

All the works shall be carried out as per CPWD General Specification for **Electrical Works, Part-I (Internal)-2013; Part-II (External) 1994 -;** as amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable and as amended up to date.

1.0 The contractor is advised to visit the site of work at his own convenience & cost to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

The brief scope of work is as following:-

Providing, Installation, Testing and commissioning of all Internal Electrical Installations and services including point wiring, light, UPS, Inverter and power wiring, rising mains, Main building panels, floor LT panels, Meter boards with smart energy meters., DBs with MCCBs, RCBO's, MCBs, Earthing, lightening arrestor, LED fittings, fans, TV wiring, DATA / VOICE, CCTV, Fire Alarm & PA System, conduiting with steel conduit, socket outlets, Modular type wall PVC Trunking / raceway and all other allied work,for all the single/ Multi-storeyed buildings including planning and designing by incorporating stipulated specifications, on design, built and handover basis including all works as per scope for Work and user requirement all complete as required.
SITC of 195mm X 50mm Modular type PVC wall raceway / trunking in corridors for distribution of light / power / LAN wiring to each room / area from LT panel / DB's in Centenary Building and suitable size of modular type PVC wall raceway .

a) Centenary Building (G+4)

Total plinth area to be constructed shall not be less than **18708 SMT** . If less/ excess area is executed recovery / payment shall be made on pro rata basis from/to the EPC contractor.

2.0 COMPLETENESS OF TENDER:

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the Tender, whether such items are specifically mentioned in the tender documents or not.

3.0 WORKS TO BE DONE BY THE CONTRACTOR:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

(i) Foundations for equipments and components where required, including foundations bolts.
(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.
(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.
(iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubicle switchboard etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.
(v) Testing and commissioning of completed installation.
(vi) Storage space for all equipments, components and materials for the work.
(vii) Cutting of chases shall be done by chase cutting machine and hole through the walls/ slabs if required will be done by core cutting machine.

4.0 STORAGE AND CUSTODY OF MATERIALS:

The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till

the same is handed over to the department. No extra Payment will be made on this account. The main contractor shall arrange for proper storage of the electrical fans and fittings at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

5.0 ELECTRIC POWER SUPPLY AND WATER SUPPLY:

Before starting execution Power and water supply will be arranged by the contractor at the site. Contractor will takedue care to ensure safety during execution of work.

6.0 TOOLS FOR HANDLING AND ERECTING:

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

7.0 CO-ORDINATION WITH OTHER AGENCIES:

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority

8.0 CARE OF BUILDINGS:

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

9.0 STRUCTURAL ALTERATIONS TO BUILDINGS:

(i) No structural member in the building shall be damaged /altered, without prior approval from the competent authority through the Engineer-n-charge.

(ii) Structural provisions like openings, cut-outs, if any, provided by the department for the work, shall be used. Where these required modifications or fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.

(iii) All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings without any extra payment beyond the agreement items.

ADDITION TO AN INSTALLATION:

Any addition, temporary or permanent, to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

10.0 WORK IN OCCUPIED BUILDINGS:

(i) When work is executed in occupied buildings, there would be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after the office hours.

(ii) The contractor shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.

(iii) The contractor shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the Engineer-in-charge

11.0 GFC DRAWINGS:

(i) The EPC contractor shall prepare all Architectural and GFC drawings as per the site requirement and also in accordance with modification there to from time to time as approved by the Engineer-in-charge.

(ii) All wiring diagrams shall be deemed to be ‗GFC DRAWINGS'. They shall indicate the main switch board, the distribution boards (with circuit numbers controlled by them), the runs of various mains and sub mains and the position of all points with their controls.

(iii) All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which they are electrically connected.

(iv) After award of the work, the firm will be required to submit the GFC drawings and technical data sheets for the proposed work. Work will be carried out as per the approved GFC DRAWINGS.

12.0 CONFORMITY TO IE ACT, IE RULES, AND STANDARDS:

All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of submission of online bids of tender unless specified otherwise).

13.0 QUALITY OF MATERIAL:

All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

14.0 INSPECTION OF MATERIALS AND EQUIPMENTS:

15.0 Materials and equipments to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:

(i) Inspection of materials / equipments to be witnessed at the Manufacturer‘s premises in accordance with relevant BIS /Agreement Inspection Procedure.

(ii) To receive materials at site with Manufacturer‘s Test Certificate(s)

(iii) To inspect materials at the authorized dealer‘s Godown / Warehouse to ensure delivery of genuine materials at site.

(iv) To receive materials after physical inspection at site.

15.1 Adequate care to ensure that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall ensure that:

(i) Material will be ordered & delivered at site only with the prior approval of the department to ensure timely delivery.

(ii) As and when the order is placed for the fittings/ fixtures, cables, switchgears, poles, other main items etc, its copy shall be endorsed to the WAPCOS Engineer-in- charge.

(iii) The contractor will submit makes & brands of electrical fittings & fans, exhaust fans, MCB‘s & DB‘s, switches & sockets, wires & cables, conduits and switchgears, rising mains, poles, outdoor fittings etc. out of preferred make list as per tender documents for approval of Engineer-In-Charge whose decision will be final in the matter.

(iv) The agency will be required to procure material like electrical fittings & fans, exhaust fans, MCB‘s & DB‘s, switches & sockets, wires & cables, conduits and switchgears, rising mains, poles , outdoor fittings etc. directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the contractor if required by the WAPCOS.

(iv) Inspection at factory or at godown, as required, shall be arranged by the agency for a mutually agreed date.

(v) Delivery of material shall be taken up only with the consent of department, after clearance of the material.

(vi) Department shall reserve the right to waive inspection in lieu of suitable test certificate, at its discretion.

(vii) The fans & fittings to be supplied by the contractor shall be procured & brought to site not before 3 months from –finishing‖ works so that these fans & fittings are not damaged & do not loose their manufacturers warrantee.

15.2 Similarly, for fabricated equipments, the contractor will first submit dimensional detailed SHOP DRAWINGS for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.

16.0 RATINGS OF COMPONENTS:

16.1 All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.

16.2 All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

17.0 CONFORMITY TO STANDARDS:

17.1 All components shall conform to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.

17.2 Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

18.0 INTERCHANGEABILITY:

Similar parts of all switches, lamp holders, distribution fuse boards, Switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

19.0 WORKMANSHIP:

19.1 Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

19.2 Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensureproper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

19.3 Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.

19.4 Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.

20.0 TESTING:

All testes prescribed in this General Specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

21.0 COMMISSIONING ON COMPLETION:

After the work is completed, it shall be ensured that the installation is tested and commissioned.

22.0 COMPLETION PLAN:

Completion plan drawn indicating the following, shall also be submitted.

(i) General layout of the building.

(ii) Locations of main switchboard and distribution boards, indicating the circuit numbers controlled by them.

(iii) Position of all points and their controls.

(iv) Types of fittings, viz. LED, pendants, brackets, bulk head, fans, exhaust fans etc.

(v) Name of work, job number, tender reference, actual date of completion, names of Division/ Sub-division and name of the firm who executed the work with their signature.

23.0 GUARANTEE

The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design / workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge.

24.0 Wherever ceiling roses are not required to be provided in the light/fan/exhaust fan points, due to site conditions, the contractor shall use suitable three pin connectors for which nothing extrashall be paid. Wiring shall be carried out with FRLS wires.

24.1 Contractor shall provide polythene/PVC plastic cover for all MDB‘s/SDB‘s/DB‘s to protect them from rust/damages, during execution of work till the work is actually completed and handed over to the department.

24.2 The loose wire boxes/cable end boxes (adaptor boxes) shall be provided on the various electrical boards to facilitate the termination of the wiring in the various mountings. The box cover shall be made from powder coated aluminium section frame with 3 mm thick ACP

sheet with lockable handle as desired by the Engineer-in-charge. The length of such boxes shall be same/or more as the width of the electrical switchboard. Such loose wire boxes are deemed included in the scope of the work and no extra payment shall be made for them.

24.3 All debris/melba resulting due to electrical work shall be removed on daily basis and completion of the work shall only be accepted after the site has been cleaned of all melba. In case, contractor fails to comply, the same shall be got removed by the other agency and the payment so made shall be recovered from the bill(s) of the contractor.

24.4 The contractor shall have to make arrangements, at his own risk and cost, for transportation of materials from the point of issue of stores to site of work, if any.

24.5 Makes of all items that are not covered in the schedule of work/additional specifications shall be got approved from the Engineer-in-charge and shall conform to relevant Indian Standard as applicable.

24.6 The contractor shall ensure that the staff employed by him for execution of the electrical work, possess the valid electrical license issued by competent authority. Consequences arising due to the default of the contractor in not complying with the above condition shall be the responsibility of the contractor.

24.7 Copper lugs shall be provided for terminating copper/aluminum/GI earth wire to all switchboards for which nothing extra shall be paid. All multi stranded /stranded wires shall be terminated through copper lugs.

24.8 All concealed work and earthing shall be done in the presence of the Engineer-in-charge or his authorized representative.

24.9 The GA Drawings of the various electrical cubical panels shall be got approved from the Engineer-in-charge before fabrication and shall comply with CPWD specifications and Indian Electricity Rules. The panels shall conform to IS: 8623/1993. All panels shall be powder coated inside out, in shade approved by the Engineer-in-charge.

24.10 All floor-mounted panels shall be mounted on 75mmX75mmX6mm thick M.S. channel on all the sides. It shall have a continuous earth bus of the same size and material as the main phase running continuously along the length of the panel extending on either side for earth connection.

24.11 The doors of all cubicle panels shall be hinged type including those of bus bar chambers and cable alleys. The locking shall be with chrome plated metal key locks. All doors shall be earthed with copper conductor wire as approved by the Engineer-in-charge.

24.12 The work shall be carried out according to GFC drawing approved by the Engineer-in-charge. The layout once approved can only be changed by the Engineer-in-charge as per requirement at site. It shall be the responsibility of the contractor to plan the layout and get the approval from the Engineer-in-charge before laying the conduits etc.

24.13 The MCB should be ‗C' type of the same make as that of MCB DB's and having a minimum breaking capacity of 10 KA. Contractor shall obtain approval of the Engineer-in-charge before procurement of MCB DB's.

24.14 All model of modular accessories required for the work shall be got approved from the Engineer-in-charge from among the approved makes. The base plate shall be preferably in sheet steel or otherwise in unbreakable polycarbonate. The cover plates shall be screw less type in shade approved by the Engineer-in-charge.

24.15 Contractor shall have to check the Site Order Book for any instructions of the Engineer-in-charge or his authorized representative and sign the site order book. He shall be bound to ensure compliance with the instructions recorded therein.

25 The MCCB‘s shall be compatible for reliable protection and accurate measurement. The rated Service breaking capacity (ka) shall be 100% of Ultimate breaking capacity (ka).All MCCB‘s shall be current limiting type with features as per relevant IS codes and CPWD specification.

25.1 MCCB‘s shall be used with terminal spreaders and all terminals shall be shrouded to avoid direct contact.

25.2 Mechanical Castle key interlock shall be provided among the incomer MCCB‘s, wherever, as applicable, two different incomer sources are provided in the panel as per the directionsof the Engineer in charge. The same is deemed included in the scope of work.

25.3 All measuring and indicating instruments shall be protected through fuses/ MCB‘s and isolating switches.

25.4 General arrangement drawing of the switchboard shall be got approved from the Engineer-in-Charge before commencement of manufacturing.

25.5 For the items like LT panels, feeder pillars and accessories, etc, the firm shall arrange for inspection in the factory and provide for all facilities for testing. The cost of the visit of Engineer-in-Charge or his representative shall be borne by department. However, firm will be responsible for arranging the inspections as required.

25.6 Conduit layout as per switching arrangement shall be prepared by contractor and got approved from the Engineer-in-Charge before slab casting.

25.7 Air conditioner wiring layout arrangement shall be prepared by contractor and got approved from Engineer-in-charge.

25.8 All Accessories of MS conduit shall have ISI marked.

25.9 To facilitate drawing of wires 16/18 SWG G.I fish wire shall be provided along with laying of recessed conduit for which no extra payment shall be made to contractor.

25.10 Conduit and termination to SDB and main board adapter box i/c connection wires to MCB,s inter connection between SDB and main board etc shall be included in thetendered rates and nothing extra shall be paid for the same.

25.11 The contractor shall provide junction boxes / looping boxes of required sizes and such boxes shall be measured as part of conduit / batten wiring without any extra payment.

25.12 Only brass screws along with brass washers will be used for fixing Phenolic laminated sheet covers and at other places aluminum alloy/ brass / cadmium plated screws will be used.

25.13 M.S. dash fastener shall be used for installation of fittings and fixtures in ceiling and for providing suspenders for the angle support, conducting, cable tray etc. for which nothing extra shall be paid

25.14 All CI/metal boxes & junction boxes should be cleaned properly and painted from inside before wiring & fixing the accessories.

25.15 In wiring items like point wiring / wiring for light and power plug /circuit wiring / sub main wiring, the item includes the cost of conduit also.

Additional technical specification for internal electrification works:-

Note: The following information given is indicative only. Execution shall be carried out as per functional requirement and design approved by engineer-in-charge

1. All internal electrical works shall be carried out with FRLS PVC insulated conductor cables (IS:694) in recessed Steel conduit. All switches, sockets, AC Starter, IP Phone socket, Data/LAN sockets, stepped type electronic fan regulators, bell push and accessories along with matching mounting boxes shall be of modular type.
2. The ceiling fan regulator shall be twin module and step type.
3. The colour and finish of the modular type switch / sockets and its accessories shall be decided by Engg-in-Charge. WAPCOS in consultation with client at the time of approval. Nothing extra payable for that.
4. All lighting fixtures should be LED type having efficacy more than 110 Lumen / Watt, CRI >80, THD <10%, LM 79 & LM 80 test report from NABL accredited lab should be submitted by the agency.
5. Required illumination level for general lighting shall be achieved on the basis of required lux level in various areas, light power density as per CPWD specification and NBC 2016**.**
6. Arrangement of luminaries in various areas of Residential and non – residential buildings shall be done on the basis of Illumination level & light power density as specified in CPWD specification Internal 2013 and National Building Code 2016 and shall be got approved from Engineer-in-charge.
7. During Design, submission photometric file in IES format has to be submitted by the Agency.
8. Ceiling fans will be provided in every building and at each location except toilets / Bath rooms irrespective of provision of air conditioners. All ceiling fans shall be of 1200 mm sweep and should be of 5 Star rated. Optimum size / number of ceiling fans for room of different sizes shall be as per provision laid down in CPWD specifications for internal EI work 2013. Minimum air delivery and service value shall be as per the above specification. Exhaust fans of suitable capacity and sweep shall be provided in all the toilets as per standard specifications and as per the approval of Engineer-in-Charge.
9. T.V outlet wiring shall be terminated in suitable size of G.I. box along with splitter. The interconnections of all splitter boxes fixed at all floors shall be done properly to form proper distribution system with the prior approval of Engineer-in- charge.
10. Meter Boards: Meter boards shall be fabricated 14 SWG CRCA sheet. It should be of cubical construction, powder coated. Number of Smart Energy meters to be accommodated in each meter board shall be equal to no. of quarters at each floor. Each meter board shall be equipped with TPNMCB/SPNMCB of suitable rating as incomer and as decided by Engineer-in-charge and MCB of suitable rating for each compartment, digital type ammeter, voltmeter, multifunction meter and selector switches, LED type indication lamps etc. Meter board shall be fabricated from a CPRI approved fabricator after approval of drawing from Engineer-in-charge.

11. The breaking capacity of MCCB shall be as per actual design fault level calculation. The breaking capacity of MCCB shall be same for all MCCB in one panel subject to minimum of 35KA for MCCB <400Amps and 50 KA for >400Amps MCCBs. The vendor shall be provide the fault current calculation of individual panel for approval.

12. Floor Panels: In all buildings, the panel boards shall be of modular type and shall have 25% spare outgoings of each rating for future expansion and fabricated as per CPWD Specifications. The incomers, outgoings, bus bar, indicating instruments etc. shall be designed as per connected load and shall be got approved from Engineer-in-charge.

13. All types of panel shall be fabricated from CPRI approved firms and strictly as per CPWD specifications. The drawing of panel boards must be got approved from Engineer – in – charge before fabrication work. The panel board shall consist of MCCB/ACB as incomer and outgoing, copper / Aluminum bus bar, digital type ammeter, voltmeter OR multifunction meter, selector switches, LED type indication lamps etc. as per standard sound engineering practice. Every multi function meter should have RS 485 port.

14. Rising mains: Upward transmission of power inside the buildings shall be done with Sandwich type bus trunking with copper bus bar with all accessories i.e; adapter box, cable end box, tap-off box with MCCB. Rating of rising mains shall be decided as per connected load of the building and future expansion and as approved by Engineer – in –Charge. Rising mains shall be conforming to IS 8623, IEC61439 as amended upto date. Rating of rising mains in various building shall be minimum of 200 amps as per design / connected load and future expansion.

15. Staircase lighting, lobby and toilet lights shall be group controlled.

16. Minimum size of copper conductor for power wiring shall be 4 Sq mm and that for light and fan points wiring shall be 1.5 sq mm.

17. The wiring and conduit route plan/drawings shall be submitted by the contractor and shall be got approved from the Engineer-in-charge.

18. To facilitate drawing of wires, 18 SWG GI fish wire shall be provided along laying of recessed conduit. Conduits laid for other services, like fire alarm, PA system etc., where wiring is not done along IEI works; fish wire shall be invariably drawn.

19. The connection between incoming switch / MCB and bus bar shall be made of suitable size of thimble and cable.

20. While laying conduits for fire alarm system, sufficient junction outlets are to be provided as per the direction of the Engineer-in-Charge for detectors as required.

21. After completing the work, necessary test results as envisaged in CPWD General Specifications Part-I (Internal)-2013 & Indian Electricity Rules 1956, shall be recorded and submitted to the

department. The results shall be in the permissible limits. Test report forms duly signed by authorized person for obtaining electric connections (energy meters) by the agency shall be given to the allottees.

22. Lightning arresters shall be provided for all buildings irrespective of height as per IS 2309-1989 as amended up to date and CPWD specifications for internal work – 2013.

23. RCBO of 30ma to 300ma sensitivity of suitable rating shall be provided as Incomer of each Distribution boards as per design and direction of engineer in charge.

24. Wherever false ceiling exist, recessed type fitting shall be provided and surface type fitting shall be provided where there is no false ceiling.

25. Lighting luminaries (LED type) in all buildings shall be decided as per functional requirement, design and drawing approved.

26. In each building, wherever lift is provided, power supply to DBs located in Lift shaft at suitable location as approved by Engineer-in-charge shall be done using suitable size FRLS copper conductor cable in recessed steel conduit.

27. Inside the lift shaft there shall be arrangement of one light point at each floor level and one light point at overhead, one light point in lift pit. All light points shall be in group controlled and wired with 2.5 sq mm FRLS copper conductor cable. 15 amp power plug and 5 amp power plug shall be provided at each floor. Wiring of these power plugs shall be done with 4 sq mm FRLS copper wires. LED Bulk head fittings of suitable rating to provide minimum lux of 110 shall be connected with each point of lift shaft.

28. For accommodating various size of cable incoming to the building, NP3 pipes of suitable size shall be provided.

29. All hardware items such as screws, thimbles, connectors, earth/neutral terminals, wires etc. which are essentially required for completing any item as per specifications will be deemed to have been included in the item even when the same have not been specifically mentioned.

30. All hardware material such as nuts/bolts/screws/washers etc. to be used in the work shall be zinc/cadmium plated iron. The galvanized boxes of modular switch/sockets etc. shall be of the same make as of switch/socket etc.

31. While laying conduit, suitable minimum number of junction boxes shall be left for pulling the wires. These shall be placed in such a way that the same do not remain noticeable.

32. Multi stranded FRLS PVC insulated copper conductors wires are to be used in the work. Termination of multi-stranded conductors shall be done using crimping type copper thimbles at both the ends. Nothing extra shall be paid for the same.

33. The connections of switches, earthing conductors & interconnections cables shall be made by adequate rating thimbles of approved standard makes only and nothing extra on this account shall be paid.

34. Check nuts shall be provided while terminating the M.S. conduits in switch board boxes for which nothing extra shall be paid.

35. All distribution boards shall be marked with circuits controlling the rooms/area/SDB controlled

36. All Materials to be used in the work shall be ISI marked. The makes of material have been indicated in the list of acceptable makes. No other make will be acceptable.

37. Samples of materials to be used at work shall be brought to site for approval of Engineer in Charge in consultation with committee before placing any order.

38. The Engineer-in-charge shall reserve the right to instruct the contractor to remove the material which, in his opinion, is not as per specifications While deciding the size of switch boxes for light points/fan point, exhaust fan point items, extra two modules will be provided for each fan point for fixing of regulator(s) (fan regulator is to be provided under different item). Wherever extra modules are available, the same shall be provided with blanking plates without any extra cost.

39. Modular type switches/sockets/TV sockets are to be provided wherever indicated in the items. The same shall be of only one make. The modular plates of switches, sockets, telephone & TV sockets etc. shall be in two parts i.e. plates with frames with in quoted rates.

40. Wherever it is not possible to provide rigid conduits, flexible conduit pipe shall be provided for drawing/running the wires. However, such arrangement has to be kept to the barest minimum and only with the prior approval of Engineer-in-charge.

41. Earthing and all hidden items of work shall be carried out in the presence of the Engineer-in-charge or his authorized representative.

42. The firm has to go through the site order book kept with the Assistant Engineer(E) regularly and has to sign the same and carryout the instructions recorded therein by various officers of the department.

43. The agency shall bring the various items & materials as per actual requirement at site at the time of execution of work. Excess quantities shall not be accepted & paid by the department.

44. The ceiling roses wherever required to be provided are included in the scope of work without extra payment and the same shall also be of modular type & of the same make as that of switches & sockets along with earthing provision.

45. MCCB should have centrally adjustable overload setting 80% to 100% & short circuit setting adjustable from 500% to 1000% of nominal current for thermal type & overload setting 40% to 100% & short circuit setting adjustable from 150% to 1000% of nominal current for microprocessor type MCCB. All MCCB should be ICS=ICU

46. Size of distribution board shall be as per number of light / power circuits. All distribution board shall be double door type. RCBO of suitable rating shall be provided as main incomer in all DBs.

47. The breaking capacity of MCCB shall be as per actual design fault level calculation. The breaking capacity of MCCB shall be same for all MCCB in one panel subject to minimum of 35KA for MCCB <400Amps and 50 KA for >400Amps MCCBs. The vendor shall be provide the fault level calculation of individual panel for approval.

48. LT panel shall be cubicle type with IP 54 protection class and fabricated from CPRI approved fabricator and shall be equipped with digital type measuring instruments like ammeter, voltmeter, frequency meter, watt meter, multi- function meter and shall have BMS facility etc. as per drawing approved by Engineer – in – charge.

49. Each floor Panel shall be fabricated from 2 mm thick CRCA powder coated 9 tank process and shall be equipped 4 pole MCCBs, MCBs, Bus bar, digital voltmeter, ammeter, multifunction meter with KWH meter, BMS compatible LED indicating lamp extended rotary handle and all accessories as required.

50. If used as incomer then it should have earth fault protection and time delay in addition to above protection. Earth leakage modules are not acceptable.

51. Earthing: Earthing system comprising of earth electrode, earth conductor, earth bus, protective conductor etc. for each building shall be as per provision laid down in CPWD Specifications Part – I 2013.Earthing system should be designed such as to maintain earth resistance as specified in CPWD specifications. Earth resistance shall be checked / tested in harsh climatic conditions.

52. All equipments shall be guaranteed for a period of 36 months (except LED fittings which shall be guaranteed for minimum 5 years), from the date of taking over the installation by the department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-in Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding on the contractor.

53. Five years manufacturers guarantee should be submitted by the contractor for LED fittings on completion of the works. A letter from the original manufacturer of Luminaires shall be

submitted along with the supply of item.

Electrical Components

A) Switch / Sockets and accessories :

a) All switches 6 Amp to 20 Amp should be latest ISI marked as per IS 3854 : 1997. 6 Amp 3 Pin and 6/16 Amp 3 Pin combined sockets should be latest ISI Marked as per IS 1293 : 1988.

b) The fan regulator should be capacitor based, Hum Free and ISI marked as per IS 11037:1984.

c) All the switches, sockets, fan regulator etc. should be completely IP 20 protected with no live part directly accessible.

B) MCBs :

Shall be 10 kA ISI marked (IS 8828 – 1996) of C Class. Should have bi-connect on both terminals and 35 sq mm termination capacity on both terminals with insulated sliding shutters.

C) RCBOs:

Should be ISI marked (IS 12640 part 2 - 2001) with MCB as integral part of the unit providing 3-in-1 protection for overload, short-circuit and earth leakage. Should have 10kA breaking capacity, bi-connect on both the terminals, 35 Sq mm terminal capacity and insulated sliding shutters.

D) MCBDBs :

a) Should be as per IS 8623 with min. 100 Amp fully insulated copper busbars , insulated neutral bar , earth bar and cable ties for cable management , door earthing , corner shields for better protection , masking sheet , reversible doors and pan assembly for easy installation.

b) Distribution Board shall be double door type. All distribution boards shall be of three phases (415 Volts) or single phase (240 Volts) type with incoming isolator or MCB and/or RCCB / RCBO. Distribution boards shall contain plug in type miniature circuit breaker mounted on bus bars. Miniature circuit breakers shall be quick make & quick break type with trip free mechanism. MCB shall have thermal & magnetic short circuit protection. MCB shall conform with IS 8828-1978 & IS 8828 - 1996. Bus bars shall be of electrolytic copper. Neutral bus bars shall be provided with the same number of terminals as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. Separate neutral & earth bus bar link to be provided for each phase. Phase barrier shall be fitted and all live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. All distribution board enclosures shall have an etched zinc base stove painted followed by synthetic stove enamel, colour light gray. A circuit identification card in clear plastic cover shall be provided for each distribution board. IK (Mechanical Stress) rating of distribution board enclosure shall not be less than IK – 09.

c) Distribution Board with single phase outgoings requirement shall be Horizontal type. Distribution Board with three phase outgoings requirement shall be Vertical/ Horizontal

type. Distribution Board installed in indoor dry locations shall conform to IP-43. Distribution Board installed in outdoor & wet locations shall conform to IP- 65.

d) Distribution board shall be provided with isolator or MCB and/or earth leakage circuit breaker. Earth leakage circuit breaker shall be current operated type and of 30mA sensitivity unless otherwise stated. Distribution board box, isolator, MCB'S used shall be of one/same manufacturer. Standard size manufactured by approved manufacturer shall be used. In case size required is not standard size of manufacturer, in that case next standard size distribution board box shall be used with incoming & outgoing MCB. Additional cutout/space for outgoing MCB shall be plugged with blank plates. No extra cost shall be paid for using bigger/higher size distribution board box and blank plates.

E) Modular Type DLP Trunking:

a) Shall be made from very high quality of heavy duty PVC with very good strength.
b) Shall be Used to distribute power as well as LAN cables.
c) Shall be installed in combination with the Internal Angles, External Angles, Flat Angles etc. in order to suit the application area where we are installing it on.
d) The different components involved are : DLP Trunking Base, Flexible Cover, Separation Partition, Clip On Partition (For creating separate compartments in 150*50 & 195*50 Size Trunking), End Caps, Internal Angle, External Angle, Flat Angle (for any 90 Degree Angle), Flat Junction (T Point), Mosaic Frames (For mounting Switches & sockets etc.)
e) The trunking Base is fixed on to the wall by using the correct fasteners on the pre drilled location. Then the cable is carried into the DLP and wherever required.

M.S. Conduit

All conduit pipes shall be of approved gauge (not less than 16 SWG for conduits of sizes up to 32mm diameter and not less than 14 SWG for conduit of size above 32mm diameter) solid drawn or reamed by welding finished with stove enamelled surface. All conduit accessories shall be of threaded type and under no circumstances pin grip type accessories shall be used. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS code. No steel conduit less than 20mm in diameter shall be used unless otherwise stated.

i) Conduit Joints

Conduit pipes shall be joined by means of threaded couplers, and threaded accessories only. In long distance straight run of conduits, inspection type couplers at reasonable intervals shall be provided or running threads with couplers and jam nuts shall be provided. In the later case the bare threaded portion shall be treated with anti-corrosive preservative. Threads on conduit pipes in all cases shall be between 13mm to 19mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipe shall have no sharp edges nor any burrs left to avoid damage to the insulation of conductor while pulling them through such pipes.

Wherever conduit passes a building expansion joint, galvanized flexible metallic conduit shall be provided for connecting rigid M.S. Conduit in either slab.

ii) Protection against Condensation

The layout of conduit should be such that any condensation or sweating inside the conduit is drained out. Suitable precaution should also be taken to prevent entry of insects inside the conduit.

iii) Protection of Conduit against Rust

The outer surface of conduit including all bends, unions, tees, junction boxes etc forming part of conduit system shall be adequately protected against rust when such system is exposed to weather by being painted with two coats of oxide paint applied before they are fixed. In all cases, no bare threaded portion of conduit pipe shall be allowed. Unless such bare thread portion of conduit is treated with anticorrosive preservative or covered with approved plastic compound.

iv) Painting of Conduit and Accessories

After installation, all accessible surface of conduit pipes, fittings, switch and regulator boxes etc. shall be painted with two coats of approved enamelled paint or aluminium paint as required to match the finish of surrounding wall, trusses etc.

v) Fixing of conduits

Surface Conduit

Conduit pipes shall be fixed by heavy gauge saddles, secured to suitable wood plugs or other approved plugs with screws in an approved manner at an interval of not more than one meter but on either side of the couplers or bends or similar fittings, saddles shall be fixed at a distance of 30cm from the centre of such fittings. The saddles should not be less than 24 gauge for conduits up to 25mm dia and not less than 20 gauge for larger diameter conduits. The corresponding widths shall be 19mm & 25mm. Where conduit pipes are to be laid along the trusses, steel joint etc. the same shall be secured by means of special clamps made of MS. Where as it is not possible to drill holes in the trusses members suitable clamps with bolts and nuts shall be used. All fixing arrangement like saddles, special purpose clamps, nuts, bolts etc. shall deemed to be included in quoted rates of conduit.

For 25mm diameter conduit width of clip shall be 19mm and of 20 SWG. For conduit of 32mm and above, width of clip shall be 25mm and of 18 SWG.

Where conduit pipes are to be laid above false ceiling, either conduit pipes shall be clamp to false ceiling frame work or suspended with suitable supports from the soffit of slab. For conduit pipe run along with wall, the conduit pipe shall be clamped to wall above false ceiling in uniform pattern with special clamps if required to be approved by the Engineer-In-Charge at site.

Recess / Concealed Conduit

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed

brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and during the conduit in mortar before plastering shall form part of point wiring work. (For chase cutting-chase cutting machine shall be used and no manual cutting shall be allowed).

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius which shall permit easy drawing in of conductors. All threaded joint of conduit pipe shall treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 metres, then circular junction box shall be provided to facilitate pulling of wires. The chicken wire mesh shall be provided by civil agency.

F) Outlet Boxes

Switch/outlet boxes shall be made of metal on all sides except on the front. Boxes shall be G.I. Up to 10cmx20cm size Box shall have wall thickness of 16 SWG and above 10cmx20cm shall have 14 SWG. The metallic boxes shall be painted with anticorrosive paint before erection. Clear depth of the box shall not be less than 60mm all fitting shall be fitted in flush pattern. Switch/outlet boxes shall be suitable to house modular type light and power accessories. Earthing stud to be provided for connection of earthing wire in side of box at near any corner.

G) Fan Box

Fan Box shall be made out of 14 gauge M.S. sheet as per CPWD specifications. (The sample to be approved before procurement by WAPCOS)

H) Wiring

All FRLS insulated copper conductor multi-stranded wires shall conform to relevant IS codes. Cable conductor size and material shall be as required.

All internal wiring shall be carried out with FRLS insulated wires of 1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan. A light/fan switch board may have more than one circuit but shall have to be of same phase. Looping circuit wiring shall be drawn in same conduit as for point wiring. Each circuit shall have a separate neutral wire. Neutral looping shall be carried out from point to point or in light/fan switch boards. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red or yellow or blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS insulated wire for RYB phase wire respectively and black colour FRLS insulated wire for the neutral wires. FRLS insulated green colour wire shall be used

as earth continuity conductor and shall be drawn along with other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing & jointing of copper conductor wires & cables shall be as per CPWD specifications.

Nominal Cross-sectional Area of conductor in Sq. mm	20mm		25mm		32mm		40mm		50mm		64mm	
	S	B	S	B	S	B	S	B	S	B	S	B
1.50	5	4	10	8	18	12	-	-	-	-	-	-
2.50	5	3	8	6	12	10	-	-	-	-	-	-
4	3	2	6	5	10	8	-	-	-	-	-	-
6	2	-	5	4	8	7	-	-	-	-	-	-
10	2	-	4	3	6	5	8	6	-	-	-	-
16	-	-	2	2	3	3	6	5	10	7	12	8
25	-	-	-	-	3	2	5	3	8	6	9	7
35	-	-	-	-	-		3	2	6	5	8	6
50	-	-	-	-	-	-	-	-	5	3	6	5
70	-	-	-	-	-	-	-	-	4	3	5	4

I) Joints

All joints shall be made at main switches, distribution board socket and switch boxes only. No joint shall be made in conduits & junction boxes. Conductors shall be continuous from outlet to outlet.

J) Sub Mains

Sub-main wiring shall be carried out with FRLS Insulated Copper multi-stranded wires/cables.

Sub-main cable where called for shall be of the rated capacity and approved make. Every sub-main shall be drawn into an independent adequate size conduit. Adequate size draw boxes shall be

provided at convenient locations to facilitate easy drawings of the sub-main cables. Cost of junction box/drawn box is deemed to be included in the rates of sub-main wiring. An independent FRLS insulated copper earth wire of proper rating shall be provided for every sub-main. Single phase sub-main shall have single earth wire whereas three phase sub-main shall be provided with two earth wire.

Where sub-mains cables are connected to the switchgear, sufficient extra lengths of sub-main and mains cable shall be provided to facilitate easy connections and maintenance. For termination of cables crimping type cable socket/lugs shall be provided. Same colour code as for circuit wiring shall be followed.

a. Load Balancing

Balancing of circuits in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

K) Conduiting and Wiring for TV System

i) Conduiting

Conduiting for TV system shall be carried out in M.S. Conduit Conduiting shall be carried out as specified in point wiring head.

ii) Outlets

All TV outlets shall be provided with modular range of cover plate, box and coaxial outlet. Cover plate shall match in shape & finish with other light and power accessories.

iii) Junction Box

Suitable size of metallic junction box shall be provided for termination of conduit for TV system. Box shall be made of 16 SWG G.I. sheet and shall be treated before galvanizing. Front of the junction box shall be provided with 3mm thick phenolic laminated sheet cover.

iv) Coaxial Cables

The coaxial cable shall be of wideband type coaxial cables.

v) Tap Off

These shall be of ultra wide bandwidth and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have a aluminium cast housing for high frequency radiation resistance.

The Tap offs shall be in one way, two way and four way configurations.

vi) Splitters

These shall be of ultra wide band width and of hybrid type. These shall have a flat frequency response over the entire operating range. These shall have an aluminium cast housing for high frequency radiation resistance.

The splitters shall be in 2 way, 3 way & 4 way configurations.

L) Sub Distribution Panel

General

Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

All the LT panels & Outdoor feeder pillars of rating 400 Amp & Above located inside the each building shall be IP 54 and the same shall be (TTTA) total type tested panels. All LT Panel incomer shall have motorised MCCB mechanism for remote operation by BMS / SCADA. The EPC contractor shall submit all type test reports of TTTA panels

All Panels and outdoor feeder pillars shall have BMS / SCADA Compatibility.

Standards

The equipment shall be designed to conform to the requirements of:

IS 8623 – Factory Built Assemblies of switchgear and control gear.

IS 4237 – General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

IS 2147 – Degrees of protection provided by enclosures for low voltage switchgear and control gear.

IS 375 – Marking and arrangement of bus bars.

Individual equipment housed in the sub distribution boards shall conform to the following IS specifications:

a)	Moulded Case Circuit Breakers	-	IS: 13947-2/IEC 947-2
b)	Miniature Circuit Breaker	-	IEC - 60898
c)	Contractors	-	IEC – 947-4-1, IS 13947-4-1
d)	Current Transformers	-	IS: 2705
e)	Indicating Instruments (Analogue)	-	IS: 1248,
f)	Indicating Instruments (Digital)	-	IS: 13875
g)	Integrating Instruments (Analogue)	-	IS: 722, IS: 13779-1999
h)	Integrating Instruments (Digital)	-	IS: 13779- 1999, IS: 14697
i)	HRC fuse links	-	IS: 13703 / IEC 269

Submittals

Shop Drawings And Technical Data

The tenderer shall furnish relevant technical data of switchgears and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

Constructions

Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, levelled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Following minimum clearance to be maintained after taking into account connecting bolts, clamps etc.

i)	Between Phases	-	32mm
ii)	Between Phases and neutral	-	26mm
iii)	Between Phases and earth	-	26mm
iv)	Between Neutral & earth	-	26mm

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access.

Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

The base frame shall be as per OEM tested design as per IEC61439.

Metal Treatment and Finish

All metal work used in the construction of the sub distribution boards should have under gone a rigorous metal treatment process as follows:

a) Effective cleaning by hot non alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution

b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

e) Drying with compressed air in a dust free atmosphere.

f) A finishing coat of powder coating of Siemens grey colour and thickness of powder coating shall not be less than 50 micron.

Bus Bars

The bus bars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade E-91E.

The bus bars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity shall be as per actual calculation.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creep age distance shall be provided on the bus bar system to minimize the possibility of fault. The main phase bus bars shall have continues current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity up to 250 Amp; for higher capacities, the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with PVC heat shrinkable sleeves.

The sub distribution boards shall be designed that the cables are not directly terminated on the terminals of MCCB etc. but are terminated on cable termination links. Capacity of aluminium bus bars shall be considered as 1.0 Amp per sq. mm of cross section area of the bus bars.

MOULDED CASE CIRCUIT BREAKERS

GENERAL

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB's shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB's shall be suitable either for single phase AC 230 volts or three phase 415 volts.

FRAME SIZES

The MCCB's shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i)	Up to 100A rating	…….	100Amp frame.
ii)	Above 100A to 200A	…….	200Amp frame.
iii)	Above 200A to 250A	…….	250Amp frame.
iv)	Above 250A to 400A	…….	400Amp frame.
v)	Above 400A to 630A	…….	630Amp frame.

CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermo magnetic type up to 250 A for adjustable overload & short circuit protection and shall be microprocessor type above 250 A for adjustable overload, short circuit & earth fault protection. MCCB shall be line load reversible type. Device shall have IDMT characteristics for sustained overload, and short circuits. MCCB shall be current limiting type.

Contacts trips shall be made of suitable are resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

Protection Functions

(i) MCCBs with ratings up to 250 A shall be equipped with adjustable Thermal-magnetic (thermal for overload and magnetic for short-circuit protection)/microprocessor based trip units.

(ii) Microprocessor MCCBs with ratings above 250A shall be equipped with microprocessor based trip units. (both variable setting).

(iii) Microprocessor units shall be adjustable as per OEM.

(iv) Thermal-magnetic trip units shall also be adjustable as per OEM .

(v) Microprocessor trip units shall comply IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)

(vi) Protection settings shall apply to all poles of circuit breaker.

(vii) The trip command shall override all other commands.

(viii) The setting of release shall be provided to make the system working with discrimination as per actual load coming at site.

(ix) MCCB shall comply to ROHS norms. Terminals shall be such designed to withstand higher thermodynamic stress cross bolted/circular as per OEM standards. It shall be invariably be used with spreader terminals. MCCB shall have min. 8000 electrical operations upto 250A and shall be available in frame sizes of 160A & 250A upto 250A.

RUPTURING CAPACITY

The Moulded Case Circuit Breaker service breaking capacity (Ics) shall be based on actual calculation.

TESTING

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

Measuring Instruments for Metering

GENERAL

Direct reading electrical instruments shall be in conforming to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

DIGITAL AMMETERS

Digital Ammeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

DIGITAL VOLTMETERS

Digital Voltmeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

Measuring : Class 1.0

Protection : Class 5 P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT‘s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Control switches

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Cable Terminations

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall

be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Control Wiring

All control wirings shall be carried out with 1100V grade single core ZHFR cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

Terminal Block

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

Labels

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

Testing at Manufacturing Work

All routine tests specified is IS: 8623-1977 shall be carried out and test certificates submitted to the Engineer – in –Charge.

Testing and Commissioning

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check

c) Insulation test: When measured with 500 V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Trip tests & protection gear test.

Automatic transfer switch

General requirements

The following covers the Automatic Transfer Switch Equipment (ATSE) and its By-Pass equipment.

The ATSE shall be composed of

- two separate Load Break Switches,
- a mechanism to operate and mechanically interlock the switches,
- an actuator made of a motorized unit or a double solenoid mechanism (both momentarily energized)
- a 3 phases monitoring device and control module (MDCM) for monitoring supply circuits and for transferring the load circuit from one supply to another.

The ATSE shall be fully integrated in one device. No additional wiring other than the power connection shall be allowed to facilitate the proper functioning of the ATSE with the MDCM.

All the elements of the transfer switch equipment and control module shall be of the same manufacturer.

The ATSE shall be of the PC type.

The ATSE shall have 3 stables positions: Normal, Isolated and Emergency.

The ATSE shall be of a Disconnector type with fully visualized breaking.

The ATSE shall be able to do On Load Manual switching.

The ATSE must be proposed in 3 and 4 poles versions.

Design requirements

The transfer switch unit shall be electrically operated and mechanically held.

It shall be no power consumption while in a stable position other than the one required for the control unit.

The electrical actuator shall be a motorized unit or a double solenoid mechanism, which is momentarily energized.

The switches shall be inherently mechanically interlocked to ensure at any moment only one out of the three stable positions.

The system shall incorporate a position indicator for the 3 stable positions.

To prevent source overlapping the transfer is operated through distinct isolated positions. The sensing and logic shall be built-in microprocessor for maximum reliability and with option of serial communications feature. To facilitate flexibility of installation there shall be provision of Line/ Load reversibility.

The switching contact shall be silver plated and maintenance free in various environments. It shall be of self cleaning capability to optimize the quality of the contact during operation

The Neutral pole of ATS shall be fully rated (100% rating as that of all 4 poles).

The 4 poles shall switch simultaneously.

Standards & Codes

The ATSE shall conform to the requirements of the IEC Standard 60947-6-1 for the source transfer function and 60947–3 for Disconnection and manual on load switching.

The MDCM shall comply with the following standards:.

Emission General standard

- EN 55022 Conductor Emission
- EN 55022 Radiated Emission

Immunity General standard

- EN 61000-4-2 Electrostatic Discharge (ESD)
- EN 61000-4-3 Radiated electromagnetic field
- EN 61000-4-4 Electrical fast transient (EFT)
- EN 61000-4-5 Surges
- EN 61000-4-6 Conducted radio frequency field
- EN 61000-4-8 Power frequency magnetic field
- EN 61000-4-11 Voltage dips, short interruptions and variations
- EN 61000-4-13 Harmonics and inter harmonics
- IEC 61010-1 Electromagnetic compatibility

Safety requirements & features

- The ATS shall be of Disconnector type as per IEC 947-3
- It shall not be possible to mix the two supplies (Normal supply and Emergency supply) in case of any failure of the equipment. This characteristic must be guaranteed by a proper design of the mechanism.
- Opening and Closing operations of the contacts must be independent from the driving mechanism. The speed of the contacts shall be independent of the speed of motor or manual operation to ensure the safety of the operator.
- In case of contacts welding, the ATSE must remain in its actual position, in Manual or Automatic operation, according to IEC 60947-3. Neither the manual nor the automatic operation can lead to a failure of the mechanism or of the interlocking. The mechanical indicator shall show the actual position in contact welded situation.
- The ATSE shall have a Manual and Automatic mode: the swap between both modes shall be possible only with a key or selector on the front face. Manual operation shall be prohibited in automatic and Automatic operation shall be inhibited in Manual mode.
- The ATSE shall have a built-in provision for padlocking in the Isolation position for the safety of the operators. A provision for a padlocking in Normal or Emergency positions shall also be provided.
- Automatic commands shall be inhibited when the product is padlocked
- The padlocking shall be possible only in Manual position.
- The ATSE shall be able to accommodate up to three padlocks at the same time.
- A handle for manual operation shall be provided for emergency transfer purposes.
- The handle shall be located on the ATSE itself to ensure a safe and quick operation during power outages. The handle shall be easily removable for automatic operation.
- Manual transfer shall be possible on load, without any upstream disconnection, with respect to the safety of the operator. This feature is essential in case of emergency and panic.
- It shall be possible to block the re-transfer process via programming. When selected, retransferring to the Main source must be validated locally or remotely via keypad or external contact.
- The replacement of the motor operated actuator shall be possible under live condition with respect to the operator safety (isolation distances, easy access to the fixing elements).

Operations

- The ATSE shall be supplied by any present source. It shall allow the ATSE to be controlled in the 3 positions with only one source present.
- The ATSE shall have high short time current withstand capability (Icw 1 second in accordance to IEC 60947-3).
- Manual retransfer function can be inhibited and must be possible either locally or from remote.
- The ATSE shall have the possibility to be electrically controlled in any of the 3 positions by mean of dry contacts. It overrides the automatic sequence. Once back in Auto mode, the ATSE shall come back to the proper position.

Automatic operation via the MDCM

The monitoring device and control module (MDCM) must be integrated within the ATSE.

Electrical Control of the product position must be possible and controlled locally or remotely. Any automatic command must be inhibited during control operation (takeover).

Parameters sensing & setting

The MDCM shall include 3 phases sensing for monitoring of voltage and frequency to detect the presence and loss of the power supply for activation of the automatic transfer. The settings are as following:

PARAMETER	SOURCES	THRESHOLD	HYSTERISIS
Under voltage	Mains and Backup, 3 phases	80 to 98%	81 to 99%
Over voltage	Mains and Backup, 3 phases	102 to 120%	101 to 119%
Under frequency	Mains and Backup	80 to 99%	80.5 t0 99.5%
Over frequency	Mains and Backup	101 to 120 %	100.5 to 119.5%

Voltage settings shall be field adjustable in 1% increments either locally with the display and keypad, or remotely through serial communication. Frequency settings shall be adjustable in 0.1% increments either locally with the display and keypad, or remotely through serial communication. All settings shall be adjustable directly from the front face, opening of the MDCM is strictly forbidden for obvious reasons of safety and possible damages. The MDCM shall have a phase sequence detection to ensure the proper voltage vectors sequence on both power supplies. The MDCM shall have programming for selection of network type 4NBL/41NBL/42NBL/3NBL/2NBL/2BL/1BL and capability to monitor the minimum and maximum voltages and frequencies threshold and hysteresis. The MDCM shall allow the setting of the sources priority. The MDCM shall be equipped with the activation of manual re-transfer mode. The MDCM must be equipped with a permutation counter to enable to record the life span of the ATSE represented by the number of transfer operations. Resetting of this counter shall be conditioned by 4 digits numerical password with 2 levels of security. Interface with the MDCM The MDCM must be easily configurable via a HMI dialogue interface complete with a 2 levels security 4 digits numerical Password for programming access right. The MDCM shall be equipped with local visualization of three phase currents, powers (P, Q, S), frequency and power factor through 3 current transformers measurement from the 2 sources. Source status shall be

clearly visible on the front of the unit for both normal & emergency, stated in a clear schematics diagram. The controller shall provide digital readout of voltage on all 3 phases, frequency and phase rotation. Inputs/outputs, communication.

The MDCM shall be able to provide up to four Inputs (Programmable NO or NC) and four Outputs (NO Type) for interfacing with control system. The inputs and outputs functions shall be versatile (no unique function), the assignment being done by the HMI or the communication. The link shall be capable of reading the voltages, timers and inputs values, setting all parameters values and inputs/outputs functions.

Timers settings

An adjustable timer of 0 to 60 seconds shall be provided to detect the priority network failure, to override any transient outages of the normal supply. (Main Failure Timer, MFT). A timer of 0 to 60 seconds shall be provided to validate the stability of emergency network before transfer, once the Generator Set supply is available. (Delay To Transfer, DTT). While transferring to emergency, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Failure timer, 0MF). An adjustable timer of 0 to 30 minutes shall be provided to detect priority network return to normal, to override any false availability of the normal supply. (Main Return Timer, MRT). While transferring back to primary source, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Return timer, 0MR). An adjustable timer of 0 to 30 minutes shall be provided to allow the generator cooling down after load retransfer from standby source to Mains source (Cool Down Timer, CDT). The controller shall provide the ability to prevent retransfer to Mains from happening, except if the user validates manually the retransfer. (Manual Re-Transfer).

Maintenance & testing

- The MDCM shall provide the possibility to run a test ON load and OFF load.
- It shall be possible to actuate these sequences from the front face HMI or via the Modbus link.
- Maintenance of the electrical parts (Controller or Motorization unit) shall be possible without disconnection of the power conductors.
- It shall be possible to change any actuator unit based on a motor technology in less than 10 minutes without disconnection of the power conductors. During this operation, it shall still be possible to operate manually the switch with the MDCM and motorization removed.
- Both Local and Remote control of test sequences shall be possible on the Switch.

Inspection at factory

The inspection / testing of all the ATS / STS shall be done at manufacturer works before dispatch by engineer in charge.

Factory testing and certification

The complete ATSE shall be factory tested to ensure proper operation of the individual components together and correct overall sequence of operations. The test must also ensure that the

operating transfer time, voltage, frequency and time delay settings are incompliance with the specification requirements.

The manufacturer shall be certified ISO 9001 : 2003 International Quality Standard and the manufacturer shall have third party certification verifying its quality assurance in design / development, production, installation and servicing in accordance with ISO 9001.

Training

The manufacturer / supplier shall ensure the training for Operating staff in the local national language, by means of fully configured Training kits to impart hands-on training to simulate various parameters and for trouble shooting exercise.

M) LT CABLES:

1.0 STANDARDS OF CODES:

This chapter covers the specifications for supply of Medium Voltage **XLPE** cables.
All equipments, components, materials and entire work shall be carried out in conformity with applicable and relevant Bureau of Indian Standards and Codes of Practice, as amended upto date. In addition, relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and /or IEC Standards shall be applicable.

2.0 CABLES:

Medium voltage cables shall be aluminum conductor XLPE insulated, PVC sheathed armored conforming to latest IS. Cables shall be rated for a 1100 Volts.

All Conductor cables shall be as per CPWD Specification and IS codes.

Conductors shall be insulated with high quality XLPE base compound. A common covering (bedding) shall be applied over the laid up cores by extruded sheath of un-vulcanized compound. Armoring shall be applied below outer sheath of PVC sheathing. The outer sheath shall bear the manufacturer‘s name and trade mark at every meter length. Cores shall be provided with following colors scheme of PVC insulation.

1 Core	:	Red/Black/Yellow/Blue
2 Core	:	Red and Black
3 Core	:	Red, Yellow and Blue
3 ½ /4 Core	:	Red, Yellow, Blue and Black

3.0 LAYING:

Cables shall be laid as per the **CPWD specifications (Amended Up to Date)** given below

3.1 Duct system

Wherever specified such as road crossing, entry to building or in paved area etc. cables shall be laid in underground ducts. The duct system shall consists of a required number of stone ware pipes, GI, CI or spun reinforced concrete pipe with simplex joints and all the jointing work shall be done according to the CPWD building specifications or as per the instructions of the Engineer-In-Charge as the case may be. The size of the pipe shall not be less than 100mm in diameter for a single cable and shall not be less than 150mm for more than one cable and so on. The pipe shall be laid directly in ground without making any special bed but wherever asbestos cement pipes are used, the pipes shall be encased in concrete of 75mm thick. The ducts shall be properly anchored to prevent any movement. The top surface of the cable ducts shall not be less than 60 cm. below the ground level. The ducts shall be laid a gradient of at least 1:300. The duct shall be provided manholes of adequate size at regular intervals for drawing the cables. The manhole cover and frame shall be of cast iron and machine finished to ensure a perfect joint. The manhole covers shall be installed flush with the ground or paved surfaces. The duct entry to the manholes shall be made leak proof with lead-wool joints. The ducts shall be properly plugged at the ends to prevent entry of water, rodents, etc. Suitable duct markers shall be placed along the run of the cable ducts. The duct markers shall at least be 15 cm. square embedded in concrete, indicating duct. Suitable cable supports made of angle iron shall be provided in the manholes for supporting the cables. Proper identification tags shall be provided for each cable in the manholes.

3.2 Cables in outdoor trenches

Cable shall be laid in outdoor trenches wherever called for. The cables in RCC trenches shall be laid on G.I. perforated cable trays with suitable size G.I. clamps and suitable M.S. supporting structure which is welded inside the trenches.

3.3 Route Marker

Cable route marker marked "Cable" shall be provided along with the route of the cable and location of loops. The route markers shall be of tapered concrete slab of 60 x 60cm at bottom and 50 x 50cm at top having a thickness of 10cm. Cable marker shall be mounted parallel to and 50cm away from the edge of the trench.

3.4 Cables in indoor trenches

Cables shall be laid in indoor trenches wherever specified. The trench shall be made of brick masonry / RCC trenches with smooth cement mortar finish with suitable removable covers (i.e chequered plates). The dimensions of the trenches shall be determined depending upon the maximum number of cables that is expected to be accommodated and can be conveniently laid. Cables shall be arranged in tier formation in trenches and if necessary, cables may be fixed with clamps. Suitable clamps, hooks and saddles shall be used for securing the cables in position.

Spacing between the cables shall not be less than 15 cm centre to centre. Wherever specified, trenches shall be filled with fine sand and covered with RCC or steel chequered trench covers.

3.6 Installation

i) Cable trays shall be installed as a complete system. Trays shall be supported properly from the building structure. The entire cable tray system shall be rigid.
ii) Each run of the cable tray shall be completed before the installation of cables.
iii) In portions where additional protection is required, non-combustible covers/ enclosures shall be used.
iv) Cable trays shall be exposed and accessible.
v) Where cables of different system are installed on the same cable tray, non-combustible, solid barriers shall be used for segregating the cables.
vi) Cable trays shall be grounded by two nos, earth continuity wires. Cable trays shall not be used as equipment grounding conductors.
vii) At no place the cable tray / rack / ladder running horizontally should rest on any building partition like Brick wall, RCC beams etc. but instead proper MS supports/ hangers to be provided at minimum of 1500 mm intervals and at every Turning Angles.

3.7 Jointing and termination‟s

Cable jointing shall be done as per the recommendations of the cable manufacturer. All jointing work shall be done only by qualified/licensed cable jointer.

All jointing pits shall be of sufficient dimensions as to allow easy and comfortable working.

Jointing materials and accessories like conductor, ferrules, solder, flex, insulating and protective tapes, filling compound, jointing box etc. of right quality and correct sizes, confirming to relevant Indian Standards.

Each termination‘s shall be carried out using brass compression glands and cable sockets. Hydraulic crimping tool hall be used for making the end termination‘s. Cable gland shall be bonded to the earth by using suitable size copper wire/tape.

N) Cable Tray

All cables trays shall be made of G.I. sheet.

Cable trays shall be complete with bends, joints, coupler plates and accessories as may be required for joining the cable trays. The bends, Tee joint, Cross joint for all sizes of cable tray shall be factory fabricated.

Cable trays shall be either perforated or ladder type as called for in the schedule of quantities.

a) Perforated Cable Tray

Standard dimensions of perforated cable trays shall be as follows:

1.	Width	:	100 mm to 1200 mm
2.	Length	:	2500 mm
3.	Thickness	:	2mm up to 750 mm width and 3mm from 900mm to 1200 mm
4.	Collar height	:	50 mm up to 600 mm and 75 mm from 750 mm to 1200mm

b) Ladder Type Cable Tray

Standard dimensions of ladder type cable trays shall be as follows:

Size of tray	size of main channel	size of rung /spacing between rungs
900mm to 1200mm	25 x100 x 25 x 3mm	20 x 50 x 20 x 2 @ 200C/C
Up to 750mm	25 x 75 x 25 x 2mm	20 x 50 x 20 x 2 @ 200C/C

Sizes of angle for cable tray supports shall be minimum 40 x 40 x 5 mm up to 600mm & 50 x 50 x 5mm minimum as specified in the drawings/schedule of quantities for sizes above 600 mm. Hangers shall be of minimum 10 mm dia steel round bars up to 600 mm & 12 mm dia steel from 750 mm to 1200 mm as specified in the drawings/schedule of quantities. All the support shall be G.I.

Fixing arrangement shall be as approved by the Engineer-in- Charge.

Hardware to be used in cable tray system shall be galvanized or zinc passivated.

The testing on galvanized material if required shall be carried out as per IS: 2633, amended to date.

4.0 Earthing

4.1 PROTECTIVE EARTHING

SCOPE

The scope of work shall cover earthing stations (earth mats and earth electrodes), laying copper/GI earth strips and connecting the power panels, DBs, switch boards and other equipments such as pumps, PLCs of BMS etc.

Indian TNS system of earthing as shown on IS: 3043 – 1987 and CPWD Specifications shall be followed for the entire installation under the scope.

All the non-current carrying metal parts of electrical installation shall be earthed properly. All metal conduits, cable trays, trunking, cable sheaths, switchgear, distribution fuse boards, light fittings and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing shall be in conformity with Indian Electricity Rules and CEA safety regulation in vogue .

The Earthing System shall totally comprise the following:

(i) Earth mats and Electrodes as per IEEE 80: 2000 and IS: 3043 - 1987

(ii) Earthing Leads

(iii) Earth Conductors

(iv) Residual current earth leakage circuit breakers where applicable as per IE rules 61A.

(v) The size of conductor to be provided for earth mat & electrodes, however contractors should verify these sizes as per norms provided in the codes and rules and should provide conductor size as per the calculation.

All three phase equipments shall have two separate and distinct body earths and single phase equipment shall have a single body earth.

Earthing of transformer neutral, DG set etc. by copper pits, BMS & SCADA equipment, and other items shall be carried out as per drawings.

All the earthing strips shall be buried in floor or wall as required and all the fastening (by nut bolts) of earthing strips shall be tag welded as well.

STANDARDS

The following standards and rules shall be applicable:

(i)	IS:3043 - 1987	Code of Practice for earthing
(ii)	IEEE 80: 2000	Guide for Safety in AC Substation Grounding

All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in the absence of Indian Standards.

EARTHING MATERIAL

Materials of which the protective system is composed shall be resistant to corrosion or be adequately protected against corrosion. Adequate margin for corrosion should be taken for the selection of the size. The material comply to the following requirements:

Copper - When solid or stranded copper wire is used it shall be of the grade ordinarily required for commercial electrical work generally designated as being of 97% conductivity when annealed, conforming to Indian standard specifications as per IEEE 80 A.

Galvanized Steel - Galvanized steel used shall be thoroughly protected against corrosion by hot dipped Zinc coating. The material coating shall withstand the test specified in IS 2309 – 1989.

The strips to be used shall be in maximum lengths available as manufactured normally avoiding unnecessary joints.

4.2 EARTH STATIONS

Earth Mats

Earth mat shall be constructed as per IEEE 80 – 2000 and IS 3043 1987. GI flats should be used for constructing earth mat of adequate size (horizontal and vertical conductors) and at depth of 500

mm or deeper as per the final earthing design as per site condition and – from ground as per IEEE 80 A. Adequate number of risers shall be brought from earth mat for further connection to equipments. Main earth terminals shall be provided in Service Yard & Terminal Building as required. The resistance of the earth mat should not be more than 1Ω.MS cooper cladded rod of suitable dia shall be placed at relevant spacing as per detailed engineering calculations.

Pipe Earthing Station

- The pipe earth shall be as shown on the approved working drawing and shall be used for equipment earth grid. The earth electrode shall be 4.5 m long, 40mm diameter, 5mm thick galvanized steel pipe. The earth resistance shall be maintained with a suitable soil treatment as shown on approved working drawings and as per plate electrodes.
- The resistance of each earth station should not exceed 1 Ω.
- The earth lead shall be fixed to the pipe with a clamp and safety set screws. The clamps shall be permanently accessible.

Maintenance Free Chemical Earth Station

This section covers the technical details for Maintenance Free Chemical Earth Station with following technical features:-

- The system should be of DUAL PIPE TECHNOLOGY (GI)
- The chemical earth electrode should be tested in CPRI (Central Power Research Institute) for Peak & RMS current.
- The earth electrode manufacturer shall be ISO 9001:2008 & ISO 14001:2004 certified company.
- The earth electrode shall be of GI construction Dual Pipe technology with the galvanization of 80-100 microns. For thickness of strips & pipes PWD & SOR specs shall be followed.
- The earth electrode shall be surrounded by resistance lowering grounding minerals to increase the overall conductive surface area in order to lower the ohmic value and also to minimize the corrosion process.
- The earth electrode shall be highly conductive and non-corrosive.
- Earth electrode should be able to carry the peak short circuit withstand current of minimum 30KA and duly tested and certified by CPRI.
- Resistance lowering grounding minerals should be of specially developed electrolytic gel which should be of highly conductive. The ―chemical‖ shall be made of natural minerals - mixture of Sulphate, Silica, Alumina, Iron Oxide, Titanium Oxide, Calcium Oxide, Magnesium Oxide, Sodium Oxide, Zinc Oxide, Potassium Oxide, Chloride, Nickel Oxide, etc and it absorbs the moisture from the surrounding soil and is non corrosive.
- The loss on ignition by mass of the chemical compound ―chemical‖ shall be less than 20%.

- The chemical compound used for back filling around the earth electrode shall be duly tested and certified by any International accredited and BIS (Bureau of Indian Standards), Govt of India accredited laboratory. The testing laboratory should be ISO 9001 & ISO 14001 certified.
- Between the inner & outer pipes, it should be adequately filled with special composition of highly conductive metallic compound which will have the continuity for fast conduction & highly resistive to corrosion.
- At any cost, usage of Salt & Charcoal with the earth electrode is strictly not permitted.

Number of Earth Stations

- Metallic covers or supports of all medium or HT apparatus or conductors shall, in all cases be connected to not less than two separate and distinct earth electrodes.

Location of Earth Electrode

- The following guidelines shall be followed for locating the earth electrodes
- An earth electrode shall not be situated less than 3 meters from any building. The excavations for electrode shall not affect the column footings or foundations of the buildings. Entrances, pavements and road ways shall not be used for locating the earth electrode. In such cases electrode may be further away from the building.
- Earth mat locations – Earth mats shall be constructed at a suitable place in the area as near to Service Yard Terminal Building as possible.
- The location of the earth electrode / mats shall be such where the soil has reasonable chance of remaining moist, as far as possible.

Method of Installing Watering Arrangement

In the case of plate earth electrode, a watering pipe of 50mm diameter of B class GI Pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided at the top of this pipe for watering the earth. The watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300 mm. A cast iron/MS frame with cover having identity mode ―EARTH‖ and having locking arrangement shall be suitably embedded in the masonry enclosure.

EARTH LEADS AND CONNECTIONS

The strip earthing leads shall be connected to the Earth Electrode / Earth mat at one end and to the main equipment at the other end. The earthing lead shall connect to the earthing network in the installation.

Earth lead shall be bare copper or galvanized steel as specified with sizes shown on approved working drawings. Copper lead shall have a phosphor content of not over 0.15 percent. Galvanized steel buried in ground shall be protected with bitumen and hessian wrap or polythene faced hessian and bitumen coating. At road crossings necessary HDPE Pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles or wall so that the strip is at least 8mm away from the wall surface.

All earth strips shall be jointed as follows:

Copper	Copper riveting with 80mm fish plate and brazing with at least 80mm brazing as a lap joint along the length
Galvanized	Lap welding with 50mm minimum lap Steel: Overlay - not less than 50 mm in all cases

Strip earthing leads shall be of copper/GI and as per specifications.

The buried strip earthing lead shall be in trench not less than 0.5 m deep. If conditions necessitate use of more than one earthing lead, they shall be laid as widely distributed as possible, preferably in a single straight trench or in a number of trenches radiating from one point.

In the case of plate earth electrode, the earthing lead shall be securely bolted to the plate with two bolts, nuts, check nuts and washers as required by IS 3043:1987. All materials used for connecting the earth lead with electrode shall be GI in case of GI Pipe earth electrodes or tinned brass in case of Copper plate electrode.

Connection of Earthing Conductors

- Main earthing conductors shall be taken from the earth connections at the substation to the earth bar at the main switch boards in the TN-S configuration and the earth bar may also be directly earthed as in Indian TN-S.
- Sub-mains earthing conductors shall run from the earth bar at the main switch board to the sub-distribution boards and to the final distribution boards.
- Loop earthing conductors shall run from the final distribution boards and shall be connected to any point on the main/sub-main earthing conductor, or its distribution board.
- Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earth bonding conductor in effective electrical contact with cable sheathing. Switches, accessories, lighting fitting etc shall be effectively connected to the Loop Earthing Conductors. A metallic conduit shall not be considered as the only protective earth conductor.
- Point wiring for lights, fans, ceiling fans, exhaust fans, power sockets and sub-main wiring, shall all have an earth continuity conductor (ECC) with the same cross section and type of wires used, the minimum in this case being 2.5-sqmm copper.

Prohibited Connections

- Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lighting protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. However, these are to be effectively earth bonded.

Resistance To Earth

- No earth electrode shall have a greater ohmic resistance than 1 Ω as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 10 Ω. The electrical resistance measured between earth connection at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuses or circuit breakers.

Note: - All joints and connection between dissimilar metal should be done by providing bimetallic conductor /plate as required of equivalent area /cross section.

EQUIPMENT EARTHING

All apparatus and equipment transmitting or utilizing power shall be earthed as per the drawings.

Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated earth continuity conductor of size related to phase conductor shall be provided. Non-metallic conduit shall have an insulated earth continuity conductor of the same size as above. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conductor shall be distinctly coloured (green) for easy identification.

Armoured cables shall be earthed by 2 bonding earth connections to the armouring at both the ends and the size of connection being as above. In multiple cables entering a panel/ DB, the cable joints shall be bonded together using a bonding wire selected on the basis of the largest size of cable in the group. In the case of unarmored cable, an earth continuity conductor shall either be run outside along the cable. Three phase power panels and distribution boards shall have 2 distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB‘s a single earth connection is adequate. Similarly for 3-Phase and 1-Phase isolating switches there shall be 2 and 1 earth connections respectively, sizes being correlated to the incoming cable.

Three Phase motors and other 3-Phase apparatus shall have 2 distinct earth connections of size equal to incoming feeder size. For 1-Phase motor and 1-Phase apparatus, the single earth connections shall be provided of the above size.

ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrodes do not give adequate low resistance to earth, as specified in clause no. 4.0, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by using methods as provided in IEEE 80A.

TESTING

The following earth resistance values shall be measured with an approved earth megger and recorded.

(i) Each earthing station / mat

(ii) Earthing system as a whole

(iii) Earth

(iv) Continuity

Lightning Protection Devices as per IEC 62305.

Standards:

IEC 62305- 2	-	Risk Management
IEC 62305-3	-	Protection against Lightning.
IS/IEC 62305	-	Protection Against Lightning Part 2 Risk Management.
IS 2309	-	Code of Practice for the protection of Building.
IEC 62561 -2 & 7	-	Earthing and Bonding.

Lightning Protection:

This part of IEC 62305 provides the requirements for protection of a structure against physical damage by means of a lightning protection system (LPS), and for protection against injury to living beings due to touch and step voltages in the vicinity of an LPS.

Lightning is one of the most devastating natural phenomena. There are many discharges during lightning storms and some of them can even reach hundreds of kilo amperes. The electrical discharges are a great hazard to people, animal, buildings and electronic equipment‘s. Until now, there is no device that can prevent lightning formation or lightning strikes. However, it is possible to create a path (divert) for the lightning discharge to the ground which will minimise the damage to the environment through a well-designed Lightning Protection System (LPS). The purpose of a lightning protection system is to protect buildings from direct lightning strikes and possible fire or from the consequences of lightning currents (non-igniting flash). If national regulations such as building regulations, special regulations or special directives require lightning protection measures, they must be implemented. If these regulations do not specify a class of LPS, a lightning protection system which meets the requirements of class of LPS III according to IEC 62305-3 (EN 62305-3) is recommended as a minimum. In principle, a risk analysis, which is described in the IEC 62305-2 (EN 62305-2) standard (see chapter 3.2.1), should be performed for an overall assessment.

An external LPS is intended to:

a) Intercept a lightning flash to the structure (with an air-termination system);

b) Conduct the lightning current safely towards earth (using a down-conductor system);

c) Disperse the lightning current into the earth (using an earth-termination system).

An internal LPS prevents dangerous sparking within the structure using either equipotent bonding or a separation distance (and hence electrical insulation) between the external LPS components and other electrically conducting elements internal to the structure.

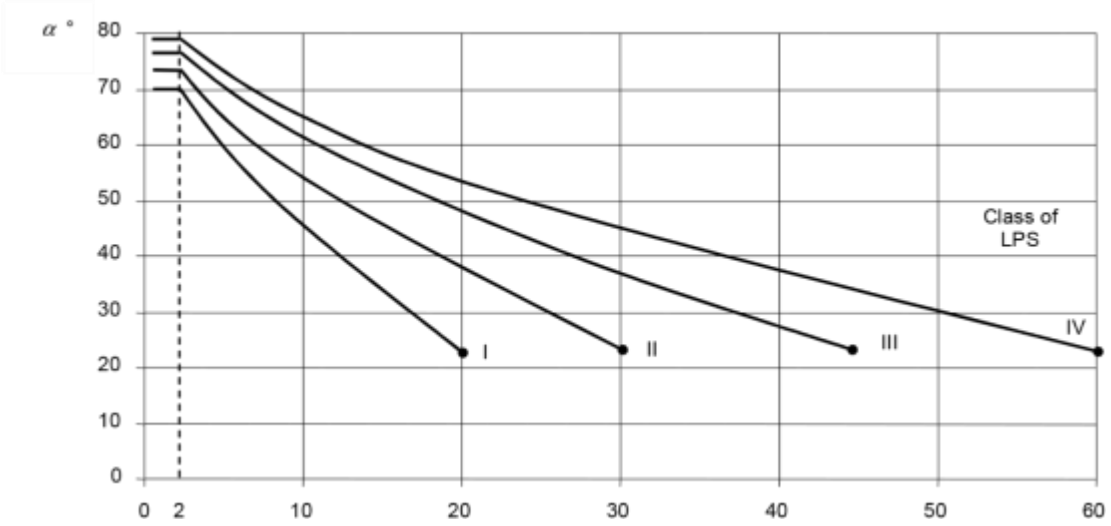
Lightning Current & Protection levels.

In order to define lightning as a source of interference, lightning protection levels I to IV are laid down. Each lightning protection level requires a set of

- Maximum values (dimensioning criteria used to design lightning protection components to meet the demands expected to be made of them).
- Minimum values (interception criteria necessary to be able to determine the areas with sufficient protection against direct lightning strikes(radius of rolling sphere).

Maximum value of rolling sphere radius, mesh size and protection angle corresponding to the class of LPS

Protection Method			
Class of LPS	**Rolling Sphere Radius r m**	**Mesh size W m**	**Protection angle α**
I	20	5 x 5	As per figure below
II	30	10 x 10	
III	45	15 x 15	
IV	60	20 x 20	



LPL levels basic design consideration:

Class of LPS	Lightning current		Interception probability	Rolling spher radius (m)	Mesh size (m)	Down Conductor Spacing
	MINIMUM	MAXIMUM				
1	3 kA	200 kA	98%	20	5 x 5	10
2	5 kA	150 kA	95%	30	10 x 10	10
3	10 kA	100 kA	88%	45	15 x 15	15
4	16 kA	100 kA	81%	60	20 x 20	20

Protection Class for the structure as per LPL (Lightning Protection Level)

Application	**LPL***
Computer Data Centres, Military Applications, Nuclear Power Stations, High raise Hotels/Hospitals, airports, essential services such as telecom towers	**I**
EX-Zones in the industry and chemical sector, Low raise Hospitals & Hotels, fuel retail outlets, gas station, compressor station etc.	**II**
Schools, Banks, Residential Buildings, Temple, Churches, Mosques	**III or IV**

Air Terminal System:

An air-termination system shall be installed to protect the upper part of tall structures from direct lightning strike (i.e. typically the topmost 20 % of the height of the structure) and the equipment installed on it.

- For positioning air-termination systems on roofs shall also apply to those upper parts of structures.
- In addition, for structures taller than 120 m, all parts which may be endangered above 120 m should be protected.
- Materiel Description: For Mesh (Horizontal) arrangement 8 mm dia Aluminium round conductor.
- For Vertical Air terminal: 16 mm dia, 10 mm dia solid aluminium rod.

Connectors & Joints:

Materiel details	**Connector Type**
Aluminium to Aluminium	Aluminium, Gun Metal
Aluminium to Steel	Gun Metal

Air Terminal Holder:

For Concrete / RCC Roof: The fixing of roof conductor holder 8 mm round at every 1 meter and shall made of DMC (Draught mould compound) with min height of 50 mm. The Holder can be fixed with glue and screw.

For Metal shed: The fixing of roof conductor holder 8 mm round at every 1 meter and shall made of DMC (Draught mould compound) with min height of 50 mm. The Holder can be fixed with heavy duty glue.

If any structure like AC panel, Vent, ducts etc need to protect from Vertical Air Terminal after calculation of separation distance.

Down Conductor:
In order to reduce the probability of damage due to lightning current flowing in the LPS, thedown-conductors shall be arranged in such a way that from the point of strike to earth:

a) Several parallel current paths exist;

b) The length of the current paths is kept to a minimum;

c) Equipotential bonding to conducting parts of the structure is performed according to the requirements.

Typical value of the distance between down- conductor and between ring conductors according to the class of LPS

Class of LPS	**Typical distance** **m**
I	10
II	10
III	15
IV	20

Down Conductor Holder:
For Concrete wall: The fixing of down conductor holder 8 mm round at every 1 meter and shall made of DMC (Draught mould compound) with min height of 50 mm. The Holder can be fixed with screw and fastener.

Test Joint:
At the connection of the earth termination, a test joint should be fitted on each down conductor, except in the case of natural down-conductors combined with foundation earth electrodes.

For measuring purposes, the joint shall be capable of being opened with the aid of a tool. In normal use it shall remain closed. The test joint shall be in IP 65 rated box and copper bus bar of 25 x 6 x 150 mm.

Earthing arrangement:
An earthing system or grounding system connects specific parts of that installation with the Earth's conductive surface for safety and functional purposes.

For earth-termination systems, two basic types of earth electrode arrangements apply.

Type A arrangement:

This type of arrangement comprises horizontal or vertical earth electrodes installed outside the structure to be protected connected to each down-conductor. In type A arrangements, the total number of earth electrodes shall be not less than two.

Type B arrangement

This type of arrangement comprises either a ring conductor external to the structure to be Protected, in contact with the soil for at least 80 % of its total length, or a foundation earth electrode. Such earth electrodes may also be meshed.

Materiel used for Type A and B:

Earthing Rod: JK Low carbon high tensile copper bonded ground rod of dia 17.2 mm, length 3000 mm with pure copper 99.9 % coating of 250 micron as per IEC 62561 – 2.

JK Reslow Earth Enhance Material as per IEC 62561 – 7 is used along with the ground rod to reduce earth resistance value.

Lightning Counter:
At least two lightning strike counters need to installed in two down conductors as per IEC 62561. The Counter shall have facility to record 7 digits.

5.0 EXTERNAL LIGHTING

TECHNICAL SPECIFICATIONS

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation. Electrical work in general shall be carried out as per following CPWD Specifications amended upto date.

General Specifications for Electrical Works - Part -II -External Work - 1994.

Wherever this specifications calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards.

Scope of Work :

The of scope of work is Supplying / fabrication, Installation, testing and commissioning of street light / compound light, landscaping bollards light and feeder pillars at IIT(ISM), Roads, compound area and landscaped area (near Centenary building). EPC Contractor shall calculate quantity of poles, fittings and cables. The contractor is required to recheck the quantities based on equipment offered by him to achieve required parameters. Subhead cover the following buildings/ area. All LT cables shall be laid in 63/65mm dia HDPE pipe directly in ground.
The Timer feeder shall have phase wise timer switch to control street lights as per the user requirement.
The EPC contractor shall also provide and install of Smart LED street light poles with facility of CCTV and wifi. (The quantity of smart street light shall be 10% of total quantity of calculated street light poles of each type)

a) Centenary building (G+4)

(Total area to be developed as per requirment.)

If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

SECTION – 1

5.1.1 FEEDER PILLAR

Outdoor type Feeder Pillars shall be suitable for 3 phase, 50Hz, 415 volts, A.C. system with phase wise timer switch and shall generally conform to IS 5039. Rating and size of Feeder pillar shall be as per designed load and requirement.

The Feeder pillar shall be fabricated out of heavy gauge 2.00 mm thick CRCA sheet steel with suitable stiffeners**.** Feeder pillar shall be constructed with slanting roof top/over hang for protection against rain & weather and adequately ventilated by providing louvers with wire mesh from inside. The Feeder pillar shall be provided with degree of protection IP 65 as per IS : 2147**.**

Feeder pillar shall be double door construction with M.S. hinges and handle for opening the door. Each door shall open to minimum 135 degrees. Locking on both the doors with two keys for each lock shall be provided with each pillar. The Feeder pillar shall be dust, vermin proof and weather proof type.

Neoprene gaskets shall be provided for the doors. The enclosure shall be provided with ventilated louver cover with wire mesh, lifting hooks, supporting legs and double earth terminal with double washer.

Feeder Pillar shall be epoxy painted after metal treatment.
Feeder pillar shall be provided with suitable size of aluminium alloy busbars.
Moulded case circuit breaker shall be provided for incoming and MCB shall be provided as per IS 8828-1978 for outgoing. Gland plate shall be 3mm thick with suitable number of flanged type brass cable glands of required sizes shall be provided. Provision shall be suitable for lighting the interior when the doors are open. Danger notice board shall be provided on front door of the Feeder Pillar**.**

All civil work for feeder pillar foundation shall form part of feeder pillar installation work. This shall include excavation, backfilling, brickwork, plastering and providing PVC sleeves. Cost of civil work shall deemed to be included in quoted rates.

Feeder pillar shall fully comply with CPWD General Specification for Electrical works (Part-II External-1994).

5.1.2 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-91E of IS : 5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity. The neutral as well as the earth bar should be capable of withstanding fault withstand capacity. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault. High tensile bolts and spring washers shall be provided at all busbar joints/connections.

The Feeder Pillars shall be designed that the cables are not directly terminated on the terminals of breaker / switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be considered as 1.0 Amp per sq.mm of cross section area of the busbar and also conforming to Table VI of CPWD specification. The main busbars shall have continuous current rating throughout the length of Feeder Pillars. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consists of main horizontal busbar and auxillary vertical busbars run in busbar alley/ chamber on either side in which the circuit could be arranged/ connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

5.1.3 MOULDED CASE CIRCUIT BREAKERS.

5.1.3.1 GENERAL

Moulded Case Circuit Breaker shall be incorporated in the Feeder Pillars wherever specified. MCCB‘s shall conform to IS : 13947 (Part-II) IEC-947(2) in all respects. MCCB‘s shall be suitable either for single phase AC 230 volts or there phase 415volts.

5.1.3.2 FRAME SIZES

The MCCB‘s frame sizes shall be as per OEM subject to meeting the fault level as specified elsewhere.

5.1.3.3 CONSTRUCTIONS

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable ―ON‖, ―OFF‖ ―and‖ ―tripped‖ indicators. Three phase MCCB's shall have common operating handle for simultaneous operation and tripping of all the three phases. Rotary type operating Handle shall be provided. MCCB shall be load/line reversible type. MCCB shall be site adjustable type with overload setting of 80% to 100%.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermo-magnetic or static release type provided in each pole and connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contacts trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

5.1.3.4 RUPTURING CAPACITY

The Moulded Case Circuit Breaker shall have a service breaking capacity (Ics) of not less than 25 KA RMS at 415 volts for Feeder Pillars.

5.1.3.5 TESTING

Routine & Type Test certificate of the MCCB as per relevant Indian Standards (IS) shall be submitted.

5.1.4 MISCELLANEOUS

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamps covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

5.1.5 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Feeder Pillars to suit the number, type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

5.1.6 LABELS

Labels shall be anodized aluminum with white engraving on black background shall be provided for each incoming and outgoing feeder of Feeder Pillars. Labels shall be properly secured with fasteners.

SECTION – 2

SPECIFICATION FOR L.T CABELS

5.2.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer‘s instructions. The cable shall be delivered at site in original drums with manufacturer‘s name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

5.2.2 MATERIALS

The L.T. Power cables shall be XLPE insulated PVC sheathed type aluminium conductor armoured cable conforming to IS : 7098 : 1988 (Part-I) with upto date amendments whereas control cable shall be XLPE insulated and PVC sheathed copper conductor armoured/ unarmoured cable conforming to IS:7098 (Part-I) 1988.

5.2.3 INSTALLATION OF CABLES

All the street light Cables shall be laid in 63/65mm dia DWC HDPE pipes, as per the direction of Engineer-In-Charge. Cable laying shall be carried out as per CPWD specifications.

5.2.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

5.2.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-In-Charge before the cables are cut to lengths.

5.2.6 CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. On straight lengths, tags shall be provided at every termination of cables.

5.2.7 TESTING OF CABLES

Prior to installation, burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.
c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer-In-Charge.

a. Insulation Resistance Test (Sectional and overall).
b. Continuity Resistance Test.
c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules**.** The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests

5.2.8 SPECIFICATIONS FOR GI REDUCED DIAMETER POLES

Type of Poles		Decorative G.I. pole with reduced diameter (Single Stem / Double Stem)
Material of base		hot roller sheet IS 1079, arm as per IS1239 and baseplate: A36/A572-50 or equivalent
Galvanizing		hot dip galvanised to ASTM A123 with minimum average GI coating of 65micron
Paint		PU painted with avg DFT of 70micron with high quality paint and primer (Colour of will be decided by WAPCOS at the time of approval)
Control Gear Box		Inbuilt with flush door at the bottom
Control Gear box accessories		Insulated Al bus bar, MCB, Supporting Insulator, Heavy duty connector and neutral link.
Door Cover		door cover with anti-theft provision
Foundation Bolts		In the scope of Supplier
Brackets		According to type of road

Note: The EPC Contractor shall design street lighting and calculate total numbers of poles required, and also provide at least 10% of total numbers of poles calculated for execution shall have provision for of CCTV cameras and Wi-fi.

SECTION 3

SPECIFICATIONS FOR LIGHT FIXTURES

5.3.1 General Requirement

i. All fixtures (luminaires) shall be designed so as to have lumen maintenance of at least 70% after 50,000 hours (L70) and 90% after 10,000 hours (L90) at an ambient temperature of 40°C in indoor and 50°C in outdoor use for LED luminaires

ii. All outdoor luminaires shall be impact resistant with suitable protection by using cover for driver and LEDs, confirming to IEC60598 specifications.

iii. All outdoor luminaires shall be designed for IP66 (and IP67 for underwater luminaires) ingress protection to prevent ingress of water and dust

iv. All LED luminaires shall use Medium or High Power LEDs Hot Tested and Binned at 85°C rated for minimum junction temperature of 120°C.

v. The make of all LEDs used in the Tender shall be limited to Philips, Havells,Cree, Nichia, Osram

vi. The approved Make / model of each light fixtures are mentioned in Tender. The tenderer is supposed to quote for the same. In case of non-availability substitutes shall be accepted on the condition that they follow a similar design, with technical and overall parameters as mentioned in this document and approved makes in this document. The substituted fitting, if any shall be approved by the WAPCOS/IIT(ISM) in writing before implementation.

vii. All LEDs shall be limited to between 3000 K and 5700 K confirming to ANSI-NEMA-ANSLG C78.377-2008 standards for CCT (correlated colour temperature range.)

viii. All LED luminaires that are Made in India shall be self-certified as per Standard Specification IS: 10322 (Part 5 Sec. 3) -1987 / IS: 10322 (Part 4) -1984; for imported luminaires the conformity to IEC 60598 is must.

ix. As per NBC - 2016 guidelines, automatic controls such as day/night sensors are to be installed for 100% of outdoor lights, this is to be included in the bid.

x. As per the ECBC 2007, lighting systems and equipment shall comply with the mandatory provisions (Section 7.2) as well as the prescriptive criteria (Sections 7.3 and 7.4) or these specifications, whichever is more stringent.

xi. All LED luminaires should be compliant with the RoHS (Restriction of Hazardous Substances) directive of 2006.

5.3.2 Electrical Specification

Properties of all proposed luminaire products for the following criteria shall be as per the table below.

S. No.	Property	Specification
i.	Voltage range or rating: on single phase for 4 hrs	180 V to 270 V

S. No.	Property	Specification
ii.	Luminaire efficiency at 5000 K (For Exterior Applications)	> 110 lumens/W
iii.	Frequency range of input power for all tests	50±5 Hz
iv.	Total input wattage to the fittings including driver losses above or below the rated power	Rated W ±10%
v.	Power factor	≥ 0.90
vi.	a. Colour Rendering Index for outdoor	> 80%
vii.	Life expectancy (for 70% lumen maintenance)	50,000 hrs
viii.	Guarantee (for dimmers and switches, supports and poles, etc.)	3 years
ix.	Guarantee (for LEDs/lamps, luminaire)	5 years (for LED luminaire)
x.	Surge Protection for indoor luminaires: differential level	Shall confirm to IEC 61547 : 2009 – Edition 2
xi.	Surge Protection for outdoor luminaires: differential level	Shall confirm to IEC 61547 : 2009 – Edition 2
xii.	Electrical insulation class	Class I
xiii.	Total harmonic distortion	≤20%
xiv.	Operating temperature	-10 °C to 50°C
xv.	Variation in illumination level in input voltage range from 180 V AC to 250 V AC	Rated illumination ±3%

5.3.3 Applicable Standards:

xii. Life expectancy shall be extrapolated by the TM21 method and manufacturer has to define/explain how LED Level life expectancy is passed on to total system life expectancy.

xiii. All LEDs must comply all the parameters of IS 16105 – 2011 or IESNA LM-80-08.

xiv. All luminaries must comply all the parameters of IS 16106 – 2011 or IESNA LM-79-08.

xv. All luminaires shall conform to IEC 60598-2-13 standard for safety and performance.

xvi. All Electrical, Mechanical and Thermal Tests of the luminaire shall be as per (Part 5 Sec. 3) - 1987 / IS: 10322 (Part 4) -1984.

xvii. The driver shall comply with IS 16101-16108 standards, specifically:

a. EN61347-1: general and safety requirements

b. EN61347-2-13: particular requirements for DC or AC supplied electronic control gear for LED modules

c. EN62384: DC or AC supplied electronic control gear for LED modules performance requirements

d. EN 61000-3-2 Limits for harmonic currents emissions

e. EN 55015 Limits for Radio disturbance characteristics of electrical equipments

xviii. All luminaries shall meet the EN 12464 standards of lighting uniformity as below:

a. Diffuser shall be used in the luminaire to restrict the glare of LEDs, and should have no yellowness during the entire life of the luminaire.

b. All the material used in the luminaire shall be halogen free and fire retardant confirming to UL94 V.0

c. Routine Tests: These tests shall be performed by the manufacturer on each complete unit of the same type and the results shall be submitted to the Engineer-in-Charge prior to offering the lot for acceptance test. The firm shall maintain the records with traceability.

d. Test Scheme shall be as below

No.	**Description of test**	**Type Test**	**Acceptance Test**	**Routine Test**
1	Visual and Dimensional check	Y	Y	Y
2	Checking of documents of purchase of LED	Y	Y	Y
3	Resistance to humidity	Y	-	-
4	Insulation resistance test	Y	Y	Y
5	HV test	Y	Y	Y
6	Over voltage protection	Y	-	-
7	Surge protection	Y	-	-
8	Reverse polarity	Y	Y	Y
9	Temperature rise test	Y	-	-
10	Ra (Colour Rendering Index) measurement test	Y		
11	Lux measurement	Y	Y	Y
12	Fire retardant test	Y		
13	Test for IP65protection	Y		
14	Environmental test	Y		
15	Reliability test	Y		
16	Life test	Y		
17	Endurance test	Y		
18	EMI/EMC	Y		

5.3.4 Data to be Submitted with the Compliance Submission:

xix. Simulations and calculation of achievement of luminosity and lighting power density (LPD) as per specifications.

xx. Lighting design report for the mock up test conditions indicating the average illuminance (lux), uniformity, maximum and minimum values.

xxi. Polar curve of the light fitting indicating the light distribution capability of luminaire.

xxii. Authorization certificate in case the Contractor is not the manufacturer.

5.3.5 Data to be Submitted with the Final Submission:

xxiii. Life of LEDs/lamps, colour characteristics and other relevant details to be supported by IS 16105 – 2011(or IESNA LM-80-08) report. The LEDs/lamp life shall be tested for at least 6,000 burning hours at 105°C and extrapolated as per TM21-2011. For LEDs, LM80 certification shall be submitted as obtained from the manufacturer of the LEDs, stating that:

a. LEDs used are from his manufacture

b. LEDs used are the same one as those certified by LM 80 reports

xxiv. Luminaire Photometric Measurement Data (luminaire efficacy, light intensity distribution diagram, co-efficient of utilization curve, electrical parameters (test voltage, current, wattage, power factor, THD) and efficiency of driver as certified by measurements as per IS 16106-2011(Or IESNA LM-79-08). The test report shall be generated by the laboratory of the manufacturer or NABL accredited labs or INTERTEK/UL labs as accepted the Institute.

xxv. Relevant LEDs/lamps and luminaire data sheets and type test certificates indicating compliance to the technical specifications/standards.

xxvi. Mounting instruction sheets.

xxvii. Make of LEDs/lamps, luminaire and electronic driver used

5.3.6 Tests Required for Completion of the Work

The following routine tests shall be conducted as per the relevant Indian Standards:

xxviii. Insulation resistance of all fixtures tested at 500 V DC and the insulation resistances someasured to be not be less than 2 MΩ between all current carrying parts and ground.

xxix. Each luminaire complete with its proper LEDs/lamps shall be shown to operate satisfactorily at its normal voltage and frequency.

xxx. Each luminaire shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.

xxxi. Type and routine test certificates for tests conducted as per relevant IS for the luminaire, accessories and workmanship.

Properties to be Achieved in each Space

The properties of general lighting to be achieved in each space shall be as per the table below (as per IS Codes).

No.	Block and Space	Luminosity	Lighting Power Density	Correlated Colour Temp	Uniformity Ratio
	Units	lux at work plane or ground as appropriate	W/sqm	K	
	Outdoor Spaces and Other				
i.	Roads 6m wide	As per NBC - 2016	2 (based on area of the road surface)	Nominal 5000/5700	0.4
ii.	Roads 9m wide	As per NBC - 2016	2 (based on area of the road surface)	Nominal 5000/5700	0.4
iii.	Roads 12m wide	As per NBC - 2016	2 (based on area of the road surface)	Nominal 5000/5700	0.4
iv.	Paths 18m wide	As per NBC - 2016	2 (based on area of the path surface)	Nominal 4000/4500	0.4
v.	Squares and courtyards, terraces and balconies	As per NBC - 2016	2 (based on area of the surface)	Nominal 4000/4500	NA
vi.	Gardens and landscape	As per NBC - 2016	1.5 (based on area of the surface)	Nominal 4000/4500	NA
vii.	Covered services and utilities	200	3.5 (based on area of the space)	Nominal 5000/5700	0.4
viii.	Open services and utilities	NA	1.5 (based on area of the surface)	Nominal 5000/5700	NA

No.	Block and Space	Luminosity	Lighting Power Density	Correlated Colour Temp	Uniformity Ratio
ix.	Boundary area (3 m from inside boundary wall)	5	1 (based on length of wall x 3 m)	Nominal 5000/5700	NA
x.	Kiosks and shops	500	10.5 (ECBC Space Function Method)	Nominal 5000/5700	0.5
xi.	Cafeteria	200	3.5 (ECBC Space Function Method)	Nominal 5000/5700	0.6

Above nominal CCT are in compliance of ANSI_NEMA_ANSLG C78.377-2008 and tolerance within 5SDCM.

5.3.7 Buildings: The minimum scale of amenities (electrical) to be provided in Buildings shall be the responsibility of the contractor to provide required number of fixtures and fittings to cater the requirement):

Electrical Point provision detail in various Area

S. No.	Description	Area wise details
A.	**Centenary building**	
2.	Class Rooms	a) 6Amp UPS Power Points b) 6/16Amp Raw Power Point c) Data Point d) For Audio Video System, 2 Nos. Data points shall be provided with dedicated network system. e) 6Amp Raw Power Point for Every 3 Seats for charging purpose. f) Audio System. (Mike, Amplifier & Speaker etc) g) IP CCTV Camera shall be provided with 100% coverage. h) Illumination & ceiling fans as per the CPWD Specification & NBC2016.
3.	Placement cell	a) 6Amp UPS Power Points b) 6/16Amp Raw Power Point c) Data Point d) Power Point for projector. e) Illumination & ceiling fans as per the CPWD Specification & NBC2016
4.	Discussion Room	a) 2 No 6Amp UPS Power Points b) 1 No 6Amp Raw Power Points c) 1 No 6/16Amp Raw Power Point d) 1 No Data Point & 1 No. Voice Point. e) Illumination & ceiling fans as per the CPWD Specification & NBC 2016

S. No.	Description	Area wise details
5.	Cafe	a) 6Amp Raw Power Points for TV b) 6/16Amp Raw Power Point c) Illumination & ceiling fans as per the CPWD Specification & NBC 2016
6.	Entrance Hall	(a) 1 No. 15 Amp Power Plug (b) 1 No. 6 Amp Raw Power Point
7.	Security desk	a) . 6/16Amp Raw Power Point shall be provided. b) DATA / VOICE Point c) 6 Amp Raw power point d) Illumination & ceiling fans as per the CPWD Specification & NBC2016
8.	Class Rooms	a) 6Amp UPS Power Points b) 16 Amp UPS power point b) 6/16Amp Raw Power Point c) Data Point d) 6Amp Raw Power Point for Every 3 Seats for charging purpose. e) IP CCTV Camera shall be provided with 100% coverage. Illumination & ceiling fans as per the CPWD Specification & NBC 2016

S. No.	Description	Area wise details
9.	Toilet/bathroom	a) Illumination & exhaust fans as per CPWD Specification & NBC2016 b) geyser point
10.	Training and placement offices	a) For each 20 sq. meter of floor area 1 No 6/16Amp Raw Power Point shall be provided. b) DATA Point c) 6 Amp raw power point b) Illumination & ceiling fans as per the CPWD Specification & NBC 2016
11.	Admin room	a) 6Amp UPS Power Points b) 6/16Amp Raw Power Point c) Data Point d) For each 20 sq. meters of floor area 1 No 6Amp Raw Power Point shall be provided. e) Illumination & ceiling fans as per CPWD Specification & NBC 2016.
12.	stage	a) Power Point as per requirement and drawing b) IP CCTV Camera shall be provided with 100% coverage. c) Illumination & ceiling fans as per the CPWD Specification & NBC 2016.
13.	Green Room	a) 6Amp UPS Power Points b) 6/16Amp Raw Power Point c) Data Point d) Illumination & ceiling fans as per the CPWD Specification & NBC 2016

S. No.	Description	Area wise details
		e) Dimming system including dimmable light shall be provided.
14.	AHU / Elect. / UPS Room	a) 6/16Amp Raw Power Point shall be provided. b) Illumination & ceiling fans as per the CPWD Specification & NBC2016
15.	Examination cell	a) 2 No 6/16Amp Raw Power Point b) 2 No Data Point c) Illumination & ceiling fans as per the CPWD Specification & NBC 2016
16.	Store room	a) 6/16Amp Raw Power Point shall be provided. b) Illumination & ceiling fans as per the CPWD Specification & NBC 2016
17.	Services/lobby	a) 6Amp UPS Power Points b) 6/16Amp Raw Power Point c) IP CCTV Camera shall be provided with 100% coverage. d) llumination & ceiling fans as per the CPWD Specification & NBC2016.
18.	Kitchen / Fast food kiosk	The power requirement of Kitchen area as per kitchen Equipment, illumination and ventilation.
19.	HVACPlant Room / Pump Room	a) For each 20 sq. meters of floor area 1 No. 6/16A Power Plug shall be provided. b) Illumination as per the CPWD Specification & NBC 2016. c) Ceiling fans as per the CPWD Specification & NBC 2016 d) 6/16Amp Raw Power Point e) 32A Three Phase Industrial Socket. IP CCTV Camera shall be provided with 100% coverage.

20		a)

General Points:-

1. Corridor / Lobby Area:-

a) For each 20 sq. meters of floor area 1 No. 6/16A Power Plug shall be provided.

b) Illumination as per the CPWD Specification &NBC 2016.

c) IP CCTV Camera shall be provided with 100% coverage.

2. Staircase :-

a) Illumination as per the CPWD Specification &NBC 2016

b) IP CCTV Camera shall be provided with 100% coverage except Residence Buildings.

3. Toilet Area for the buildings:-

a) Illumination as per the CPWD Specification &NBC 2016

b) 6/16A Raw Power point shall be provided.

c) Hands in type, ABS body hand dryer shall be installed.

4. Drinking water area:- for all floors and each location

Supply, installation, testing and commissioning of water drinking water fountain with bottle filler 1 nos bubbler activation of bubbler through manual push pad with mechanical front bubbler button electronic sensor and mechanical both opyion cooling antimicrobial SS finish ADA complaint wall hanging R1 34A refrigerant delivering minimum 30 ltr chilled water per hour. Unit are designed to eliminant splashing and standing water 260 watt working on 230V single phase operates on 3 certified LEED certified GRIHA certified LED certified GRIHA certified Supply installation testing commissioning of 50 LPH RO with LTR HPT tank with enclosed cabinet 50N LPH RO with 60 ltr HPT tank auto built pressure 7 kg automatic flushing TDS rejection ability -90% consists of 2 nos booster pump minimum 75 GPD 4 nos. RO membrane RO will be in cabinet.

5. All buildings shall have Wi-Fi points at suitable location, considering 100 % coverage of Internet with specified speed.

6. For other area, the points shall be provided as per requirement and standards.

7. Fire Fighting and fire detection & alarm system, exit signages, emergency lighting and fire evacuation / escape route plan shall be designed and provided as per NBC 2016 and CPWD specifications.

8. Power wiring and circuit wiring through MCBDB in hostel building shall be done by suitable size modular PVC DLP trunking. Only submain wiring from panel to DB shall be done by MS conduit in slab.

Light Fixture

1. Illumination & ceiling fans as per theCPWD Specification & NBC 2016.
2. All light fixtures shall be LED having LM79 and LM80 certification from NABL accredited laboratory and relevant approved IES files for Dialux.
3. Nos. of fittings shall be provided to have required LUX level as well as maintaining aesthetic look.
4. The fixtures shall be of surface/ recessed type as required as per drawing.
5. Number of fittings shall be provided on the basis of average illumination range for different areas mentioned above subject to maximum LPD specified in CPWD internal specification 2013 (Section 2.9) & ECBC Table 7.1.
6. Cabin fans / wall mounted /room/ work areas as per prescribed norms/architectural drawings.

Sl. No.	Area	Luminaire	Specification
1.	Class Room / Placement Cell / R. Scholar / Seminar / Conference / HOD / Discussion Room / Faculty	LED Surface Mounted Panel Light-30-32 Watt	Surface mounted LED panel made of CRCA housing with high efficiency PMMA Diffuser , LED Used shall be SMD type and fixture should have minimum efficacy at System level (Not Chip Level) >= 120 lumens / watt with Minimum system Lumens 3600, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, THD<10% & PF >0.95, fixture Min working temp range - 0°C < Ta < 45°C, Minimum Internal Surge Protection 2.5KV , luminaries manufacture shall provide LM79report from NABL accredited lab & LM80 report to be issued by LED manufacturer.
2.	Class Room	LED Surface Mounted Panel light dimmable -30-	Surface mounted DALI Dimmable LED panel made of CRCA housing with high efficiency PMMA Diffuser , LED Used shall be SMD type

Sl. No.	Area	Luminaire	Specification
		32 Watt	and fixture should have minimum efficacy at System level (Not Chip Level) >= 120 lumens / watt with Minimum system Lumens 3600, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, THD<10% & PF >0.95, fixture Min working temp range - 0°C < Ta < 45°C, Minimum Internal Surge Protection 2.5KV , luminaire manufacture shall provide LM79 report from NABL accredited lab & LM80 report to be issued by LED manufacturer.
3.	Corridor / Lift Lobby	LED Surface / Suspended Batten Light Fitting - 18-20 Watt	Surface/suspended LED batten made of aluminium extruded housing with high efficiency polycarbonate/Acrylic diffuser, LED Used shall be SMD type and fixture should have minimum efficacy at System level >=110lumens/watt with Minimum system Lumens 2000, Life of fixture: 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, PF >0.95 & THD<10%, Minimum Internal Surge Protection 2.5KV. Luminaire manufacture shall provide LM 79 report from NABL accredited lab & LM80 report issued by LED manufacturer.
4.	Staircase / Toilet	LED Surface Mounted Down lighter 10-12 Watt	Surface mounted LED down lighter fitting, fixture should have minimum efficacy at System level (Not Chip Level) >=110lumens/watt, with Minimum system Lumens 1100, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT should be 5700K-6500K, CRI >80, PF >0.95, THD<10%, IP-20 rated, Aluminium Extruded/Die Cast Housing with PMMA Diffuser. Luminaries manufacture shall provide LM79 report from NABL accredited lab & LM80 report issued by LED manufacturer.
5.	Toilet	Surface Mounted Batten-10W (Mirror Light)	Surface mounted 600mm LED batten made of aluminium extruded housing with high efficiency polycarbonate/Acrylic diffuser, LED Used shall be SMD type and fixture should have minimum efficacy at System level >=110lumens/watt with

Sl. No.	Area	Luminaire	Specification
			Minimum system Lumens 1100, Life of fixture: 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, PF >0.95 & THD<10%, Minimum Internal Surge Protection 2.5KV. Luminaire manufacture shall provide LM 79 report from NABL accredited lab & LM80 report issued by LED manufacturer.
6.	Services Room	Surface Mounted Batten-20W	Surface LED batten made of aluminium extruded housing with high efficiency polycarbonate diffuser, LED Used shall be SMD type and fixture should have minimum efficacy at System level >=110lumens/watt with Minimum system Lumens 2000, Life of fixture: 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, PF >0.95 & THD<10%, Minimum Internal Surge Protection 2.5KV. Luminaire manufacture shall provide LM 79 report from NABL accredited lab & LM80 report issued by LED manufacturer.
7.	Lift Shaft / Terrace Area	Bulk Head - 7-10 Watt	LED Bulkhead with a minimum system efficacy of 100 lm/W with Minimum system Lumens 800,. The luminaire should have a color temperature of 5700K-6500K and CRI > 80. The luminaire shall meet IP65 rating and IK 08 rating with THD < 10% and PF > 0.9. The luminaire housing should made of High pressure die cast Aluminium with polycarbonate front diffuser.
8.	Double height area	LED Highbay Light - 75-80 Watt	LED based Luminaire, housing made up of Aluminum Die-casting with effective thermal management. The fixture should have a minimum system efficacy of 125 lumen/Watt with Minimum system Lumens 10000. The fixture shall be designed for a system life of 50,000 hours @70% lumen maintenance. Ingress Protection of IP65 (lamp and gear Compartment) and Mechanical Impact Resistance Rating of IK 06.The fixture driver should have an operating voltage range of 140-270 V, surge protection of >=3KV, PF >0.95 and THD<10%. LM 79 and LM80 reports need to be submitted from a

Sl. No.	Area	Luminaire	Specification
			NABL/UL accredited lab to verify above parameters.
9.	Kitchen Area	Surface Mounted Batten-36-40W IP65	Surface mounted IP65 LED batten made of PC housing with high efficiency diffuser, LED Used shall be SMD type and fixture should have minimum efficacy at System level (Not Chip Level) >=100lumens/watt with Minimum system Lumens 3600, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, PF >0.95 & THD<10%. Minimum Internal Surge Protection 2.5KV. Luminaire manufacture shall provide LM79report from NABL accredited lab & LM80 report issued by LED manufacturer.
10.	AC Plant Room	Surface Mounted Batten-20W IP65	Surface mounted IP65 LED batten made of PC housing with high efficiency diffuser, LED Used shall be SMD type and fixture should have minimum efficacy at System level (Not Chip Level) >=110lumens/watt with Minimum system Lumens 1800, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT of 5700K-6500K, CRI >80, PF >0.95 & THD<10%. Minimum Internal Surge Protection 2.5KV. Luminaire manufacture shall provide LM79report from NABL accredited lab &

Sl. No.	Area	Luminaire	Specification
			LM80 report issued by LED manufacturer.
11.	All toilets	Hands in type hand dryer	wall mounted Polycarbonate ABS body, single phase, brushless DC motor type, Touch-Free Infra-Red Activation operation having 80-85 db noise level and upto 1000 watt rated power. Hand dry time – 7to10 secAuto cut off - 18 – 20 sec
12.	For Landscaped Area of Individual building - Bollard Light	LED 8-12 Watt Light	IP65 LED Bollard with dark grey polyester coated rust proof Die cast Aluminium housing ,with symmetrical dual optics and PC diffuser The luminaire shall have initial system lumen of 400lm with System efficacy of >50Lumen/W. The LED shall have a CCT of 3000K with LEDs shall be LM80 Compliant with TM21 report for life of 25000 hrs at 35 Deg C. and CRI 80 with beam angle of 360°.The Fixture shall have IP65 potted driver with THD<25%, PF>0.9,with operating volatge range of 180-270V. The fixture shall comply with IS 10322 part 5/Sec 1 1987 and LM79 LM80 reports are tested and certified by NABL accredited Lab.
13.	For Main Roads - Bended Conical GI / PU painted Poles (Area of application – Roads having combination of vehicular road, cyclepath and pedestrian)	Height of Pole Double Stem 6.0m/4.0m	Decorative pole with reduced diameter with base plate 370 x 370 x 16mm, material of base - hot roller sheet as per IS 1079, arm as per IS1239 and base plate: A36/A572-50 or equivalent, hot dip galvanised to ASTM A123 with minimum average GI coating of 65micron, PU painted with average DFT of 70 micron with high quality paint and primer. The column shall also be provided with flush door at the bottom with proper strengthening to the cutout of the door opening, door cover with anti-theft provision, having double stems.

14.	Faculty Lounge / Student Lounge	LED Surface Mounted Down lighter- 13-15 Watt	Surface mounted LED down lighter fitting, fixture should have minimum efficacy at System level (Not Chip Level) >=110lumens/watt, with Minimum system Lumens 1500, Life of fixture (Including Driver) : 50000 burning Hrs. @ L70B50 Lumen maintenance, CCT should be 5700K-6500K, CRI >80, PF >0.95, THD<10%, IP-20 rated, Aluminium Extruded/Die Cast Housing with PMMA Diffuser. Luminaire manufacture shall provide LM79 report from NABL accredited lab & LM80 report issued by LED manufacturer.

Sl. No.	Area	Luminaire	Specification
15.	drinking water area	120 / 100 Ltr storage capacity water cooler with inbuilt UV	Technical specifications : 1. Storage capacity : 100 / 120 Ltr. 2. Water outlet with temp at 17+/- 1 degree : 70 / 80 LPH 3. Power supply : Single phase 230 volts, 50 Hz 4. No. of Filtration stages : 3 a) 1st stage : sediment filtration b) 2nd stage : carbon filtration c) 3rd stage : UV filtration 5. Operation voltage : 180-250 V 6. Material of tank & body : SS 304 7. Refrigerant : R-134a
16.	For Compound Lighting - Post top Light	LED 35 Watt Light	Post top luminaire consisting of a high-pressure powder coated die-cast aluminium housing, a canopy made of plastamid and a UV resistant high impact polycarbonate protector. The luminaire emits a pleasant, glare-free light due to the highly efficient white reflector (symmetrical light distribution). The complete luminaire is sealed to IP 66 & Impact resistance of IK08. Electronic temperature monitoring prevents overheating of LEDs and power supply within the LED compartment (ThermiX®). It is designed for LED light sources of 35W having a neutral white light. Surge protection of 10kV.
17.	Compound Light Pole for Post Top Light	3/4 Meter high Pole	3/4m high pole made out of G.I, tubular pole made in two sections - bottom section of 1/1.5m having dia of 114mm and top section of 2/2.5m having dia of 76mm, with base plate 200x200x12mm, material of pole shaft - steel tube grade YSt240 and baseplate: A36/A572-50 or equivalent, hot dip galvanised to ASTM A123 with minimum average GI coating of 65micron, PU painted with avg DFT of 70micron with high quality paint and primer. The column shall also be provided with flush door at the bottom with proper strengthening to the cutout of the door opening, door cover with anti-theft provision.

Main Distribution Panel

The building shall have following Panels for Power distribution:-

S. No.	Building Description	Description
1)	Centenary building (Auditorium& lecture hall)	1. 2 Nos. Main DG Backup Panel shall have 1 Incomer, required numbers of outgoing feeders, multifunction metering as per GRIHA-5 requirement etc. 2. 1 Nos. Main Non-DG Backup Panel shall have 1 Incomer, required numbers of outgoing feeders, multifunction metering as per GRIHA-5 requirement etc. 3. Each floor shall be 2 No. Floor Panel of DG Backup and Non-DG Backup. 4. The Floor Panel shall be feed through XLPE Cable from Main Panel. 5. Lift Panel shall be 2 nos. Incomer with ATS. 6. Ventilation Panel shall be fed from Main Distribution Panel. 7. The Light, AHU, UPS and Lifts feeders shall have Energy Meter as per GRIHA-5. The Distribution Board (DB's) shall be SPN / TPN / VTPN, the design shall be submitted for approval.
		8. 1 Nos. Main DG Backup Panel shall have 1 Incomer, required numbers of outgoing feeders, multifunction metering as per GRIHA-5 requirement etc. 9. 1 Nos. Main Non-DG Backup Panel shall have 1 Incomer, required numbers of outgoing feeders, multifunction metering as per GRIHA-5 requirement etc. 10. Each floor shall be 2 No. Floor Panel of DG Backup and Non-DG Backup. 11. The Floor Panel shall be feed through XLPE Cable from Main Panel. 12. Ventilation Panel shall be fed from Main Distribution Panel. 13. The Light, AHU, UPS and Lifts feeders shall have Energy Meter as per GRIHA-5. 14. The Distribution Board (DB's) shall be SPN / TPN / VTPN, the design shall be submitted for approval.

57. Fire / Exit / Escape Route Signages :

Scope of Work : Designing, manufacturing, providing and fixing of self glowing photo luminescent safety signages on 1.6 to 2 mm thick aluminium sheet of various matter as briefed by the Engineer-in-charge such as electrical safety precaution, instructions for lift passengers, fire safety measures, indication of various shafts, entrance , exit, stairs, toilets, fire exit etc having single side printing /computerized setting of letters on the photo luminescent as base chemical covered with stabilizer coating complete as required for various buildings under construction. Wherever required light illuminated signages shall be used.

Various types of signage are proposed in the complex as per NBC 2016 Part -4. Material of signage shall be of acrylic/aluminum of required dimensions. At every floor near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE USE STAIRS UNLESS INSTRUCTED OTHERWISE'. The signage shall be above call push button in Lift Lobby. Floor Signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape route. These Signage may be LED lit with UPS power backup or of photo Luminescent paint as per requirement & directions of E-I-C so that they will be visible in dark in case of power failure. Signage for Assembly Point also needs to be provided. Evacuation path signage & Emergency Exit signage shall also be provided. Some of the signages shall be hung from ceiling (both ways) to have proper visibility.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to
–Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment. WAPCOS has decided to implement this policy.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-2
MRL LIFTS

GENERAL CONDITIONS

1.0 Scope

The EPC contractor shall design, supply, inspection as may be necessary before dispatch, delivery at site, installation, testing commissioning and handing over in working condition of following Electrical MRL Lifts. The details of MRL lifts are :

S. No.	Building Name	Floors	Type of Lift	Lift Capacity	Speed	No. of Floor Served	No. of Lifts
1	Centenary Building Auditorium	G+4	Passenger Lift	16 Passenger	1.5 MPS	5	3
1	Centenary Building Lecture Hall	G+4	Passenger Lift	16 Passenger	1.5 MPS	5	3

Technical Specifications

	Specifications	Remarks
Application	Passenger, handicap friendly	
Type	Machine Room less	
Motor	PMS Gearless with Regenerative drive	
Capacity	1088kg, 16 Passenger	
level/stops	G+4, 05 stops	
Speed	1.5 meter per second with jerk less acceleration, deceleration and stopping with 3mm level accuracy	
Drive	Full Collective, AC VVVF Compatible with BMS	
Power supply	AC 400/440V, 3 phase and single phase, 50 cycles/sec.	
Car design	Car front: Stainless Steel mirror finish Side Panels: Stainless Steel Leather finish Rear Panel: Stainless Mirror finish All finishes shall be of 304 Grade Stainless Steel.	
Car door	Automatic Stainless Steel Mirror Centre opening Cardoor panels	
Car door protection	Multiband full height infra-red detector.	
Landing doors	Stainless steel Car door panels with vision panel. Door shall match to the Car door	
Direction & Position indicators	Large display LCD Car Position Indicator in COP at lower height	
Car Flooring00	Anti-skid, slip resistant material having a slip resistance value of 45–70 (optimally 50–65), as measured with 4S to sugar rubber on a pendulum test on single piece Artificial Granite Flooring	
Car lighting	Lighting levels in the lift are a minimum of 100 lux (approximately 50–75 lux at floor level and shall be confirmed using Luxmeter) (only LED fittings shall be used)	

Ventilation	Side corner blower ventilation arrangement	

Travel	As per drg./details	
COP suitable for physically handicap & Visually impaired	Protruding type Brail encrypted Car buttons at a height easily accessible bywheelchair bound or visually impaired passenger.	
Hall Fixtures	LED/LCD hall position indicators to benefit visually impaired and physicallyhandicap users Hall lanterns with car arrival gong at a height not more than 1200mm from floor	
Car size of	As per standard	
door opening	As per standard (Centre)	
pit depth	As per NBS	
overhead height	As per standard	
hoist way dimensions	As per standard	
entrance height	As per standard	
inside car height	As per standard	
Special features	Full Height 2D electronic cross beam detectors Large display LCD Car Position Indicator in COP at lower height Hand rails on three sides with height not more than 900mm from floor Voice announcement for all COP operations for visually impaired userOverload Warning with audio visual indicators Auto fan and Light Cutoff,Automatic Rescue Device. Door open/Door close button in car. IP Addressable CCTV provision in the lift 2MP, fixed dome type, 120dB WDR, ON board storage with 128GB memory stick, vandal proof housing for the Lift Cabin – This shall be integrated with the existing Surveillance system of the Institute. Anti-Nuisance Travel	

1. SCOPE

The scope of Bid is to cover design, manufacture, supply, install, test, commission, obtain all necessary statutory approval and maintenance of Lifts during the Defect Liability period and Maintenance period in the Building complex as per the documents and drawings. The scope also includes minor Civil and Structural steel works connected with the installation of Lifts.

All electrical works connected with Lifts beyond power supply point shall also be included in the scope of the Bid as per this document. During the Defect Liability period of 3 years after successful commissioning, handing over of Lift and taking over by the Employer, the Bidder shall carry out comprehensive

maintenancefor 2 years of Lift free of cost.

Particulars of Lift Service requirement

Sr. No.	***Particulars***	***Recommended***
1	Application	Passenger, Handicap friendly
2	Capacity	16 Persons
3	Load	1088 KG
4	Number of Lifts	06 NO
5	Speed	1.5 MPS
6	Level	**G+4**
7	Travel	As per details
8	Servicing	Lift should serve -**G+4** Thus servicing 5 levels and 5 openings same side for six lifts
9a	Size of the lift car	To be given to suit to available & liftshaft.
9b	Entrance width and type of door	To be given (as per standard to enable to enter wheel chair) Center opening/telescopic automaticpower operated
10	Car enclosure &Door	Shall be of hairline finish stainless steel with mirror with handrail etc. Inner surface of Car door shall be Hairline finish stainless steel with full size vision panel all as per General specification.
11	Car floor	Anti-skid

12	Car fittings	LED light with auto as well as manualcontrol
13	Drive & Machine	A.C. variable voltage variable frequencytype & Gearless, Permanent Magnet
14	Control Operation	Elevator served and should be in simplex control with /without attendant.

Sr. No.	***Particulars***	***Recommended***
15	Safety Gear	Over speed Governor instantaneous typeoperating on Electro Mechanical basis.
15a	Hoist way size in mm-	as required
15b	Hoist way door	Stainless steel hairline finish.
16	Lift pit depth	As required – As per standard
17	Intercom	3-way intercom system will be provided. Additionally, there should be provision to fix IIT intercom to be mounted flush to car wall which will be connected to IIT EPABX.
18	Car EmergencyLight	Emergency Battery operated power supply (EBOPS) for light, alarm and a fan to be provided with electric power supply to the light in the car, when the main power supply is not a available. The operation to be automatic and no need of manual intervention to be required.

19	Load weighing Device with bypass function	To be provided which senses the load. Facility to be provided for bypassing a registered landing call be a car loaded more than 80%
20	Full length infra-red safety light curtain infra-red operated doors safety system.	To be provided. The Light Curtain to consist of infra-red-light beams passing between Car Door Entrances and one side of the Entrance the light source is being sensed by sensors. If an object cuts the light beams the receivers will sense and give door command to the door operating system. This is to sense the passenger movement without being getting in to physical contact of doors with human being or other materials like trolley .perambulator etc., which ensures the highest safety to the passenger and other items transported by Elevator This infra-red light curtainto operate as low as from 100 mm to a height of 2 meters ., so the system can even detect the movement of child pet etc., and thus ensures complete safety to users.
21	Fireman Drive	Provision for Fireman drive to be made to bring the car to the main floor immediately after the fire switch is operated. Thereafter the car is for operation by the rescue person. All landing calls are ignored. Lift answers one car call at a time. The rescue person controls opening and closing of doors at a floor. Returns to normal when fire switch is

Sr. No.	***Particulars***	***Recommended***
		opened. Fireman switch Drive to be provided to ground all the lifts.
22	Automatic rescue device:	To bring the car to the nearest landing in case of power failure and also System failure.
23	Battery operated emergency alarmbell.	To be provided
24	Stainless steel signal fixtures:	To be provided
25	Individual lightand fan on/off switches	To enable the passenger, use the lightand fan switches to his/her choice.
26	Cooling fan for lift motor	To keep the motor in a cool condition against heating up of motor coil is increased thereby

27	Cooling fan for lift controller	To keep all electronic components in a cool condition, all safety logic circuits are protected Lives of electronic components are increased.
28	Door open/door close functions in car	Door open/door close functions to be provided in the car to deal with the emergency situations and to have a better operation by the attendant.
29	Direction and position indicator in car and landings	Direction and position indicator to beprovide in car and all Landings.
30	Home floor parking selection	Lift will stay after service at the landing it last arrived. If required by client, contractor to make Home parking arrangement at the designated floor.
31	Main entrance floor selection	This is the floor at which the fireman switch and alarm bell will be fixed. So that in case of emergency the lift can be taken control by the firemen at that floor.
32	Variable door opening time.	The opening time of the car door and landing door can be varied according to the requirement.
33	Full collectivelogic	Full collective control system to be provided to facilitate the optimum function of the elevator. Here the lift will accept the car and landing calls in both directions
34	Inspection Clause	Contractor has to arrange inspection of factory for WAPCOS/IIT(ISM) Dhanbad officials at their own cost.

Note:

1. The Contractor has to arrange at their own cost including supply, fabricate and erect in position structural steel required for support of machine, brackets for guide rails, fascia plates at all landings etc., including three coats of anti-corrosive paint of approved make and shall arrange for connected Civil works. The Civil works such as cutting of holes, chases etc., in brick work, concrete etc., including necessary scaffolding in/out of lift wells, floors on partitions together and making good holes for fixing brackets in lift walls, grouting of all bolts, sills, brackets / control board/button boxes, limit switches etc., all in position for all lifts together..
2. Provision shall also be made available in the controller and wherever necessary for the lift(s) to directly travel to ground floor on any signal from Fire Alarm Control Panel having led to lift machine room, automatically, ignoring direction of travel and other pending commands as per special condition of the Bid.
3. The offer shall include identification of Fireman's Lift, having break glass panel and other specific functional requirement. Requirements indicated in the National Building Code of India (Equivalent

to BS) in respect of Fire Protection requirements of lifts shall be fully complied with in respect of Design, Manufacturing and Erection of the Lifts.

4. Contractor shall provide full set of tools required for maintenance of lifts in the Lift Machine Room.
5. Notice required from the statutory authority shall be obtained.
6. Fastener needs to be placed in concrete structure or incase of brick work the same needs to be placed after providing concrete block of required strength in no case it is allowed to be placed in Brick work.
7. Cost Includes; Factory inspection is to be arranged for WAPCOS/IIT ISM personnel.

QAP for factory inspection may be submitted with tender document.

GENERAL / DETAILED SPECIFICATIONS FOR LIFT

1. a) Drawings:

The work shall be proceeded with the preparation of the general arrangement drawings based on the site/building plans handed over for the purpose and submission of the same for approval of the Architects according to the time Schedule specified. Any doubt on dimensions shall be got cleared by verifying at site/building.

b) Project information / data:

Design ambient for electrical equipment is 40°C.

c)Technical:

i) Variations in Power supply:

All equipment's shall be capable of working efficiently under conditions of Voltage and frequency variations.The range of variation is as below: Voltage ± 10% Frequency: -± 5% Combined Voltage & Frequency: -+ 10%

2.Lifts

a) Lift Car

(i)Car Frame:
The Car frame shall consist of suitable Structural shape, properly braced and securely fastened together.

(ii) Car Enclosure:

Car enclosure shall be of Stainless Steel of suitable thickness which shall be mentioned.

(iii)Car Platform:

The Lift Car Platform shall consist of an outside metal frame, which will have steel sheet / Aluminum chequered plate flooring. The steel sheet flooring shall be covered with Granite Tile flooring.

The platform shall rest on rubber pads supported on an ancillary steel frame fastened to the car frame, thus forming an isolated cushion between the Car and the Steel Car frame.

(iv) Car Door:

The Car entrance shall be provided with a Center opening flush type for as designated passenger lift and Center/side opening flush type, horizontal sliding door which shall be hung on rubber-tired sheave hangers with a steel track and guided at the bottom by non-metallic shoes sliding in a thresh hold groove. It shall also be of solid type with fire resistance of at least one hour. The inside surface of the Car door shall be of hairline finish stainless steel.

(v) Car Fittings:

The lift Car shall be provided with a LED, battery operated Emergency light and a fan/blower.

(b) Lift Operation:
The type of operation offered shall be as per Clause 2.42.3 of I.S. 1860 with one button in Car for each landing level served and up and down buttons at the intermediate landings and a single button at such terminal landing.

All stops registered by the momentary pressure of the Car buttons shall be made in the order in which the landings are reached after the buttons have been pressed, irrespective of the sequence in which calls were registered.

The type of operation offered shall also cover the provision for operation with attendant.

Provision for manual raising or lowering of lift in case of emergency shall also be made.

A home landing shall be established at the main floor to which the Car shall automatically return when all calls have been cleared and park.

Provision shall also be made in the controller and wherever necessary for the lift(s) to directly travel to ground floor on any signal from Fire Alarm Control panel having led to controller, automatically, ignoring direction of travel and other pending commands as per special condition of the Bid.

c)Car Operating Panel:

One number car-operating panel shall be provided.

The Car operating panel shall be flush mounted in the Car enclosure and fitted with the following: -

i. A bank of buttons including braille buttons to correspond to the various landing levels served.

ii. An emergency stop switch for stopping the Car independently of the regular operating service.

iii. An alarm button connected to an alarm bell located at the main floor landing outside of and adjacent to the hoist way.

iv. A ‘Door Close’ button and a ‘Door Open’ button shall be provided. The door open button shall be capable of reversing the doors while closing.

v. The panel shall also include a non-stop switch for by passing landing calls, which shall however remain registered till they are answered.

vi. The following provision shall be covered in the operating panel for use of the attendant.

1) A buzzer for notifying the attendant when an up trip should be made in answer to hall bells.
2) Key operating switch for cutting in and out the additional equipment for “WITH

ATTENDENTOPERATION".

3) Up and down light jewels for indicating the direction of the Car, set to travel.

vii) A plainly marked push button shall be provided in the Car operating panel with wiring connected to an emergency alarm bell.

viii) The following shall also be included in the car-operating panel.i)up' push button, (ii) 'Down' push button, (iii) Braille plate on the side of each button.

ix) The following operating devices shall be included.

In the machine room/control room – 'UP' push button, 'DOWN' push button, 'STOP' push button, Hand cranking device, Slow speed operation.

On the top of the car: 'UP' push button, 'DOWN' push button, 'STOP' push button (Emergency PUSH to lock), 230 V, 1 Phase Receptacle.

x) The following indicating devices shall be included.

In the landing: 'UP' direction of travel, 'DOWN' direction of travel,
Location of the position indicator, call registered 'UP' indicator, call registered 'DOWN' indicator, Lift out of order / under maintenance.

xi) The following car accessories shall also include the following.

a Hand rail
b. Car Operating Panel (COP)

(c) Car Position Indicators:

A LCD/TFT Digital Car position indicators shall be provided with Stainless Steel face plate in each elevator Car which will indicate the landing at which the Car is stopping or passing.

Illuminating direction arrows to indicate the direction of travel shall also be provided along with Car position indicator referred above.

(e) Call Registered Lights:

Each hall button faceplate in Stainless Steel shall be provided with registered lights, which shall illuminate when Corresponding button in the faceplate is momentarily pressed (Luminous buttons) and remain illuminated until call is answered.

(f) Hall Position Indicator:

A Seven Segment Digital position indicator shall be provided on side of entrances at all landings indicating the position of the Car in the hoist way at all times.

(g) Hoist way Entrance:

Centre opening/telescopic Steel doors with provision for emergency key opening at all landings shall be provided.

The door shall be of solid type with fire resistance of at least one hour. The outside surface of Hoist way door to be hair line finish Stainless Steel as specifically provided for.

(h) Alarm Bell:

An emergency alarm bell including wiring shall be provided at a location adjacent to the hoist way on inside at ground floor landings and at the top of the car.

(i) Automatic Terminal Stops:

The elevator shall be equipped with an automatic stopping device arranged to bring the Car to a stop at the terminal landings independent of the regular operating device in the Car.
The final limit switches shall be provided in the hoist way separated by the Car and arranged to stop the Carand prevent normal operation should it travel beyond the zone of the normal stopping device.

(j) Fireman's Switch:

A Fireman's switch of two-button housed in a glass fronted box adjacent to the lift shall be provided at the entrance level in Ground Floor.
The switch in 'On' condition shall not cause landing call-points operative.

(k) Car and Hoist Way Door Operation:

Doors on the Car and at each hoist way landing (Side opening / Centre opening sliding doors) shall be operated quietly and smoothly by an Electric Operator which shall open the Car door and hoist way door simultaneously. All electric contact for the Car door shall be provided which shall prevent elevator movement away from the landing unless the door is in the closed condition.
Each hoist way door shall be equipped with a positive electro mechanical interlock and auxiliary door closing device so that the elevator can be operated only after interlock circuit is established. In case of powerinterruption or failure of the operator, it shall be possible to open the doors manually from within the Car.

(l) Door Safety:

The Car and landing doors shall be provided with mechanical as well as electric / electronic safety device (Infra-red) to instantly stop the closing of the doors on sensing an obstruction and to retract.
A protective device, effective along the front edge of the car door to its full height shall be provided in such away that doors of the car and hoist way shall return to their position on touch of a person or object while the Car door is on move for closing. The doors shall remain open until the expiration of a pre-determined interval and then close automatically.

(m) Door Hangers and Tracks:

Sheave type hangers and tracks at each hoist way entrance shall be provided with complete Sheaves and rollers. They shall be of Steel. Adjustable ball bearing rollers shall take up thrust of the doors.

An air cord drive or suitable arrangements shall be provided for transmission of motion from one door to the other.

(n) Ropes if applicable (Not applicable in case of belts)

The Car hoist ropes shall be of traction steel of suitable size, construction and number to ensure the proper operation of the elevator and give satisfactory wearing qualities.

Governor ropes shall be of Steel. All ropes shall consist of at least Six strands, wound around a hemp core center and shall be specially designed and constructed for elevator application. The minimum factor of safety in rope

capacity shall be 10.

(o) Safety Device and Governor:

The safety device shall be of friction type safety gear and mounted on the bottom members of the Car frame or otherwise as per manufacturers specification and shall be operated by an over speed governor located over the hoist way. The safety device shall be provided to stop the Car whenever excessive descending speed is attained with means to cut off power from the motor and apply the brake prior to application of the safety device.

(p) Guide Rails & Fastenings:

Pinned Steel 'T' shape elevator guide rails with ends tongued and grooved shall be provided for the car and counter weight. They shall be erected plumb and fastened securely to the hoist way framing by heavy steel brackets. The guide rails shall be connected by steel splice plates. All such ancillary steel structures shall be included in the quoted rate.

(q) Counter Weights:

The counter weights shall consist of iron weights contained in Structural Steel Frame and shall be equal to the weight of the complete Elevator Car plus 40% to 50% of the Contract load.

(r) Buffers:

Buffers shall be provided for car and Counter Weight including required pipe struts of suitable type for speed more than 1.8 m/ s. Spring Buffer for goods elevator and machine room less elevator. The stroke of the buffer shall be as per the applicable IS standards.

(s) Machine:

Machine shall be of gearless.Motor:

Motor shall be of A.C. Type having variable Voltage Variable frequency motion control system, specially designed for lift duty and of design such that there should be proper lubrication possible if required.

The motor shall be Class-F insulated and shall be sized for 125% of contract load.
An alternative method of motor and / or motor control which gives better performance, proven system may also be submitted by Bidder along with Bid.

(v)Levelling Accuracy:

- ±3 mm at all load

condition.(w)Electric Wiring:

Insulated wiring with conduit or tubing together with necessary fittings, metal boxes, troughs and ducts shall be provided.

Separate conduits shall be used for carrying conductors of different voltage ratings. In all, International standards and Rules of B.S /Indian Electricity rules shall be followed. Copper wire of 1100 volts rating only shall be used.

(x) Power Supply:

400V, 3 Phase, 4Wire, 50 Hertz Alternate Current and Single Phase 230V, 50 Hertz Alternating Current will be made available at a convenient point in the ground floor on a distribution board arranged along with the main work. Lift shall operate under voltage fluctuation of + 10% (i.e. between 360 to 440V)

(y) Steelwork & Civil Works:

All Structural Steel fabrication, supply and delivery to site, erecting it in place, including painting, making necessary holes, chases in concrete masonry etc., aligning and grouting steel members in Cement Concrete of approved proportion including curing shall be done unless otherwise considered separately.

The Structural Steel work shall cover all items necessary for efficient and safe functioning of the lifts such as Machine beams, hoisting beams, guide rails, strut angles at every landing, rail brackets, bearing plates, hitch beams, stretchers, separators, buffer supports, cleats, bolts, etc. All guide rail brackets shall be provided with adequate supports. No claim for extra payment shall be admitted on account of missing out any of these aspects while quoting for the work.

Also, all Civil works necessary for the installations and commissioning of the lifts such as beams, pedestal or lift buffer springs grouting of all the pockets, holes etc., including fixing in position of indicator call bell and other boxes, grouting of sill and patching around the entrance etc., shall also be covered in the quoted price unless otherwise considered separately. Making good of cutting of walls etc. and rectification of repair works shall be carried out using specifically fire retarding material of approved make.

Suitable and adequate Scaffolding required for the erection of the lift(s) and hoisting of all machinery and equipment to the required heights shall be arranged by the contractor and nothing extra will be paid.

OTHER PARAMETER FOR LIFTS:

1. GENERAL:

a) The manufacture, supply and installation of Lifts shall be complete in all respect in a first class workmen like manner and shall cover all work including Structural Steel work necessary for the supporting structures for the Lift machine and other minor Civil works such as scaffolding etc., required for installation and materials, all complying the requirement of local body if any, and in accordance with the I.S. specifications I.S. 1860, 2365, 14665, 3534, 9878 and 4666 and I.S 4951-1968. (Re-affirmed – 1991) and fire protection requirement as per National Building Code of India.

b) Quality Assurance Plan (QAP) in respect of Lift shall be submitted before commencement of work for approval of the WAPCOS/IIT(ISM) Dhanbad.

2. PARTICULAR:

(a) Salient features of the Equipment provision as to manufacture, furnishing, finish etc. shall be highlighted with reference to the material input and operational supremacy.

(b) Necessary Shop drawing and working drawings showing the general arrangements of the equipment etc. shall be furnished for approval from WAPCOS/IIT(ISM) Dhanbad prior execution of work.

(c) The materials and workmanship of the Lifts and its installations shall be guaranteed and the guarantee shall cover making good of any defects, not due to any ordinary wear and tear or improper use and care, which may develop within 3 years of defects liability period and after that 2 years of Maintenance period from the date of handing over of installations duly tested and commissioned. Test certificates of the material used on site for installation and operation of the lift shall be submitted.

(d) The Lifts installations shall be maintained for a period of 60 (sixty) months (3 years of Defects liability period and 2 years of maintenance period) commencing from the date, the Elevator equipment's are taken over to use and the maintenance shall include periodical lubrication of the equipment and adjustment thereof, if any, under supervision and direction of Competent Personnel and replacement of parts that

become necessary due to normal wear and tear during the guarantee period , defects liability period and maintenance period. All Operation / Maintenance shall be performed during regular hours of regular working days.

(e) The Lift service particular and General Specification/Condition appended shall be adhered to in all respect.

(f) The equipment supplied and erected shall be in accordance to IS-4666/1968, 1860/1968 & 1980, 3534/1979, I.S. 4591-1968. (Re-affirmed – 1991).

(g) The local statutory Lift Rules for Lift Control as applicable shall be complied with, no extra payment shall be considered either due to escalation or amendments / modifications to local Act / Rules issued during the contract period.

Bidder / Contractor in co-ordination with client shall be responsible to obtain necessary License from the Electrical / Lift Inspectorate of Government of Jharkhand for installation / operation of Lifts before handing over of the installation(s) by taking timely action in submission of prescribed application form therefor along with documents like completion drawing etc., duly making payment of required statutory fees / charges in the manner specified by the Inspectorate on behalf of the Employer and further follow up action. Paymentfor this special service shall be reimbursed as per actual basis on evidence of payment.

3. Insurance: -

The work shall have adequate insurance cover as specified by the employer and the employer shall be kept indemnified from all claims unless otherwise provided for.

4. Test at Site: -

Tests on site shall be carried out as per I.S. 4666 Clause 24.3 or equivalent to BS before the lifts(s) is/are putinto normal use.

5.Approval of Installations and Completion Certificate: -

Approval/Completion Certificate from the Chief Electrical Inspector to Government for installation and Commissioning of Lifts shall be obtained and made available to the Employer before handing over Lifts at no extra cost. Fees payable to the authorities shall however be made by the employer.

6. Servicing: -

The servicing facilities shall be made available at Dhanbad for maintenance of Lift(s) during guarantee period, free of cost.

PREFERRED LIST OF MAKES:

Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of preferred make attached in the tender, shall be used in the work.

In case of non-availability of the brand specified in the contract the contractor shall be allowed to use alternate equivalent brand of the material subject to submission of documentary evidence of non- availability of the specified brand.

Sample of all the materials will be used only after approval of Addl. Chief Engineer, WAPCOS Limited.

SI. No.	Items	Preferred makes / Brands/manufacturers
1	Cement (PPC/OPC43)	Ultra Tech / Ambuja / J.K. Cement / ACC /Birla / Lafarge / Wonder
2	White Cement	J.K. White / Birla White / Ultratech / Wonder
3	Reinforcement Steel	Tata Steel / SAIL / RINL /JSPL / JSW
4	Structural Steel	TISCON / SAIL / RINL /JSPL / JSW
5	Welding Rods	Esab / Bohler / Advani Oerilikam / D&H / ADOR
6	Admixtures, Plasticizers	FOSROC/ SIKA/ BASF/ MBT / CICO / Asian Paints
7	Dash Fasteners / Anchors	Hilti / Bosch / Fischer / Wurth
8	Wall putty Exterior grade (white cement based)	Birla Wall Care Putty / JK Wall / Asian Paints Professional Wall Putty / Dulux Wall Putty
9	Epoxy Primer and Paints / Wood Primer/ Steel Primer	Akzonobel India (ICI Dulux) / Kansai Nerolac / Asian Paints
10	Synthetic Enamel Paint	ICI Dulux (Dulux Hi Gloss) / Kansai Narolac (Narolac Hi Gloss) / Asian Paints (Apcolite Premium Gloss) / Berger (Luxol)
11	Exterior Acrylic Emulsion Paint	ICI Dulux (Weather Shield) / Kansai Narolac (Excel) / Asian Paints (Apex) / Berger (Weather coat)
12	MRL LIFTS	FUJITEC,HITACHI, TOSHIBA,HYUNDAI,ORONA,MITSUBISHI, SCHNINDLER
13	Housing Motor	AS PERMANUFACTURER'S STANDARDS; AND APPROVAL OF WAPCOS/IIT(ISM)
14	Rope	AS PERMANUFACTURER'S STANDARDS; AND APPROVAL OF WAPCOS/IIT(ISM)

64. <u>Preference to PPP-M – II Policy (Make in India):</u>

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-3

FIRE FIGHTING SYSTEM

TECHNICAL - GENERAL REQUIREMENTS

1. SCOPE:

This section covers the general technical requirements to be complied with in respect of requirement of NBC – 2016 and CPWD Specifications.

The brief scope of work is as following:-

Planning, Design & preparation of Drawings for E & M services, obtaining approvals from the department, Supply, installation, testing and commissioning of Fire Fighting system as per the requirement of NBC 2016 with amendments, updated BIS codes, local bodies, Fire bye-laws of Govt. of JHARKHAND and CPWD specifications for all the single/ Multi-storeyed buildings to be constructed including planning and designing by incorporating stipulated specifications, on design, built and handover basis including all works as per scope for Work and user requirement all complete including defect liability period for three years from the date of handing over as per direction of Engineer in Charge

a) Centenary Building(G+4)

(Total plinth area to be covered in this subhead shall not be less than 18708 SMT

If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

TEST CERTIFICATES:

Copies of all documents like routine and type test certificate of the equipment carried out at manufacturers premises shall be furnished, as required.

2. PAINTING:

The tendered cost shall include cost of painting of entire iron works in the completed

installation. All iron works barring the contact areas of moving parts shall be painted before dispatch to the site at the shop with two coats of anti-corrosive primer paint. Final finishing and painting shall be invariably done at site. One coat of final finishing of approved colour may be done at the factory before dispatch, if considered necessary by the tenderer, on such components, which will not need removal of such paints at site during assembly work. After completing the installation and assembling a final coat of painting of approved colour shall again be given to the equipment.

3. STANDARDS:

The tenderer shall clearly state in his offer standards adopted for the design and manufacture of the equipment and the components. All electrical equipment shall conform to latest Indian Electricity Regulations as regards safety, earthing and other provisions specified therein for installation and operation of the electrical plant.

The entire work shall also conform to the relevant parts of CPWD specification for electrical works as applicable and amended up to date in general and to detailed requirements under this specification, in particular. Any deviation made by the tenderer should be clearly brought out under "Schedule of Departure" giving reasons for the deviation as well as explaining how the deviations would add to an improved performance.

4. GENERAL WORKMANSHIP:

All manufactured/fabricated items shall conform to first class workmanship and shall comply with the best commercial standards for ruggedness of construction.

5. INTERCHANGEABILITY:

All similar equipments, materials removable parts of similar equipments etc shall be interchangeable with another standard make.

6. DATA MANUAL & GA DRAWINGS TO BE FURNISHED BY THE TENDERER AFTER AWARD OF WORK:

The successful tenderer would be required to submit the following GA DRAWINGS within 1 (one) month of award of work for approval before commencement of installation.

(a) Bar chart giving programme for supply and installation of all equipments.

(b) All general arrangement DRAWINGS of the system.

(c) Schematic arrangement and circuit diagram of control panel.

(d) Complete lay out dimensions for every unit/ group of units with dimensions required for erection purposes.

(e) Any other drawing/ information not specifically mentioned above but deemed to be necessary for the job by the Contractor.

The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance i/c preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue and workshop procedure for repairs, assembly and adjustment etc. all in triplicate.

7. AS BUILT DRAWINGS / Documents to be furnished on completion of installation

Three sets of the following as built DRAWINGS shall be submitted by the contractor while handing over the installation to the Department. Out of these three, one set of Sl. no. (i) below shall be laminated on the hard base for display in the Substation / wet riser room

i) Wet riser installation giving complete details of all the equipments including their foundations. Cable laying plan with route and sizes of cables Line diagram and layout of all electrical control.

ii) Manufacturer‘s technical catalogues of all equipments and accessories.

iii) Operation and maintenance manual of all major equipments, detailing all adjustments, operation and maintenance procedure.

8. Extent of work.

1.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by the specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all lay out charts whether or not those have been mentioned in details in the tender document in connection with this contract.

1.2 Minor building works necessary for installation of equipment, foundation, making opening in walls or in floors and restoring to their original condition, finish and necessary grouting etc as required.

1.3 Maintenance (Routine & Preventive for one year from date of completion and handing over

1.4 The work is turnkey project. Any item required for completion of the project but left in-advertantly shall be executed within the quoted rates.

9. Inspection and testing:

9.1. The successful tenderer will arrange Staff/ fuel/POL for test run at his cost.

9.2. Copies of all documents of routine and type test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in- charge and consignee.

9.3. After completion of the installation work in all respects, the Contractor shall offer the system

for testing. Testing shall be carried out as per design.

10. Safety measures

All equipments shall incorporate suitable safety provisions to ensure safety of the operating personnel as per manufacturer‘s standard practice.

11.1 Compliance with regulations and Indian standards

11.2 All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:-

(i) Factories Act.
(ii) Indian Electricity Rules.
(iii) Indian Electricity Rules.
  (a) I.S & B.S Standards as applicable.
  (b) Work men‘s compensation Act.
  (c) Statutory norms prescribed by local bodies like CEA, etc.

11.3 Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

11.4 Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs 200/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of the tenderer and recover the cost there of from him.

APPROVAL BY LOCAL BODIES

It shall be the responsibility of the contractor to obtain the approval of and to get the installation inspected and passed by the concerned agencies as may be necessary. Any License fee shall be paid by the EPC Contractor to the concerned agencies.

12.0 Guarantee

1. The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee of material from the manufacturer to the department. AMC of Fire Fighting system during the defect liability period will be in the contractor scope, nothing extra payable for AMC during defect liability period.
2. Sufficient trained and experienced staff shall be made available to meet any exigency of work during the **guarantee period of three years** from the date of handing over of the installation.

3. The maintenance, routine as well as preventive for three years from the date of handing over the installation as per manufacturer‘s recommendation shall be carried out and the record of the same shall have to be maintained.

DETAILED PARTICULARS AND REQUIREMENTS

Scope:
This covers detailed particulars and requirements for supply, installations, testing and commissioning of wet riser (requirements and equipments).

Location:
IIT(ISM) Campus, JHARKHAND.

Scope of work: -
The overall scope under proposal is to provide electric fire pumps, diesel engine driven fire pumps, pressurizing pumps as mentioned in NBC - 2016. Fire fighting is proposed through a suitable no. of wet risers and down comers for each building. Required number of internal hydrants is proposed inside the building connected with branch lines to ring main. The electric/automatic diesel engine driven pump proposed shall be of suitable capacity to maintain a pressure of 3.5 kg/cm2, at the farthest topmost outlet. The scheme also covers one lot associated complete piping work (all sizes) and valves including accessories such as bends, tees, reducer, flanges, couplings, sockets, nut and bolts and other hardware, packing sheets, orifice plates, check valves, foot valves, instrumentation control elements and switches, electrical work including power and motor Control panel etc. pertaining to the wet riser installation pumping scheme, ring mains risers, fire brigade connections, hose pipes hose cabinets, hydrants and all associated accessories, valves of different sizes etc are also included. Provision is also included for automatic priming arrangement.

The scope of the work of this tender would cover entire equipment including piping and accessories (all sizes) required together with instrumentation and controls as needed, necessary independent suction lines for the three pumps from the pump room, necessary break tank, necessary control panels, control wiring works etc. Various pipe quantities assumed for size wise for the entire job based on the above data may be furnished by the tenderer, if he so desired together with suitable layout drawing. Should there by any variation in any of these items for which quantities have been mentioned in the tender, adjustment rate also shall be indicated by the tenderer.

The scope of work of this tender would also cover SITC of External hydrant for forest fire, along the main road.

Fire Fighting System

Technical Specification

Work under this sub-head consists of furnishing all Labor, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the

Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the followings:

- Providing M.S. black steel (Class C) pressure pipe line main including Valves, Fire Hydrants, Excavation for Pipe, Laying of pipe, Painting of pipe and Making Connection to supply system.
- Black Steel Pipe, Mains Laterals, Branches, Valves, Hangers and Appurtenances.
- Hose Reels, Rubberized fabric lined hose pipes, Hose cabinets, Sprinkler heads and Landing Valves.
- Portable Fire Extinguishers
- Fire Fighting Pumps, diesel operated pumps, panels and all connected accessories including suction & delivery pipes.
- Testing Commissioning and giving live demonstrations to the various Inspection Authorities and Obtain their ―No Objection Certificate‖ (NOC) for occupation of the building.

General Requirements

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge.

Pipes and Fittings shall be fixed truly Vertical, Horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause any obstruction in shaft, passage etc.

Pipes shall be securely fixed to walls and ceiling by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings.

Valves and other appurtenance shall be so located that they are easily accessible for operation, repairs and maintenance.

Pipes

All pipes within and outside the building in exposed locations and shafts including connections buried under floor shall be M.S. Pipes as follows:

- Pipes 150 mm dia and below IS: 1239 (Class C) Heavy Class
- Pipe 200 mm dia and above IS 3589 of thickness specified.

Pipe Fittings

Pipes and fittings means tees, elbows, couplings, flanges, reducers etc. And all such connecting devices that are needed to complete the piping work in its totality.

Fabricated fittings shall not be permitted for pipe diameters 50 mm and below.

When used, they shall be fabricated, welded and inspected in workshops under supervision of Engineer-in-Charge whose welding procedures have been approved by the TAC as per TAC rule 4102 for sprinkler system and applicable to hydrant and sprinkler system. For "T" connections, pipes shall be drilled and reamed. Cutting by gas or electrical welding will not be accepted.

Jointing

Screwed (50 mm dia pipes and below)

Joint for black steel pipes and fittings shall be metal-to-metal thread joints. A small amount of red lead may be used for lubrication and rust prevention. Joints shall not be welded or caulked. (With screwed MS forged fittings)

Welding (65 mm dia and above)

Joints between MS pipes and fittings shall be made with the pipes and fittings having "V" groove and welded with electrical resistance welding in an approved manner. Buried pipes will be subject to X Ray test from an approved agency as per the TAC norms at the cost of contractor. (With welded M.S. fittings heavy class with V-Groove). The welding machine shall be 3 Phase rectifier of required current and capacity. The vendor for welding will be approved by Engineer-in-Charge.

Flanges

Flanged joints shall be provided on:

- Straight runs not exceeding 30 m on pipelines 80 mm dia and above.
- Both ends of any fabricated fittings e.g. bends, tees etc. of 65 mm dia or larger diameter.
- For jointing all types of valves, appurtenances, pumps, connections with other type of pipes, to water tanks and other places necessary and required as good for engineering practice.

- Flanges shall be as per IS 6392-1971, Table 17/18 with appropriate number of G.I. nuts and bolts, half threaded of with 3 mm insertion neoprene gasket complete.

Unions

Provide Approved type of dismountable unions on pipes lines 65 mm and below in similar places as specified for flanges shall be provided.

Pipe Protection

All pipes above ground and in exposed locations shall be painted with one coat of Red Oxide Primer and two or more coats of Synthetic Enamel Paint of approved shade.

All black steel pipes under floors or below ground shall be provided with protection against corrosion by application of 100mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE over the pipe, as per manufacturers specifications.

Pipe Supports

All pipes shall be adequately supported from ceiling or walls from existing/new inserts by Structural clamps fabricated from M.S. Structural e.g. Rods, Channels, Angles and Flats as per details given in approved shop drawings and specifications. All clamps shall be painted with one coat of red lead and two coats of black Enamel paint.

Where inserts are not provided, the Contractor shall provide anchor fasteners. Anchor fastener shall be fixed to walls and ceilings by drilling holes with Electrical drill in an approved manner as recommended by the manufacturer of the fasteners.

Testing

All pipes in the system shall be tested to a hydraulic pressure of 1.5 times of the working pressure or minimum of 15 kg/cm2 without drop in the pressure for at least 2 hours.

Rectify all leakages, make adjustment and retest as required.

Anchor Block

Contractor shall provide suitable cement concrete, anchor blocks of ample dimensions at all bends, tee connection and other places required and necessary for overcoming pressure thrusts in pipes. Anchor blocks shall be of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

Valves, Gauge and Orifice Plates

Sluice Valves above 65 mm shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to type PN 1.6 of IS:780-1980, valves up to 65mm shall be of Gunmetal Full way Valve with wheel tested to 20 kg/cm2 class-II as per I.S: 778-1971. Valve wheels shall be of right hand type and have an arrow head engraved or cast thereon showing the direction for turning open and closing.

Non-return valves shall be of Cast Iron body and Bronze/Gunmetal seat. They shall conform to class of IS: 5312 and have flanged ends. They shall be swing check type in horizontal runs and lift check type in vertical runs of piping. They shall not be spring-loaded type.

External Yard Hydrants

The Contractor shall provide External Fire Hydrant in the Ring or on External Fire Line, as per specifications and as shown in approved tender drawings. The spacing of the hydrants and the distance from the building shall be maintained as per relevant requirements of latest relevant codes, unless specified herewith.

Each External Fire Hydrant shall be provided with an External Fire Hose Cabinet of M.S of size 76.8 x 61.44 x 25.80 cm, as approved by the WAPCOS in consultation with client to equip 2 nos. of 63 mm dia controlled percolating hose and accessories as required. The cabinet shall be installed near the Hydrantas per details, approved by the WAPCOS in consultation with client

Internal Hydrants

The Internal Hydrant outlet shall comprise ―Single Headed Single Outlet Gunmetal Landing Valve‖ conforming to type ‗A' of IS: 5290-1977. Separate valve on the head shall form part of the landing valve construction.

A cap with chain is provided on one head of the outlet. The hydrant will have an instantaneous pattern female coupling for connecting to Hose Pipe.

The Landing Valve shall be fitted to a Tee connection on the wet riser at the landing.

First-Aid Hose Reel Equipment

First aid hose reel equipment shall comprise reel, hose guide fixing bracket hose tubing globe valve, stopcock and nozzle. This shall conform to IS:884 - 1969. The hose tubing shall confirm to IS:1532-1969.

The hose tubing shall be 20 mm dia and 36.5m long. The GM nozzle 5mm and globe valve shall be of 20 mm size.

The fixing bracket shall be of swinging type. Operating instructions shall be engraved on the assembly. This heavy duty mild steel and cast iron brackets shall be conforming to IS: 884 - 1969. The first-aid hose reel shall be connected directly to the MS pipe riser taken independently from ring.

Hose Pipes

- Two numbers Hose Pipes shall be rubber lined woven jacketed and 63mm in dia. 15m long. They shall confirm to type A (Reinforced rubber lined) of IS:636 - 1979. The hose shall be sufficiently flexible and capable of being rolled.
- Each run of hose shall be complete with necessary coupling at the ends to match with the landing valve or with another run of hose pipe or with branch pipe. The couplings shall be of instantaneous spring lock type. This shall be conforming to IS: 903.

Branch Pipes

Branch pipe shall be of Gunmetal 63 mm dia and be complete with male instantaneous spring lock type coupling for connection to the hose pipe. The branch pipe shall be externally threaded to receive the nozzle.

Nozzle

The nozzle shall be of Gunmetal 20 mm in (internal) diameter. The screw threads at the inlet connection shall match with the threading on the branch pipe. The inlet end shall have a hexagonal head to facilitate screwing of the nozzle on to the branch pipe with nozzle spanner.

End Couplings, Branch pipe, and Nozzles shall conform to IS:903 - 1985.

Two C.P hoses of 15m length with couplings shall be provided with each External (Yard) Hydrant. Two RRL hoses of 15m length, as specified, with couplings shall be provided with each Internal Hydrant. One nozzle and one branch pipe with coupling shall be provided with each Yard Hydrant and Internal Hydrant.

Hose Cabinet

The internal hose cabinet shall accommodate the Hose pipes, branch pipe, Nozzle First aid Hose Reel and Hydrant Outlets and shall be fabricated from 2 mm thick or 14 mm gauge MS/aluminum sheet. The overall size shall be 2100x900x715 mm, or as specified in the Architectural details. This shall have lockable centre opening glazed doors as per the requirement and as per Architectural details. Where the niche for wet riser is provided with shutters, separate hose cabinet as above may be dispensed with.

The hose cabinet shall be painted red and stove enamelled and woods FIRE written in front glazed portion.

Fire Brigade Inlet Connections

Fire Brigade Inlet connection shall be provided near the pump house and to the wet riser system as specified, for the following purposes:

- Fire Brigade suction connection for fire static tank with provision of foot valve.
- Fire brigade inlet connection to fire static tank.
- Fire brigade inlet connection to the wet riser system. Each connection shall be provided with similar dia of Sluice valve and Non return valve.

The locations of this Fire brigade connection shall be suitably decided with the approval of Engineer-in- Charge and with a view that these are easily accessible to the fire brigade, without any possible Hindrance.

Hydraulic Siren

A siren shall be provided in the system, to indicate the flow of water in the wet riser system. Alternative arrangements may also be adopted. This shall be turbine type.

Valve Chambers

Contractor shall provide suitable Brick Masonry Chamber in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick in 1:5:10 mix (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) 15 mm thick plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling complete.

Valve chambers shall be of following size:

- For depths 100 cm and beyond 90x90x100 cm

Portable Fire Extinguisher

Portable fire extinguishers shall be provided as per the approved shop drawing and shall confirm to IS:15683.

- Two 9 lit. water CO2 type for every 600 m2 area with minimum of 1 extinguishers per floor as per I.S: 15683
- Dry Chemical powder type of 5 Kg. Capacity as per (IS:15683)
- CO2 type of 4.5 kg capacity as per (IS:15683)

Sprinkler Heads

Sprinkler heads shall be provided at approximate spacing to cover 9 to 12 m2 per Sprinkler head. The spacing shall however, be in conformity with the approved drawings and properly coordinated with Electrical Fixtures, Ventilation Ducts and Grills and other services along the ceiling.

Sprinkler heads shall be chrome finished Brass/Gunmetal with quartz bulb with a temperature rating of 68°C. Sprinkler heads shall be of type and quality approved by the local fire brigade authority. The inlet shall be screwed. Sprinkler heads shall be pendent, recessed or special application side wall Sprinkler types as shown in approved shop drawings. All Sprinklers should have the Specifications.

Contractor shall supply spare Sprinkler Heads of each type as per requirement and one Spanner for each type of sprinkler neatly installed in a steel box with glass shutters at locations approved by the Engineer-in-Charge.

Alarm Valve & Automatic Water Motor Gong Valve

The alarm valve & water motor gong valve UL approved shall be provided on the Sprinkler main delivery pipe complete in all respects.

Shop Drawings & Specifications

The Contractor shall submit to the Engineer-in- Charge two copies of Shop Drawings for Fire Fighting works as an Advance Copy to the Engineer-in-Charge for approval before start of work. Subsequent to the approval of the shop drawings, the Contractor shall submit six copies of Shop Drawings for execution to the Engineer-in-Charge. Also the Contractor shall submit four copies of the Technical Specifications and Catalogues.

Shop drawings shall be submitted for the following conditions:

- Structural supports/hanging/laying and jointing details for all types of pipes as required.
- Fire Fighting layout plans as required and for any changes in the layout of Fire Fighting/Architectural drawings.

The Contractor can only commence the work after the approval of above documents by Engineer-in-Charge.

Fire Fighting Pumps

Electrical Operated Main Fire, Sprinkler and Jockey Pumps

- Pumping sets shall be single stage horizontal centrifugal single outlet with cast iron body and dynamically balanced bronze impellers. Connecting shaft shall be of stainless steel with bronze sleeve and grease-lubricated bearings.
- Pumps shall be connected to the drive by means of spacer type love-joy coupling which shall be individually balanced dynamically and statically.

- The coupling joining the prime mover with the pump shall be provided with a sheet metal guard.
- Pumps shall be provided with approved type of mechanical seals.
- Pumps shall be capable of delivering not less than 150% of the rated discharge at a head of not less than 65% of the rated head. The shut-off head shall not exceed 120% of the rated head.
- The System shall meet the requirements of the National building Code 2016 (NBC).
- Necessary 'Y' strainer on the suction side and pressure gauge with GM cocks on the delivery side including bypass arrangement (with 50 valve and up to 5M G.I. Medium pipes) for periodical testing of the working of the pumping set shall be provided.
- Pump shall be mounted on common base frame fabricated from MS channel as per manufacturer‘s specification.
- Suitable RCC Pump-foundations as per manufacturer's design and 4 nos. Dunlop (cushy foot) heavy duty Anti vibration mounting pads shall be provided.
- Detail of Pumps as per DBR/NBC-2016 (Part-IV) Fire & Life safety.

Motors for Electric Driven Pumps

- Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors.
- Motors for fire protection pumps shall be at least equivalent to the horse power required to drive the pump at 150% of its rated discharge and shall be designed for continuous full load duty and shall be design proven in similar service.
- Motors for fire pumps shall meet all requirements and specifications of the tariff advisory committee.
- Motors shall be suitable for 415 volts, 3 Phase, 50 cycles A.C supply and shall be designed for 33^{O}C ambient temperature. Motors shall conform to I.S: 325.
- Motors shall be designed for two start system.
- Motors shall be capable of handling the required starting torque of the pumps.
- Contractor shall provide heating arrangements for the main fire pump motor to ensure that motor windings shall remain dry.

Air Vessel for Fire Pumps

Provide an air vessel fabricated from 10mm M.S. sheet with dished ends and suitable supporting legs, air vessel shall be provided with a 100mm dia flanged connection from pump, one 25mm dia drain with valve, one gunmetal water level gauge and 25mm sockets for pressure switches. The vessel shall be 450mm in dia and 2000 mm high and tested to 10.0Kg/cm2 pressure.

The fire pumps shall operate on drop of 1 Kg/cm2 pressure in the mains. The pump operating sequence shall be arranged in a manner to start the pump automatically but should be stopped manually by starter push buttons only.

Operating Conditions for the Service Pumps

Fire Service Pump	Nos.	Cut in Pressure	Cut Out Pressure	Remarks

Jockey pump	Two	-	-	To auto start and auto stop on pressure switch on air vessel.
Main pump	One	-	Push button manual	To auto start on pressure switch on air vessel and manual off.
Diesel Fire Pump	Two	-	Push button manual	To auto start on pressure switch on air vessel and manual off.
Sprinkler Pump	One	-	Push button manual	To auto start on pressure switch on air vessel and manual off.

Diesel Fire Pump

Scope

This section covers the details of requirements of the standby fire pump, operated by a diesel engine.

General

The diesel pump set shall be suitable for automatic operation, complete with necessary automatic starting gear, for starting on wet battery system and shall be complete with all accessories. Both engine and pump shall be assembled on a common bed plate, fabricated from mild steel channel.

Drive

The pump shall be only direct driven by means of a flexible coupling. Coupling guard shall also be provided. The speed shall be 1450/1800 rpm.

Fire Pump

The fire pump shall be horizontal split casing centrifugal type. It shall have a capacity to deliver 2280 lpm as specified, developing adequate head so as to ensure a minimum pressure of 3.5 Kg. per cm2 at the highest and the farthest outlet. The delivery pressure at the pump outlet shall be not less than 8 Kg. per cm2 in any case. The pump may be single stage or multi stage as specified. The pump shall be capable of giving a discharge of not less than 150% of the Rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of the rated head.

The pump casing shall be of cast iron to grade FG 200 to I.S: 210 and parts like impeller shaft sleeve, wearing-ring etc. shall be of non-corrosive metal like bronze/brass/gunmetal. The shaft shall be of stainless steel. The pump shall be provided with mechanical seal.

The pump casing shall be designed to withstand 1.5 times the working pressure.

Bearings of pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

Diesel Engine

Environmental Conditions - The engine shall be required to operate under the conditions of environment as required as per site conditions.

Engine Rating - The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc). The engine shall be multi cylinder/vertical 4 stroke cycle, water cooled diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions as mentioned. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run.

The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to B.S: 649/I.S: 1601/I.S: 10002, all amended up to date.

Engine Accessories - The engine shall be complete with the following accessories:-

- Fly sheet dynamically balanced.
- Direct coupling for pump and Coupling Guard.
- Radiator with hoses, fan, water pump, drive arrangement and guard.
- Corrosion Resister
- Air cleaner, oil bath type/dry type
- Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.
- Pump for lubricating oil and lub. oil filter
- Elect. starting battery (2x12 v)
- Exhaust silencer with necessary pipe work
- Governor
- Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual staring).
- Necessary safety controls
- Winterization arrangement, where specified.

Cooling System - The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

Fuel System - The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall

mounted on brackets at a height not less than 60 cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction (3mm thick) and of capacity sufficient to allow the engine to run on full load for at least 8 hours. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

A semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of work.

Lubricating Oil System - Forced feed lub. oil system shall be employed for positive lubrication. Necessary lub. oil filters shall be provided, located suitably for convenient servicing.

Starting System - The starting system shall comprise necessary batteries (2x12 v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The battery capacity shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

Exhaust System - The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 5 meter from the engine manifold. (Adjustment rates for extra length shall also be given). The total back pressure shall not exceed the engine manufacturer‘s recommendation. The exhaust piping shall be suitably lagged.

Engine Shut Down Mechanism - This shall be manually operated and shall return automatically to the starting position after use.

Governing System - The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

Engine Instrumentation - Engine instrumentation shall include the following:-

- Lubricant oil pressure gauge.

- Lubricant oil temperature gauge.
- Water pressure gauge.
- Water temperature gauge.
- Tachometer.
- Hour meter.

The instrumentation panel shall be suitably resilient mounted on the engine.

Engine Protection Devices - Following engine protection and automatic shutdown facilities shall be provided: -

- Low lub. oil pressure
- High cooling water temp.
- High lub. oil temperature
- Over speed shut down.

Pipe Work - All pipe line with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust systems. Copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S. piping will be permitted for exhaust.

Anti Vibration Mounting - Suitable vibration mounting duly approved by Engineer-in-Charge shall be employed for mounting the unit so as to minimise transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

Battery Charger - Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

Cables

- Contractor shall provide all power control cables from the motor control center to various motors, level controllers and other control devices.
- Cables shall conform to I.S: 1554 and carry ISI mark.
- Wiring cables shall conform to I.S 694.
- All power and wiring cables shall be aluminum conductor PVC insulated armored and PVC sheathed of 1100 volts grade.
- All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer‘s name.
- All cable joints shall be made in approved manner as per standard practice.

Cable Trays

- Contractor shall provide G.I. slotted cable trays at locations as per regulation.
- Cable trays shall be supported from the bottom of the slab at intervals of 60cms at both ends by anchor fasteners.

Earthing

There shall be an independent earthing station. The earthing shall consist of an earth tape connected to an independent plate made of copper or G.I. having a conductivity of not less than 100% international standard. All electrical apparatus, cable boxes and sheath/armor clamps shall be connected to the main bar by means of branch earth connections of appropriate size. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sweated.

Earth plates shall be burried in a pit of 1.20x1.20M at minimum depth of 3M below ground. The connections between main bar shall be made by means of three 10mm brass studs and fixed at 100mm centers. The pit shall be filled with coke breeze, rock salt and loose soil. A G.I. pipe of 20mm dia with perforations on the periphery shall be placed vertically over the plate to reach ground level for watering.

A brick masonry manhole 30x30x30cm size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated in this manhole for testing.

Control Panels / Starters

Switch board cubicles of approved type shall be fabricated from 16-gauge M.S. sheet with dust and vermin proof construction. It shall be painted with powder-coated finish of approved make and shade. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the followings:-

- Incoming main isolation MCCB of required capacity.
- Fully Aluminum taped Bus Bar of required capacity.
- Isolation MCCB one for each motor.
- Fully automatic as specified D.O.L/Star Delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps. (DOL up to 7.5 HP and Star Delta from more than 7.5 H.P)
- Single phase preventer of appropriate rating for each motor.
- Panel type ampere meters one for each motor with selector switch.
- Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase-to-phase.
- Neon phase indicating lamps for incoming main and on/off indicating lamps for each motor.
- Rotary switch for manual or auto operation for each pump (manual/auto off).
- Fully taped separate aluminum bus bars of required capacity and with required outlets.
- Space for liquid level controllers as specified + 1 extra space.
- The panel shall be pre-wired with color-coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switchboard panel.
- Provision of main incoming cables from the top of the panel.

All switch gears and accessories shall be of approved make such as ―Siemens, Larsen & Toubro‖ or equivalent.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers. All floor-mounted switchboards shall rest on minimum 225mm high platform. The contractor shall provide the shop drawings for base and panels.

Vibration Eliminators

Provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump. Length of the connector shall be as per manufacturer‘s details.

Illuminated Facsimile Annunciator Panel

Scope

Scope of this section comprises the supply, installation, testing and commissioning of illuminated facsimile annunciation panel.

Illuminated Facsimile Enunciator

- Illuminated facsimile enunciator shall be provided with facsimile of the building, constructed of acrylic panels of suitable dimensions, showing the Basement, Ground floor plans and section showing the location of Zonal Panels on each typical floor, entry points, various facilities shown with enamels in various colors.
- Alarm lights to indicate fire location shall be arranged within the acrylic panel and shall be either automatically lighted by operation of any automatic fire detection devices or manual station, or by control of push button incorporated in the control desk.
- Indicator of each building or facility shall include two lamps connected in parallel and so arranged that the failure of either of the lamps is readily apparent when a call or test is made.
- Power for the Enunciator shall be supplied from the power supply for the control desk.
- Representation of the various plans/Drawings on the acrylic of the Enunciator shall be by negative film processing with colored Discrimination of various zones for which the drawings shall be furnished for approval.

Gas Based Fire Suppression System

For Low Voltage equipment /Laboratories,& other Critical Areas

The Total Room Flooding system of fire detection and quenching is proposed in all Low Voltage Equipment rooms where Water sprinklers cannot be used. The Gas cylinder assembly should be UL/FM approved with seamless CCOE approved cylinder and will be connected to discharge nozzles through metal Piping. The master cylinder Kit fitted on Gas cylinder will be operated through separate Fire detection Panel and will release zero Ozone depletion potential Gas through the nozzles in case of fire.

For Electrical panels

Tube based Fire protection system is used in the Electrical Panels to be installed in substations. UL listed fire detection Tube shall be installed throughout the compartment of panels. The location and spacing of tube shall be above the hazard to be protected. Cylinder equipped with brass valve, pressure Gauge isolation valve will be fitted on the wall of the panel with suitable brackets and will be connected to the detection tube. in case of fire the tube shall rupture at a point. The rupture Tube shall result in formation of discharge point and release Gas Agent in Uniform pattern.

Portable Fire Extinguishers

ABC Powder stored pressure type Fire Extinguishers of 6 KG capacity IS : 15683 & CO2 gas based Fire Extinguisher of 4.5 Kg capacity with IS : 15683 is proposed for all floors near internal hydrant locations.

4.5 kg carbon dioxide extinguisher, IS marked shall be complete with high pressure discharge tube, horn, control valve & CCE approved cylinder. It shall be suitable for extinguishing Class B & C fires. It shall be provided with Wheel type /Squeeze grip type with discharge hose & horn. It shall be suitable for operation within the temperature range of (-)20 degree Celsius to 55 degree Celsius. The test pressure shall be 250 Bar. The minimum effective discharge shall be 95 percent.

6 kg & 9 kg Mono Ammonium Phosphate (ABC) type cartridge operated extinguishers. The minimum effective discharge shall be 85% & the minimum jet length shall be between 2-3 meters. The discharge pressure time shall be between 8-13 seconds. The hydraulic test pressure shall be 35 kg/sqcm & the charge test pressure shall be 15 kg/sqcm & the operating range shall be within (-)5 to 55 degree C. The operating valve shall be squeeze grip type with discharge hose & nozzle.

Higher capacity Trolley mounted Dry Chemical; Powder type Fire Extinguisher of capacity 25 kg. confirms to IS 10658, bearing ISI mark, (Outside Cartridge). CO2 type Fire Extinguisher of capacity 22.5 kg filled with Co2 Gas as per IS 15222 with control discharge mechanism fitted with Hose, Horn & Trolley confirms to IS 2878 bearing ISI mark. Co2 Cylinder as per IS 7285. The hydraulic test pressure shall be 250 Bar. The Operating range shall be between (-) 30 to 55 degree C. It shall be suitable for extinguishing fires of class B &C.

50 Lit. trolley mounted cartridge type fire extinguisher (foam) :- It shall be suitable for extinguishing fire of class A & B. The minimum effective discharge shall be 90% & minimum jet length shall be 10 meters. The discharge pressure time shall be between 60-180 seconds. The hydraulic test pressure shall be 30 kg/sqcm & type of extinguisher media shall be water & AFFF (3 lit. of 6% concentrate).

The ISI marked Extinguisher and their installations shall be in accordance with acceptable standard of NBC 2016. These units shall be mounted at a convenient height to enable to its quick Access. The requirement shall be as per NBC 2016 Part – 4 Table -7.

Fire Signage's

Various types of signage are proposed in the complex as per NBC 2016 Part -4. At every floor near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE USE

STAIRS UNLESS INSTRUCTED OTHERWISE'. The signage shall be above call button in Lift Lobby. Floor Signage indicating Exit path will be provided in each floor within the staircase. The Numerical shall be Bold Type of minimum 75 MM height. Each corridor of every floor will have directional signage indicating Fire Escape route. These Signage may be LED lit with UPS power backup or of Photo Luminescent paint. So that they will be visible in dark in case of power failure. Fire related signage's shall be printed on Photo luminescent U1000 aluminum sheet of 1.0 mm (+-10%)/Acrylic Board containing Lumigen II as base chemical, covered under UV stabilized coating and of appropriate size including fixing on wall, door, ceiling etc. with proper clamps, hangers, cleats, anchor fasteners etc. complete in all respects. Text shall be double sided or single sided as per requirements.

SITC of illuminated LED signages and emergency lighting including planning and designing by incorporating stipulated specifications, as per the requirement of NBC 2016 with amendments, updated BIS codes, local bodies, Fire bye-laws of Govt. of JHARKHAND and CPWD specifications for all the single/ Multi-storeyed requirement, all complete including defect liability period for three years from the date of handing over as per direction buildingsto be constructed in phase 1C on design, built and handover basis including all works as per scope for Work given and user of Engineer in Charge.

a) Centenary Building (G+4)

(Total plinth area to be covered in this subhead shall not be less than 18708 SMT)
If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

Clean Agent Fire Extinguishers

Clean Agent Fire Extinguishers are proposed to be provided in areas proposed for extinguishing fire of sensitive equipment, the HFC 236fa or equivalent Clean Agent Extinguisher shall be the most eco-friendly extinguisher. FE36 Clean Agent Extinguishers shall leave no residue, pack in mega power and shall be absolutely safe for use on any sensitive electronic equipment.

They should have zero ODP (Ozone Depletion Potential). They shall be extremely lightweight, yet packed with tremendous power and shall throw, to penetrate past even the finest grills and meshes.

It shall be Residue free: It shall leave no residue making it safe for use on sensitive equipment.

Valve Construction : Forging & Machining

Internal Coating of Can : Epoxy Powder coating

External Coating of Can : Epoxy Polyester Powder coating

Tests: Helium Leak Detection

Sheet metal thickness: 1.60 mm (approx.),

It shall be Lightweight: Extremely lightweight, yet packed with tremendous power and throw, to penetrate past even the finest grills and meshes.

It shall be Easy snap safety seal: A completely tamper proof safety seal that can be broken in seconds.

It shall be complete with pressure gauge, discharge mechanism with Easy Snap Lever Lock, EPDM rubber hose & shall Fight Class A , B and electrically started Fire, extinguisher has ISO 9001 and CE certifications, preferably UL listed & FM approved, and conforms to ISI standards & shall have preferably 5 years of warranty.

It shall be preferably of 4 kg (minimum) capacity with Discharge time: 8 Secs (approx.) & Range: 2 Meters (approx.)

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.
ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.
iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.
iv. The minimum local content of 50% is considered for the complete item including labour component.
v. The agency shall obtain the certificate for all items except for sundry items.

Part E-4

Fire Alarm System

General Scope of Works

This section of the specification includes Intelligent Addressable Fire detection & Alarm system with Photo thermal detectors, Heat detectors, Control Modules for AHU tripping, Ventilation fan, etc. MCP, Hooters, intelligent interface unit BACnet/ Modbus protocol i.e. supplying communication links between building management system and fire alarm control panel, Fault isolator, Repeater panel, central graphical fire alarm management system, Fire Alarm Control Panel with MS conduiting and 2X1.5 sq.mm FRLS PVC insulated copper conductor, single core cable shall be provided as per drawings and as per the NBC 2016/ Local Bodies and CPWD specification for Fire Detection 2018 as amended up to date.

The brief scope of work is Planning, Design & preparation of Drawings for E & M services, obtaining approvals from the department, Supply, installation, testing and commissioning of Automatic Fire Alarm System, PA System and Exit signage's on design, built and handover basis as per the requirement of NBC 2016 with amendments, updated BIS codes, local body, Fire bye-laws of Govt. of JHARKHAND and CPWD specifications for all buildings
as per scope for Work and user requirement, all complete including defect liability period for three years from the date of handing over as per direction of Engineer in Charge.

a) Centenary Building (G+4)

(Total plinth area to be covered in this subhead shall not be less than 18708 SMT)
If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

The system shall be designed such that each loop shall limited to only 80% of its total capacity at initial installation.

All equipment/components shall be new & the manufacturer's current model. The materials, appliances, equipment and devices shall be tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling (fire alarm) system. The authorized representative of the manufacturer of the major equipment, such as control panels, shall be responsible for the satisfactory installation of the complete system.

All equipment and components shall be installed in strict compliance with each manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics,

physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation/termination/wiring data.

All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

Reference for Installation

UL / EN 54.

Submittals and Shop Drawing

Sufficient information shall be clearly presented and shall include manufacturer‘s name, model numbers, power requirements, equipment layout, device arrangement and complete wiring.

- Sequence and description of operation.
- Product Data for each type of equipment, initiating device, signal device, peripheral device and cable provided on the project.
- Shop drawings shall include battery calculations, floor plans and wiring diagrams.

Operation Manual

Operation manual shall include:

- Installation instructions for use by installing contractor.
- Operational instructions or manual for use by building personnel, including Name and phone number of service representative.
- Maintenance instructions as required for use by building personnel.
- Copy of approved shop drawings.

Basic System

The system shall be a complete, electrically supervised fire detection and evacuation system using fire fighter telephone with microprocessor based operating system having the following; capabilities, features and capacities:

Communication between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide displays. Any network node shall be capable of supporting a local system in excess of 4000 input/output points.

The local system shall provide status indicators and control switches for all of the following functions:

Audible and visual notification alarm circuit zone control.

Status indicators for sprinkling system water-flow and valve supervisory devices. (if any)

Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

Each intelligent addressable device or conventional zone on the system shall be displayed at the fire alarm control panel by a unique alphanumeric label identifying its location.

Specification

This specification is intended to set out in general outline the minimum requirements and standards of installation for the various units of equipment and works it covers. Provision set out, or claim made in the successful tender which are in excess of, or improved upon the basic requirements of the specification shall unless otherwise determined by the client become part of the requirements of the specification whether or not they are subsequently incorporated in addenda to the specification.

The specification shall be read in conjunction with the tender drawings (as per schedule of drawings) and are intended to be mutually explanatory and complementary to one another. All works and specification called for by one, i.e. specification or drawings even if not by the other shall be fully executed and complied with in total.

The entire system shall be engineered by the contractor based on the guidelines furnished in the specification, various codes / standards, with good engineering practice.

Supplies and services to be covered under this tender specification and the conditions thereof are detailed in the subsequent sections of the specifications. In case of conflict among various sections, subsections, documents, drawings the same shall be referred to purchaser whose decision shall be final and binding to the Bidder

Material & Workmanship

Unless expressed to the contrary, all materials, and equipment supplied by the contractor shall comply with the applicable Indian standards (I.S) or various codes or specifications with good practice as approved by the Indian standards.

Where a standard is referred to, that standard shall be the latest published edition thereof, unless otherwise stated.

All materials and equipment supplied shall be new and of the best type for each particular purpose and of the first quality with regard to design, manufacture and performance.

The equipment and materials shall be suitably designed and constructed for safe, proper and continuous operation under all conditions described or implied in this specification without undue heat, strain, vibration, corrosion or other operating difficulties.

Unless otherwise specified, the equipment and material within the scope of this specification shall be

of a standard proven design. Design incorporating components which may be considered prototype in nature will not be accepted.

Equipment and equipment components shall be designed and supported to permit free expansion and contraction without causing excessive strains, distortion or leakage.

Parts subject to wear, corrosion or other deterioration, or requiring adjustment, inspection or repair shall be accessible and capable of reasonably convenient removal, replacement and repair. All such parts shall be of suitable material for keeping maintenance to a minimum.

The equipment shall be designed to permit replacement of parts and ease of access during inspection, maintenance and repair.

Vibration, noise, mechanical and thermal stresses and susceptibility to corrosion and erosion shall not be greater than with similar plant of first class design and workmanship operating under similar conditions.

All works shall be carried out in accordance with the best engineering practice by experience tradesmen of appropriate grades to the approval of the Indian Standards.

Where disagreement occur between the drawings and the specification or within either document itself, the item or arrangement of better quality, greater quantities, or higher cost shall be deemed to be included in this -contract.

Shop Drawing

The contractor shall immediately upon the award of the sub-contract prepare and submit to the project Engineer-in- Charge for approval all plant and equipment layout drawings showing full details within four weeks. Detailed calculations shall be submitted where applicable. All equipment and materials proposed shall be submitted for approval.

Shop drawings shall cover complete details for the following but not limited to:

- Dimensions of panels, equipments and accessories which include the details drawings of superstructure construction necessary to finalize the superstructure requirements.
- Equipment room layout, showing all clearances for operating, servicing and sufficient details to ensure that the provision made in the working drawings shall be adequate and satisfactory.
- Control equipment, system wiring and control diagrams and power requirements.
- Hangers and supports
- Foundations details.
- Chases, openings in walls, floors, roof slabs and beams.
- Piping, ducting and electrical cable runs.

These layout drawings shall be modified as required to suit the specified materials and equipment to be provided, to fit in with the latest available information on building construction details and the requirements of other services and equipment and also to incorporate any improvements proposed by the contractor.

Five (5) copies of each drawing shall be submitted for approval.

Upon approval of the drawings, the contractor shall deliver four (4) copies of each approved drawing to the project engineer for the purpose of contract administration.

The drawings shall be submitted in ample time for review and approval by the project engineer and no work shall be carried out until such drawings are approved.

Inspection of shop and working drawings is not to be considered as a guarantee of measurements or building conditions. Where drawings are inspected and approved by the project engineer, such approval does not in any way relieve the contractor neither from his responsibility nor from the necessity of furnishing material or performing work required by the drawings and specification which shall in the event of a dispute, take precedence over shop drawings.

Schedule of submission of shop drawings shall be submitted for approval not later than 6 weeks after award of the Sub-contract.

Approvals

The system shall have proper listing and/or approval from the internationally recognized UL/EN54

The Fire Alarm Control Panel and all modules/devices shall meet the listing requirements of UL/ EN54 Factory Mutual Each subassembly, including all printed circuits, shall include the appropriate UL/EN54 modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts. Systems that do not include modular labels may require return to the factory for system upgrades, and are not acceptable.

As Built Drawings and Manuals

Prior to the completion of the works, and not later than the date of practical completion, the contractor shall submit to the satisfaction of the project manager six (6) hard cover bound sets of comprehensive/non-comprehensive operation and maintenance manuals and data sheets published by the equipment manufacturers, six (6) hard cover bound sets of "As-Installed" drawings and one (1) set of "As-Installed" drawings in polyester film transparency (intermediates) and two (2) sets of "As-Installed" drawings in AutoCAD (latest release) compact discs subject to project managers approval.

These instruction manuals shall be typed in good quality paper and neatly bound into a manual having rigid covers. A draft shall be approved before final submission.

The operation manual and as-built drawings shall be bound with hard covers.

All "As-Installed" single line drawings and control diagram shall be endorsed and signed by the contractor's professional engineer.

The manuals shall contain and be set out as follows:

Description of System

This section shall simply but clearly describe the operation of the system and the equipment.

Summary of Equipment List

This section shall include all major equipment/components complete with makes, models, serial number with technical catalogues (at least one set to be original and others in legible print).

Spare Parts, Special Tools and Equipment List

Include manufacturer's list of all recommended spare parts for replacement and special tools and equipment for maintenance used.

Operational Procedure

This section shall fully described start and stop sequence of operation; program for alternate running of plant to even out wear and testing procedures for all sections of the plant, including emergency procedures and breakdown trouble-shooting.

Manufacturer's Handbook

Include Manufacturer's technical literature on all components of the installation, particularly as applying to operation and maintenance. The technical literature shall include all major equipment, control instruments and equipment used and other related materials

Installation Instruction

Maintenance and Trouble Shooting Instruction

Include manufacturer's technical literature on all components of the installation, particularly as applying to operation and maintenance.

Equipment Operation Instruction

Hang-up Instructions

Equipment/component Suppliers

This section shall comprise a full list of names, addresses and telephone numbers (including after office hours numbers) of all contractors and suppliers of equipment (local and overseas) incorporated in the installation.

Maintenance & Breakdown Service

This section shall comprise a list of the names and telephone numbers of the company's maintenance

and servicing section personnel for normal maintenance and breakdown request.

In the event of the contractor failing to fulfil the aforesaid requirements, the project manager shall reserve the right to obtain all of the required operating and maintenance manuals by other means and shall deduct all cost incurred thereof from monies due to the contractor. In addition the project manager shall forfeit the rights of the contractor in relation to further payment and the issue of the Certificate of Practical Completion will also be withheld until he has so complied accordingly.

Guarantee

4. The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee of material from the manufacturer to the department. AMC of Fire Alarm & PA System during the defect liability period will be in the contractor scope, nothing extra payable for AMC during defect liability period.
5. Sufficient trained and experienced staff shall be made available to meet any exigency of work during the **guarantee period of three years** from the date of handing over of the installation.

The maintenance, routine as well as preventive for three years from the date of handing over the installation as per manufacturer‘s recommendation shall be carried out and the record of the same shall have to be maintained.

Basic System

System shall provide an output port for monitoring purposes by external systems. Communications to an external system shall be Ethernet, RS-232 or RS-485 communications and must be BMS compatible.

At least 32 panels shall be networkable on a Cluster.

Multiple Clusters shall be networked on a Backbone and shall be approved in accordance with UL / EN54-13.

At least 64 panels shall be networked in a multi-cluster Backbone.

The networked panels shall provide peer to peer communication and support system wide automatic interactions to fulfil smoke control or evacuation functionalities.

The homogenous network structure shall be such that only a single remote transmission to emergency services is necessary.

Any panel shall be configurable to display and operate all messages from other panels in the network.

Full redundancy shall be provided at all levels of the network structure.

The system shall provide the remote access connection via Ethernet to completely program and control

the fire detection system.

The local system shall provide status indicators and control switches for all of the following functions:

Audible and visual notification alarm circuit zone control.

Status indicators for sprinkler system water-flow and valve supervisory devices.

Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

Individually colored LED adaptable to the specific status indication (programmable red, green or yellow).

Each intelligent addressable device or conventional zone on the system shall be displayed at the Central Alarm Receiving Terminal and the local fire alarm control panel by a unique alphanumeric label identifying its location.

Fire Panel System

The Fire Panel system shall have the ability to connect to the Danger Management System (DMS). Danger Management System shall be a PC based, display and software package EN listed for this application. The DMS shall have as a minimum, the following:

- Intuitive graphical user interface
- Global and local command abilities
- Time based control for entire system
- Multi-level passwords.

The system shall have the ability for up to 30 command centers pro server with full control of the fire detection.

System Operation

The system shall monitor and act accordingly for the following conditions:

Fire alarm

- The system shall enter the fire alarm condition upon:
- Activation of any manual call point.
- Receipt of an alarm signal from any individual automatic detector.
- Receipt of pre alarm signals from more than one detector.
- Activation of sprinkler pressure switch.
- Fire alarm signal from sub system.

The fire alarm condition shall:

Illuminate the general fire alarm indicator.

Be indicated on the control panel display giving details of the device & zone number, alarm type, number of devices in alarm and a programmable location text with a minimum of 40 characters.

- Sound the control panel internal warning sounder.
- Activate the required sounders as per the attached cause & effect schedule.
- Activate the required outputs as per the attached cause & effect schedule.
- Activate the required detector remote LED outputs as per the attached cause & effect schedule.
- Activate fire brigade communication equipment or start alarm verification concept as required in attached cause & effect schedule.
- Display alarm verification concept delay time remaining.
- Return all lifts to the ground floor.
- Close all fire doors in the building normally held open by door release units.
- Close all fire doors on the floor of the initiating alarm device normally held open by door release units.
- Release all external fire doors.
- Operate fire dampers as described in the attached cause and effect schedule.
- Shut down air handling equipment as described in attached cause & effect schedule.
- Activate boiler cut off switch.
- Activate boiler cut off switch after a delay of 3 minutes.
- Pre-alarm
- The system shall enter the pre alarm condition upon:
- Receipt of a pre-alarm signal from any automatic detector.
- The pre-alarm condition shall:
- Be indicated on the control panel display giving details of the device & zone number, number of devices in alarm and a programmable location text with a minimum of 40 characters.
- Sound the control panel internal warning sounder.
- Activate the required sounders as per the attached cause & effect schedule.
- Activate the required outputs as per the attached cause & effect schedule.
- Fault
- The system shall enter the fault condition upon:
- Any short circuit, open circuit on the detection loops, sounder circuits and fire brigade connection equipment.
- Any earth fault capable of affecting the reliable operation of the system.
- Any CPU fault as per EN54-2.
- Any power supply fault.
- Any network fault.
- Removal of any addressable device.
- Fault signals from connected input modules.
- Any fault signal generated by internal monitored functions of addressable devices.
- The fault condition shall:
- Display the device number and/or description of the fault.
- Sound the control panel internal warning sounder.
- Activate the required outputs as per the attached cause & effect schedule.
- Activate fire brigade communication fault output or initiate the fault intervention concept as required in attached cause & effect schedule.
- Display fault intervention concept delay time remaining.
- Degrade Mode Functionality
- The system shall include a degrade mode functionality such that should a network participant fail or the network cease to function a common fire alarm may still be generated such that the

fire brigade communication equipment is still activated.

- Software Redundancy
- The system shall include a software redundancy mode such that in case of failure, a reboot is triggered. Should reboots fail, the panel goes into software redundancy mode. As last resort, the panel goes in degrade mode.
- In case of a CPU failure, the memory is reconfigured using the software redundancy mode.
- In addition, in case of a failure of a., b., and c., the degrade mode provides hardware-oriented emergency operation to control the transmission system and acoustic alarming devices.
- Control outputs can be activated by an autonomous logic.

Fire Brigade Communication

The system shall be connected to a secure fire brigade communication system via separate monitored fire & fault outputs. The system shall also be capable of receiving a common fault signal from the fire brigade communication equipment.

The system shall provide signals to the fire brigade communication system in accordance with the following alarm verification concept:

Mode Manned – Alarms from automatic detectors will activate the system sounders and initiate a timer (T1) programmable from 10s to 5 minutes. Providing a responsible person acknowledges the panel within this time period no signal will be sent to the fire brigade communication equipment. Upon acknowledgement a second timer (T2) programmable from 10s to 10 minutes will be initiated. Again providing the system can be reset within this time period no signal will be sent to the fire brigade communication equipment.

Operation of any manual call point will immediately cancel the delay timers and a signal will be sent to the fire brigade communication equipment.

Mode unmanned – Alarms from any manual call point or automatic detector will immediately send a signal to the fire brigade communication equipment.

CONTROL AND TERMINALS REPEATER PANELS

Control and Terminal Repeater Panels must provide at least the following:

- Integrated Ethernet interface for connection to danger management, building management or system management tools.
- Secure network connection for the connection of further networkable control panel and / or terminal panels into a redundant peer to peer network of up to
- 64 participants.

In addition to the indicators required for compliance with UL / EN54-2 the panels shall provide the following additional indicators:

- Premises manned LED (Amber)
- Alarm display scroll highlight button (Red).
- Four freely programmable amber LED‘s for site specific functions.
- Two amber LED‘s for free programmable site specific control buttons.
- Sprinkler pump running LED (Amber).

- Maintenance page sent LED (Amber).
- Display: In addition to the LED indications the panel shall include an integral 128 x 635 pixel LCD with the following features:
  - Header area giving details on the type of event, number of events and the time remaining before any delay to the fire brigade communication equipment runs out.
  - Simultaneous display of up to two devices in alarm including information on zone number, device address, type of alarm and up to 40 characters of free programmable descriptive text.
  - Alarm display shall automatically show the first device to alarm at the top and last to alarm in the fields below. A scroll button shall allow display of all other alarm events.
  - Additional information shall be available via context specific soft keys allowing further device information to be obtained as well as up to x intervention texts of x characters each
  - In addition to the controls required to meet the requirements of EN54-2 the panel shall provide the following:
  - Decimal keypad including star & hash buttons.
  - Sound alarms button.
  - Two freely programmable buttons.
  - 3 x context specific soft keys adjacent to the display to assist in ease of use.
  - Individual fire & fault LED‘s for each zone c/w adjacent area for zone description texts.
  - Set production area to low sensitivity button.
  - Bomb alert activate button.
  - Extend working hour‘s button.
  - Cancel working hour‘s extension button.
  - User access shall be via:
  - 4-6 digit access code.
  - Key switch.

Future upgrades – Fire alarm control panels shall include a facility to allow future software & firmware updates to be downloaded via the control panel programming tool. This facility will include updates to all other control panels on the system network, connected floor repeaters and ASA technology detection devices.

Full function repeater panels – The networkable control panel shall have the facility for the connection of a repeater panel as a network participant. This panel shall have the ability to provide all the control, indication and programmability of the control panels.

Network – Networkable control panels shall be capable of being connected into a single homogenous networked system. This network shall be a secure proprietary network being fully monitored and connected in a loop for fault tolerance. The network shall include degrade mode functionality such that should a network participant fail or the network cease to function a common fire alarm may still be generated such that the fire brigade communication equipment is still activated.

All network components required for the backbone cluster structure (including the Ethernet switches) shall be included in the EN54 approval certification.

It shall be possible to increase the cable distance possible between panels by adding a network repeater facility.

The communication between networkable panels shall be possible via fiber optic connections.

All networkable control panels shall have the possibility to include an integral 40 column thermal printers.

BacNET – Fire alarm control panels shall be BacNET/ISA compatible.

Ethernet – Fire alarm control and terminal repeater panels shall have an integrated Ethernet connection to enable system connection, reporting & control functions from associated management systems.

Designated monitored fire output for connection to remote ARC communication equipment. This circuit also provides operation in degrade mode according to UL / EN54 requirements for systems with more than 512 detectors.

Designated fire output with clean contacts. Provides operation in degrade mode according to UL / EN54 requirements for systems with more than 512 detectors.

Designated monitored fault output for connection to remote ARC communication equipment.

Designated fault output with clean contacts.

Networkable panel with eight free programmable input/outputs.

Integral 24Vdc monitored power supply to EN54-4 with integral battery backup for up to 72hrs + 30minutes full alarm.

The panel construction shall allow for:

Sufficient cable entries for all connectable detection loops, sounder circuits, network cables & mains supplies.

Attractive removable molded front cover with metal back box providing minimum ingress protection of IP30.

Surface or semi-flush mounting.

Manned / Unmanned operation:

Control panels shall have a dedicated monitored fire brigade communication output and shall be capable of operating in two distinct modes:

Mode Manned – Alarms from automatic detectors will activate the system sounders and initiate a timer (T1) programmable from 10s to 5 minutes. Providing a responsible person acknowledges the panel within this time period no signal will be sent to the fire brigade communication equipment. Upon acknowledgement a second timer (T2) programmable from 10s to 10 minutes will be initiated. Again providing the system can be reset within this time period no signal will be sent to the fire brigade communication equipment. Operation of any manual call point will immediately cancel the delay timers and a signal will be sent to the fire brigade communication equipment.

Mode unmanned – Alarms from any manual call point or automatic detector will immediately send a signal to the fire brigade communication equipment.

It shall be possible to select mode manned by any of the following:

Automatically selected during working hours using internal system clock with automatic switching of

summer / winter time. It may be possible to extend working hours by up to 4 hours (programmable) by pressing a separate control. (Extend working hours control). This extension can be subsequently cancelled by pressing a (cancel working hour‘s extension control). Or

Manually selected with premises manned control button. Or

Automatically selected when intrusion system unset. Or

Automatically selected with input from Access control system.

Delays to the fire brigade communication equipment can be cancelled by pressing the alarm delay off control on the control panel.

Fault attendance monitoring: Control panels shall have a dedicated monitored output to communicate with fault communication equipment this shall work in two distinct modes manned & unmanned.

Mode manned - A fault activates local alarming and starts the delay t1 for attendance monitoring. The operating personnel acknowledge the fault at the operating terminal prior to the expiry of t1, thus silencing the local alarming equipment. If the fault is not acknowledged, global alarming is activated before the expiry of t1. Simultaneously to the delay t1, the service intervention time ts starts in the 'intervention monitoring' part. If the fault is not eliminated prior to the expiry of ts, the maintenance personnel are called up.

Mode unmanned – Faults are reported directly.

Conditions: Fire alarm control panels shall be capable of receiving and handling all of the following conditions from field devices:

Alarm.

Pre-alarm.

Device fault.

Device impaired.

Device isolated.

Device isolator activated

Detector drift compensation limit exceeded.

CO pre-warning

CO warning

Programmable functions: Fire alarm control panels shall be capable of being configured to do all of the following:

Manned / unmanned mode:

Selectable by time of day.

Selectable on specific days.

Selectable by remote input.

Selectable manually.

Programmable times for presence & investigation times.

Selectable for sounders during first timer, off, on or pulsed.

Detector behaviour:

It shall be possible to select the required parameter set for each detector at the panel via the programming tool.

It shall be possible to configure each individual device to work within the manned/unmanned concept or not.

Control cause & effect:

Fire alarm control panels shall have the possibility to create complex cause & effect controls including AND, OR & NOT functions or combinations thereof.

In addition, controls can be programmed with respect to panel functions and be time related.

It shall be possible to program separate cause & effect for CO pre-warning & warning signals.

Sounders:

It shall be possible to select sounder tones and volume from the control panel. Up to two different tones shall be selectable for each sounder and configured to operate with different cause & effect scenarios.

Alarm indicators:

It shall be possible to configure an individual extension LED to be activated from any of several detectors.

Disablement – Fire alarm control panels shall allow the isolation of any individual device, zone, section or area. Any isolation shall have the ability to be restored after a pre-defined time period.

Renovation mode – Fire alarm control panels shall include a renovation mode which can be set during periods of temporary building renovation. This mode sets all detectors in the selected area to a lower sensitivity ―Renovation‖ parameter set.

Test Modes – Fire alarm control panels shall allow the following tests to be performed:

Lamp test – The control panel shall include a control button that will illuminate all panel indicators and highlight the complete display.

Detector test – The control panel can set zones into detector test mode. This increases the sensitivity of all detectors within that zone with robust parameter setting. On test the detector alarm indicator shall be illuminated but sounders & controls shall not be activated. Base sounders directly connected to the detector tested shall operate briefly.

Installation test - The control panel can set zones into detector test mode. This increases the sensitivity of all detectors within that zone with robust parameter setting. On test the detector alarm indicator shall be illuminated and all programmed sounders and controls shall operate as required.

Walk test – The operating panel can set groups in walk test mode. When a detector is triggered, the alarm sounders are activated for 10 seconds.

Floor repeater panels with control – The control panel shall allow connection of up to 4 repeater panels on each detection loop. These panels will repeat the indication of the main display and allow for silencing and reset of the system. In addition these repeaters will have 6 freely programmable buttons and associated indicators. Repeater panels may be powered from the detection loop or from a remote 24Vdc power supply.

Additional cards – Networkable fire alarm control panels shall allow the integration of the following additional cards:

Loop extension card

2 x 4 way sounder cards.

Network cards.

RS232 interface card

RS485 interface card.

Additional cards – Networkable fire alarm control panels (756 devices) shall allow the integration of the following additional cards:

Detection loop card (4 loops)

Loop extension card

I/O card (programmable)

2 x 4 way sounder cards.

Network cards.

RS232 interface card

RS485 interface card.

Additional cards – Networkable expandable fire alarm control panels shall allow the integration of the following additional cards:

Detection loop card (4 loops)

Loop extension card

Fire control and terminal repeater panels shall allow remote servicing via telephone modem or internet connection.

In the case of a malfunction of the main networkable control panel, a networkable standby fire panel or terminal will take over the system‘s visibility. Standby functionality shall be also possible by the management station.

CONTROL PANELS – ADDRESSABLE TYPE

Self-contained addressable control panels capable of operating in a network of at least 32 panels and terminals or 16 panels if connected to a management station system. Panels shall have VDS and FM approval to UL / EN54 and meet the relevant requirements of country regulation.

I/O card (programmable)

2 x 4 way sounder cards.

Network cards.

RS232 interface card

RS485 interface card.

The fire alarm panel shall allow the exchange of defect module and verify if the firmware of the new card has the correct version for the main software application

The fire alarm panel shall allow the exchange of defect module bus cards in a running system.

The Control Panel shall allow configuring which event categories should be displayed

Up to 4 alarm concepts within a Fire alarm control panel shall be available

Up to 8 alarm concepts within a Fire alarm control panel shall be available

Programmable time for inputs before it is evaluated as active.

Alarm counter, which can be set with parameters for:

Alarms counter from one or more fire control panel

Test alarms will be counted as yes / no

Fiber optic cable network modules single mode 40 km, multi mode 4 km.

TERMINALS REPEATER PANELS

Self contained addressable terminal repeater panels capable of operating in a network of at least 64 controls and terminals panels. Panels shall have LPCB, VDS, and FM approval to EN54 and meet the relevant requirements of country regulation.

Terminal Repeater Panels must provide at least the following:

Power supply option:

From one control panel

Optional local power supply with battery backup

Additional cards – terminal repeater panels shall allow the integration of the following additional cards:

RS232 interface card

RS485 interface card.

Network cards.

DETECTION LOOP POWERED ADDRESSABLE REPEATER PANELS

Addressable repeater panels shall provide remote indication of system status. The indications given will be programmable so that it is possible to only view essential information at each display. The repeater shall connect directly to the detection loop it shall be possible to power the display directly from the loop. It shall also be possible to remotely provide power as an option where loop power capacity has been exceeded.

The addressable repeater terminal shall provide the following:

Large backlit LC display with plain text of 6 x 40 characters.

Acknowledge, reset and silence buttons.

Scroll key

6 x free programmable buttons.

Nordic Key-switch access.

PC REMOTE CONTROL AND INDICATION SOFTWARE

The system shall be capable of being controlled by remote PC using software that can dial into a connected panel to allow remote interrogation and operation. The software shall be arranged so as to appear as a direct replica of the control panel and shall be capable of displaying all the information and controlling all the features of the panel itself.

The system shall be capable of being controlled by an application installed on a Smart Phone using software to allow remote interrogation and operation. The software shall be arranged so as to appear as a direct replica of the control panel and shall be capable of displaying all the information and controlling all the features of the panel itself. The secure data transfer shall be assured by pairing IMEI of Smart Phone to the fire panel.

EVENT PRINTER

The system shall be capable to connect an event printer. The printer shall be supervised and printer fault are reported to the control or terminal repeater panel.

The control and terminal repeater panel shall have the option to program which category event of alarm, fault or messages have to be printed

The event printer shall be possible to be connected via:

Internal printer via RS 232

External printer via serial connection RS232

External printer via Ethernet

MOBILE APP –SMART PHONE ENABLED VIEWING & CONTROL-ANDROID VERSION 4.X

The system shall be capable to connect to remote smart phone through android application. All 64 panels networked can be viewed through smart phone by WAN / LAN within local campus or outside the campus premises. No limit for addition of smart phones for viewing the networked panels.

The smart phone can Display Events

The smart phone shall have Different access levels:

view only

full access, –Acknowledge‖ and –Reset‖

Through smart phone, panel can be Silenced, acknowledged ,Fault & Alarm , Reset

PERIPHERALS

Detectors (general)

Point type smoke & heat detectors shall mount on a common base such that they can be readily exchanged should the need occur.

Detectors shall have a locking facility to stop un-authorized removal.

Where a detector is exchanged for one of a different type a fault warning shall be given.

Removal of a detector shall not lead to the loss of any other device.

All detectors shall be intelligent with integrated algorithms for comparison with actual sensor signals.

All detectors shall have an integral short circuit isolator.

The detection loops should be wired without tees, spurs or stubs but the system should be able to accept such wiring to give enhanced levels of flexibility during the systems lifetime.

Optical Smoke Detector

Smoke detectors shall be intelligent devices with integrated algorithms for comparison with actual sensor signals ensuring fast & reliable detection. Detectors shall fulfil and be approved to EN54-7. The detector should have been designed to have high tolerance to dust, dirt, temperature fluctuations and air currents. In addition the detector shall include:

Selectable application specific parameter sets.

For the communication of 3 different danger levels for differentiated alarm activation.

The facility to detect if the detector is in an unsuitable environment and give a separate warning of such to the panel.

Compensation for the gradual build-up of dust & dirt to ensure a consistent level of detection over time. When the detector reaches a point where it can no longer retain this consistent detection a separate warning signal shall be given to the control equipment.

Internal fault monitoring with faults reported with separate signals to the control panel.

An integral short circuit isolator.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Operation in the temperature ranges -10°C to + 55°C

EMC compatibility of 50V/m

Heat Detector (Static+ RoR)

Heat detectors shall be intelligent devices with integrated algorithms for comparison with actual sensor signals ensuring reliable detection. Detectors should fulfil and be approved to UL / EN54-5. In addition the detector shall include:

Selectable application specific parameter sets.

Communication of 3 different danger levels for differentiated alarm activation.

Internal fault monitoring with faults reported with separate signals to the control panel.

An integral short circuit isolator.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Operation in the temperature ranges -10°C to + 55°C

EMC compatibility of 50V/m

Multi-sensor smoke detector

Multi-sensor smoke detectors shall incorporate an optical chamber as well as a thermal sensor. All sensor signals shall be monitored and compared with integrated algorithms ensuring the fastest possible response with all fire types while still offering a high degree of false alarm rejection. Detectors shall fulfil and be approved to UL / EN54-7 including test fire 1. The detector shall have been designed to have high tolerance to dust, dirt, temperature fluctuations and air currents. In addition the detector shall include:

Selectable application specific parameter sets.

For the communication of 3 different danger levels for differentiated alarm activation.

Compensation for the gradual build-up of dust & dirt to ensure a consistent level of detection over time. When the detector reaches a point where it can no longer retain this consistent detection a separate warning signal shall be given to the control equipment.

The facility to detect if the detector is in an unsuitable environment and give a separate warning of such to the panel.

Internal fault monitoring with faults reported with separate signals to the control panel.

An integral short circuit isolator.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Operation in the temperature ranges -10°C to + 55°C

EMC compatibility of 50V/m

ASA Technology Neural Fire Detectors

Neural fire detectors shall incorporate Advanced Signal Analysis (ASA) whereby the signals from the detector sensors are compared with a dynamic algorithm set thus ensuring the fastest possible response with all fire types while still offering a high degree of false alarm rejection. The Neural fire detector shall incorporate an optical chamber with two light emitters illuminating aerosols from different directions as well as two thermal sensors. Detectors shall therefore fulfil and be approved to EN54-7 including test fire 1, EN54-5 as well as CEA standard. The detector shall have been designed to have high tolerance to dust, dirt, temperature fluctuations and air currents. In addition the detector shall include:

Selectable application specific ASA parameter sets.

3 different danger levels for differentiated alarm activation.

Programmable time related switching of detector behaviour.

Compensation for the gradual build-up of dust & dirt to ensure a consistent level of detection over time. When the detector reaches a point where it can no longer retain this consistent detection a separate warning signal shall be given to the control equipment.

The facility to detect if the detector is in an unsuitable environment and give a separate warning of such to the panel.

An internal self-test facility to ensure correct operation of the optics & electronics. Faults will be reported with separate signals to the control panel.

Redundant operation in the event of a single sensor failure.

An integral short circuit isolator.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Operation in the temperature ranges -25°C to + 55°C

EMC compatibility of 50V/m

ASA Technology Neural Fire Detectors with CO sensor

Neural fire detectors with CO sensor shall incorporate Advanced Signal Analysis (ASA) whereby the signals from the detector sensors are compared with a dynamic algorithm set thus ensuring the fastest possible response with all fire types while still offering a high degree of false alarm rejection. The Neural fire detector with CO sensor shall incorporate an optical chamber with two light emitters illuminating aerosols from different directions, two thermal sensors as well as a CO sensor. The CO sensor shall permit the safe early recognition of small quantities of carbon monoxide generated by fire.

Detectors shall therefore fulfil and be approved to EN54-7/17 including test fire 1, EN54-5 as well as CEA standard. The detector shall have been designed to have high tolerance to dust, dirt, temperature fluctuations and air currents. In addition the detector shall include:

Selectable application specific ASA parameter sets for fire detection.

3 different fire danger levels for differentiated alarm activation.

Programmable time related switching of fire detector behaviour.

Separate signalling of hazardous CO concentrations with 2 warning levels.

Selectable CO parameter sets including static & dynamic thresholds. The dynamic setting shall adapt its response time dependent upon the concentration of CO detected.

Selectable specific average CO values to allow CO warning signals to be given if average CO concentrations exceed a given level over a 15 minute period.

Compensation for the gradual build-up of dust & dirt to ensure a consistent level of detection over time. When the detector reaches a point where it can no longer retain this consistent detection a separate warning signal shall be given to the control equipment.

The facility to detect if the detector is in an unsuitable environment and give a separate warning of such to the panel.

An internal self-test facility to ensure correct operation of the optics & electronics. Faults will be reported with separate signals to the control panel.

Redundant operation for optical and thermal detection in the event of a single sensor failure.

Recalibration functionality in the situation of a failure of the gas sensor. The detector shall continue to operate with the remaining four sensors (two optical and two thermal) with adjusted parameter.

An integral short circuit isolator.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Operation in the temperature ranges -10°C to + 50°C

EMC compatibility of 50V/m

Line Adapter Ex

Ex Line adapter shall allow the connection of up to 31 intrinsically safe fields devices in the Hazardous Area. Line Adapter Ex shall therefore fulfil and be approved to UL / EN54-17 and UL / EN54-18 standard, ATEX directives 94/9/EC and shall be suitable for use in Hazardous Area Zones 0, 1 and 2. Line Adapter Ex modules should connect directly to the loop and not require further power supply connections. The Line Adapter EX module shall additionally include:

Galvanic isolation

DC/DC converter acting as isolator

Earth-ground connection free

Limitation of voltage current and power to intrinsic safe value

Operation in the temperature ranges -25°C to + 55°C

Safety Barrier

Safety Barrier shall allow the connection of up to 31 intrinsically safe field devices in the Hazardous Area. Safety Barrier shall therefore fulfil and be approved to UL / EN54-17 and UL / EN54-18 standard, ATEX directives 94/9/EC and shall be suitable for use in Hazardous Area Zones 0, 1 and 2. The Safety Barrier shall restrict the electrical energy between non-intrinsically safe and intrinsically safe circuits. The Safety Barrier shall additionally include:

Galvanic isolation

DC/DC converter acting as isolator

Earth-ground connection free

Limitation of voltage current and power to intrinsic safe value

Operation in the temperature ranges -25°C to + 55°C

Technology Hazardous Area Neural Fire Detectors

Hazardous area neural fire detectors shall incorporate Advanced Signal Analysis (ASA) whereby the signals from the detector sensors are compared with a dynamic algorithm set thus ensuring the fastest possible response with all fire types while still offering a high degree of false alarm rejection. The hazardous area neural fire detector shall incorporate an optical chamber with two light emitters illuminating aerosols from different directions as well as two thermal sensors. Detectors shall therefore fulfil and be approved to EN54-7 including test fire 1, EN54-5 as well as CEA standard and shall be suitable for use in Hazardous Area Zones 0, 1 and 2. The detector shall have been designed to have high tolerance to dust, dirt, temperature fluctuations and air currents. In addition the detector shall include:

Selectable application specific ASA parameter sets.

3 different danger levels for differentiated alarm activation.

Programmable time related switching of detector behaviour.

Compensation for the gradual build-up of dust & dirt to ensure a consistent level of detection over time. When the detector reaches a point where it can no longer retain this consistent detection a separate warning signal shall be given to the control equipment.

The facility to detect if the detector is in an unsuitable environment and give a separate warning of such to the panel.

An internal self-test facility to ensure correct operation of the optics & electronics. Faults will be reported with separate signals to the control panel.

Redundant operation in the event of a single sensor failure.

A separately controllable remote indicator output for activation from this or other detectors.

An integral response indicator with 360° viewing angle.

Wireless communication device to facilitate testing; enable readout of current status and wiring diagnostics. In addition the detector shall give data on its length of time in service to aid scheduled maintenance routines.

Operation in the temperature ranges -35°C to + 70°C

EMC compatibility of 50V/m

Hazardous Area Manual Call Points

Manual call points will be break glass and press button type suitable for surface mounting and approved to EN54-11 and EN54-17. It shall be suitable for use in Hazardous Area Zones 0, 1 and 2 and zones 20, 21 and, 22. The call point shall include a test key feature for the rapid testing of the device without removing the glass. The call point shall also incorporate the following:

Alarm response indicator.

Facility for adding additional protective flap.

Wireless communication device to facilitate testing; enable readout of current status and wiring diagnostics.

Operating temperature: -35°C to + 70°C

An EMC Compatibility of at least 50V/m

Ingress protection of at least IP44 (IP64 with protection seal)

Ex Infrared Flame Detector.

Hazardous area flame detectors shall analyse signals from 3 IR sensors & compare to integrated algorithm sets ensuring fast & reliable detection. The flame detector shall be approved for use in Hazardous area zones 1 & 2 as well as fulfil and be approved to UL / EN54-10/Class 1. In addition the flame detector shall:

Selectable application algorithms

A separately controllable remote indicator output for activation from this detectors.

Operation in the temperature ranges -35°C to + 70°C

EMC compatibility of 50V/m

Ingress protection: IP67.

Ex Manual Call Point, Double Action

Manual call points will be break glass type suitable for flush or surface mounting. The call point shall include a test key feature for the rapid testing of the device without removing the glass. The call point shall also incorporate the

following:

Alarm response indicator.

Facility for adding additional protective flap.

Operating temperature: -25°C to + 70°C

Ingress protection of at least IP54 (IP65 with protection seal)

Ex Manual Call Point, Single Action.

Manual call points will be break glass type suitable for flush or surface mounting. The call point shall include a test key feature for the rapid testing of the device without removing the glass. The call point shall also incorporate the following:

Alarm response indicator.

Facility for adding additional protective flap.

Operating temperature: -25°C to + 70°C

Ingress protection of at least IP54 (IP65 with protection seal)

One Input / Output Modules

Input / output modules shall comply with the requirements of and be approved to UL / EN54-17. Input / output modules should connect directly to the loop and not require further power supply connections. Each input / output module shall take one address. Input / output modules shall additionally include:

Inputs monitored for short & open circuit.

Inputs can be configured for normally open or normally closed operation.

Outputs to be rated at 250VAC 4A resistive & 30VDC 4A clean contacts.

Output to be selectable as continuous or as pulsed operation. Pulse duration to be selectable between 1 & 20 seconds.

Integral short circuit isolator.

LED indication of normal, fault, test, & activation conditions.

Module can be configured as fail safe.

Modules to be mounted in an IP66 housing with clear lid for device status indication.

Modules should additionally be suitable for DIN rail mounting.

Operating temperature: -25°C to +60°C

EMC compatibility: 50V/m

Four Input Modules

Input modules shall comply with the requirements of and be approved to UL / EN54-17. Input modules shall connect directly to the loop and not require further power supply connections. Each input module shall take one address but have four separate programmable inputs. Input modules shall additionally include:

Inputs monitored for short & open circuit.

Inputs can be configured for normally open or normally closed operation.

Integral short circuit isolator.

LED indication of normal, fault, test, & activation conditions.

Option for configuration as fail safe operation.

Programmable activation delay filter from 0-240 seconds.

Modules to be mounted in IP54 housing with clear lid for device status indication.

Where modules are to be mounted outside or in other areas likely to be subject to damp or water spray they are to be mounted in IP66 housing with clear lid for device status indication.

Modules should additionally be suitable for DIN rail mounting.

Operating temperature: -25°C to +60°C

EMC compatibility: 50V/m

Four Input / Output Modules

Input / output modules shall comply with the requirements of and be approved to UL / EN54-17. Input / output modules should connect directly to the loop and not require further power supply connections. Each input / output module shall take one address but have four separate programmable inputs and four separate programmable outputs. Input / output modules shall additionally include:

Inputs monitored for short & open circuit.

Inputs can be configured for normally open or normally closed operation.

Outputs to be rated at 250VAC 4A resistive & 30VDC 4A clean contacts.

Output to be selectable as continuous or as pulsed operation. Pulse duration to be selectable between 1 & 20 seconds.

Integral short circuit isolator.

LED indication of normal, fault, test, & activation conditions.

Module can be configured as fail safe.

Programmable activation delay filter from 0-240 seconds.

Modules to be mounted in an IP54 housing with clear lid for device status indication.

Where modules are to be mounted outside or in other areas likely to be subject to damp or water spray they are to be mounted in an IP66 housing with clear lid for device status indication.

Modules should additionally be suitable for DIN rail mounting.

Operating temperature: -25°C to +60°C

EMC compatibility: 50V/m

Addressable Combined Sounder Controller / Zone Monitor.

Addressable combined sounder controllers/ zone monitors shall comply with the requirements of and be approved to UL / EN54-17. These modules shall have two circuits each and be configurable either as a conventional zone monitor or a sounder controller. The modules shall connect directly to the loop and be powered from a separate monitored UL / EN54-4 compliant power supply. Each module will take one address but identify both sub circuits separately. In addition the module will include:

Two independent circuits monitored for short & open circuit.

The ability to be programmed as a zone monitor. The module circuits will monitor up to 32 conventional detectors and call points each.

The ability to be programmed as a sounder controller. The module can control sounders and visual warning devices with a maximum current of 2A divided across both circuits.

Integral short circuit isolator.

LED indication of normal, fault, test, & activation conditions.

Module can be configured as fail safe.

Modules to be mounted in an IP54 housing with clear lid for device status indication.

Where modules are to be mounted outside or in other areas likely to be subject to damp or water spray they are to be mounted in an IP66 housing with clear lid for device status indication.

Modules should additionally be suitable for DIN rail mounting.

Operating temperature: -25°C to +60°C

EMC compatibility: 50V/m

Manual Call Points

Manual call points will be with direct operation by pull down / pushing on the plastic element suitable for flush or surface mounting and approved to UL / EN54-11 and EN54-17. The call point shall include a test key feature for the rapid testing of the device without removing the glass. The call point shall also incorporate the following:

Integral short circuit isolator.

Alarm response indicator.

Facility for adding additional protective flap.

Wireless communication device to facilitate testing; enable readout of current status and wiring diagnostics.

Operating temperature: -25°C to + 70°C

An EMC Compatibility of at least 50V/m

Ingress protection of at least IP44 (IP64 with protection seal)

Addressable Alarm Sounders Red

Alarm sounders shall be addressable units connected & powered directly on the loop. They shall meet the requirements of and be approved to UL/ EN54-3. In addition they shall:

Have an integral short circuit isolator that in case of short-circuit on the loop the sounder/beacon must continue to sound.

Have a locking facility to prevent unauthorized removal.

Have 11 programmable tones selectable from the panel.

Have the ability to switch between tones for alert & and evacuate purposes.

Be fully synchronized with other sounders connected to the control panel.

Have 3 volume settings selectable from the panel.

Be able to provide an output of at least 99dBA at 1m.

Colored in red with RAL 3000

Have an operating temperature in the range of -25°C to +70°C

Have minimum EMC compatibility of 50V/m

Addressable Sounder with Supplementary Optical Indicator – Red

Alarm sounded with supplementary optical indicator shall be addressable units connected & powered directly on the loop. They shall meet the requirements of and be approved to UL/ EN54-3 and EN54-17. In addition they shall:

Have an integral short circuit isolator that in case of short-circuit the sounder/beacon must continue to sound.

Have a locking facility to prevent unauthorized removal.

Have 11 programmable tones selectable from the panel.

Have the ability to switch between tones for alert & and evacuate purposes.

Be fully synchronized with other sounders connected to the control panel.

Have 3 volume settings selectable from the panel.

Be able to provide an output of at least 99dBA at 1m.

Have a peak light output of at least 3.2cd

Colored in transparent red

Have an operating temperature in the range of -25°C to +65°C

Have minimum EMC compatibility of 50V/m

Detector Base

Detector base shall include the following features:

Cable capacity 0.2 – 1.5 mm2

Space for auxiliary terminals as micro terminals 0.5 mm2 or connection terminals 2.5 mm2

Pure white RAL 9010

Detector Base with Integral Sounder

Detector base sounders shall fulfil the requirements of and be approved to EN54-3. The sounders shall also:

Have 11 programmable tones selectable from the control panel.

Have the ability to switch between one tone for alert & one tone evacuate purposes.

Be fully synchronized with other sounders connected to the control panel.

Have 2 programmable sound levels selectable from the control panel.

Be able to provide an output of at least 88dBA at 1m.

Have minimum EMC compatibility of 50V/m

Have an operating temperature in the range of -25°C to +70°C

Detector Base

Detector base for addressable sounder or sounder/beacon shall be made from impact-proof and scratch-resistant synthetic material. Large opening in the detector base permits the reuse of existing boreholes from older systems. Screw less connection terminals 'orange'. For fire detectors with addressable signal processing. For recess supply wiring. For surface supply wiring, cable diameter up to 6 mm.

Cable capacity 0.2 – 1.5 mm2

Space for auxiliary terminals as micro terminals 0.5 mm2 or connection terminals 2.5 mm2

Pure white RAL 9010

Sounder Interbase with Supplementary Optical Indication

Sounder interbase with supplementary optical indication shall fulfil the requirements of and be approved to UL / EN54-3. The sounders shall also:

Have 11 programmable tones selectable from the control panel.

Have the ability to switch between one tone for alert & one tone evacuate purposes.

Be fully synchronized with other sounders connected to the control panel.

Have 2 programmable sound levels selectable from the control panel.

Be able to provide an output of at least 87dBA at 1m.

Have a peak light output of at least 3.2cd

Colored in transparent red

Have minimum EMC compatibility of 50V/m

Have an operating temperature in the range of -25°C to +65°C

The system shall be a complete, electrically supervised fire detection and evacuation system using fire fighter telephone with microprocessor based operating system having the following; capabilities,

features and capacities:

Communication between network nodes, each supporting an interactive, self-standing, intelligent local control panel, with system wide displays. Any network node shall be capable of supporting a local system in excess of 4000 input/output points.

The local system shall provide status indicators and control switches for all of the following functions:

Audible and visual notification alarm circuit zone control.

Status indicators for sprinkling system water-flow and valve supervisory devices. (if any)

Any additional status or control functions as indicated on the drawings, including but not limited to; emergency generator functions, fire pump functions, door unlocking and security with bypass capabilities.

Two way firefighter‘s telephone circuit zone control

Speaker circuit zone control

Each intelligent addressable device or conventional zone on the system shall be displayed at the fire alarm control panel by a unique alphanumeric label identifying its location.

EXAMINATION

Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

Proceed with installation only after unsatisfactory conditions have been corrected.

INSTALLATION

Where a cable passes through an external wall it should be contained in a smooth bore sleeve of metal or other non-hygroscopic material sealed into the wall. This material will slope downwards towards the outside and should be sealed with a suitable waterproof compound.

Where cables, conduits or trunking pass through floors, walls, partitions or ceilings the surrounding hole shall be made good with a fire stopping material with sufficient fire resistance to maintain the integrity of the construction.

Each junction box will include the legend –Fire Alarm System‖ on its cover.

All wires shall be provided with an identifying permanent label within 25mm of its termination.

A consistent colour code for fire alarm conductors will be used throughout the installation.

Wiring within enclosures will be arranged to allow accessibility to equipment for adjustment & maintenance.

BOXES, ENCLOSURES AND WIRING DEVICES

Boxes shall be installed plumb and firmly in position.

Extension rings with blank covers shall be installed on junction boxes where required.

Junction boxes served by concealed conduit shall be flush mounted.

Upon initial installation, all wiring outlets, junction, pull and outlet boxes shall have dust covers installed. Dust covers shall not be removed until wiring installation when permanent dust covers or devices are installed.

CONDUCTORS

Each conductor shall be identified as shown on the drawings at each with ferrules at terminal points.

All wiring shall be supplied and installed in compliance with the requirements of the Electrical Code and that of the manufacturer.

All splices shall be made using solderless connectors. All connectors shall be installed in conformance with the manufacturer recommendations.

Crimp-on type spade lugs shall be used for terminations of stranded conductors to binder screw or stud type terminals. Spade lugs shall have upset legs and insulation sleeves sized for the conductors.

The installation contractor shall submit for approval prior to installation of wire, a proposed colour code for system conductors to allow rapid identification of circuit types.

Wiring within sub panels shall be arranged and routed to allow accessibility to equipment for adjustment and maintenance.

DEVICES

Wiring within enclosures will be arranged to allow accessibility to equipment for adjustment & maintenance.

All devices shall be mounted to or in a suitable electrical box.

COMMISSIONING

The entire system shall be inspected & tested to ensure that it operates in accordance with this specification and the country requirements. In particular that:

- All manual call points & automatic fire detectors function correctly.
- All devices carry an accurate identification label.
- All manual call points and automatic fire detectors when operated result in the correct text & zone indications at all necessary indicating equipment.
- That sound pressure levels meet as per requirements.
- That the systems cause and effects match the requirements of this specification.
- The sitting of all manual call points & automatic fire detectors meet the country requirements.

- Readings taken & recorded of all insulation resistance, earth continuity and circuit impedance.

DOCUMENTATION

On completion of the system the contractor shall provide the following documentation:

- Complete listings of fitted devices, their programmed parameters, texts and assignments.
- Documentation of all programmed cause & effects.
- Documentation of actual field wiring topology.
- System log book.

TRAINING

Training shall be provided as follows:

The contractor shall provide full training on system operation & user responsibilities to at least two persons nominated by the IIT.

CERTIFICATION

Upon completion the contractor will provide the following certificates in accordance with the country regulation:

- Design certificate.
- Installation certificate.
- Commissioning certificate.
- Acceptance certificate.
- Verification certificate.

Fire Survival Cable for Fire Detection & PA System

Low Smoke Zero Halogen Silicon Insulated Fire Survival Cable with Drain Wire Armouring, solid copper conductor cable approved by LPCB as per BSEN 50200:2015 PH 120 (Fire, Mech Shock & Water 120 Minutes @ 830 deg Celcius, Fire & Mech Shock every 5 Min for 2 Hours- Both test conducted on same sample) and BS-6387 CWZ The cable shall sustain 950 deg. C. For 3 hours approved along with accessories/ termination glands and all necessary materials to complete the installation including termination material. The cable shall be approved for BS EN 60332-1-2:2004 for Bunched Flame Retardancy.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in Indial and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-5

DATA NETWORKING SYSTEM

CONDITIONS AND SPECIFICATIONS FOR DATA NETWORKING

1. The scope of work includes all the active and passive network equipment, Wi-Fi equipments required for completion of the LAN, Wi-Fi Networking System, and firewall for functional requirement. The brief scope of work is SITC of DATA NETWORKING & LAN and Wi-Fi SYSTEM as per given detailed specifications including planning and designing by incorporating stipulated specifications, all E&M works related services on design, built and handover basis including all works as per scope for Work and user requirement, all complete including defect liability period for three years from the date of handing over as per direction of Engineer in Charge.

a) Centenary Building (G+4)

(Total plinth area to be covered in this subhead shall not be less than 18708 SMT)
If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

All sundry equipment, fittings, unit assemblies, accessories, hardware items, software for integration, and all other items which are useful and necessary for efficient assembly and installation of equipment and components of the work shall be deemed to have been included in the tender irrespective of the fact whether such items are specifically mentioned in the schedule of quantities and in the tender documents or not.

2. COMPLETENESS OF TENDER

All sundry equipment, fittings, unit assemblies, accessories, hardware items, software for integration, and all other items which are useful and necessary for efficient assembly and installation of equipment and components of the work shall be deemed to have been included in the tender irrespective of the fact whether such items are specifically mentioned in the schedule of quantities and in the tender documents or not.

3. COMPLETION PERIOD

The completion period indicated in the tender documents is for the entire work of planning, designing, approval of drawings etc., arrangement of materials & equipments, delivery at site including transportation, installation, testing, commissioning and handing over of the entire system to the satisfaction of the Engineer-in-charge.

4. GUARANTEE

4.1 All equipments shall be guaranteed for a period of 36 months, from the date of taking over the installation by the department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forthwith repaired or replaced free of cost, to the satisfaction of the Engineer-in Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & building on the contractor.

4.2 The tender shall guarantee among other things, the following:

a) Quality, strength and performance of the materials used as per manufacturers Standards.
b) Safe mechanical and electrical stress on all parts under all specified Conditions of operation.
c) Satisfactory operation during the maintenance period.

5. POWER SUPPLY:

The contractor has to make its own arrangement for power supply required for execution of the work.

6. WATER SUPPLY:

The contractor has to make its own arrangement for water supply required for execution of the work.

7. ACCEPTABLE MAKES OF VARIOUS EQUIPMENTS:

The acceptable makes of various equipments/components/accessories have been indicated in "Acceptable Makes" appended with the tender documents. The tenderer shall work out the cost of the offer on this basis. Alternate makes are not acceptable.

8. DATA MANUAL AND DRAWINGS TO BE FURNISHED BY THE TENDER:

8.1 The Agency shall submit detailed technical literature, pamphlets and performance data for appraisal and evaluation of the offer along with drawings for approval

8.2 The successful tenderer would be required to submit the following drawings after award of work for approval.

9.0 The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance including preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts catalogue etc. all in triplicate.

10 **EXTENT OF WORK**

The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract as this is a turnkey job.

11. Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

12. Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs.2000/- for each default per week. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

13. INDEMNITY:

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer on account of the above.

14. ERECTION TOOLS:

No tools and tackles either for unloading or for shifting the equipments for erection purposes would be made available by the department. The successful tenderer shall make his own arrangement for all these facilities.

15. COOPERATION WITH OTHER AGENCIES:

The successful tenderer shall co-ordinate with other contractors and agencies engaged in the construction of buildings, if any, and exchange freely all technical information so as to make the execution of this work/contract smooth. No remuneration should be claimed from the department for such technical cooperation. If any unreasonable hindrance is caused to other agencies and any completed portion of the work has to be dismantled and re-done for want of cooperation and coordination by the tenderer during the course of work, such expenditure incurred will be recovered from the successful tenderer if the restoration work to the original condition or specification of the dismantled portion of the work was not undertaken by the tenderer himself.

16. The work will be carried out with least disturbance during shifting & shut down taken in consultation with the client department.

17. INSURANCE AND STORAGE:

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

18. MAINTENANCE:

Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of Three year from the handing over of the installation.
The maintenance, routine as well as preventive, for one year from the date of taking over the installation as per manufacturer‘s recommendation shall be carried out on quarterly basis.

19. INTERPRETING SPECIFICATIONS:

In interpreting the specifications, the following order of precedence shall be followed in case of contradictions:

a) Technical specifications
b) Drawing (if any)
c) General specifications.
d) Relevant BIS or other international code in case BIS code is not available.

20. The Wi-Fi and LAN points shall be provided to cover complete area of all buildings under Phase-1C except quarters blocks. However, the minimum tentative quantity building wise are given below (for indicative purpose only, any extra points needed to facilitate proper coverage shall be executed and nothing extra shall be paid on this account).

TECHNICAL SPECIFICATION

1. FIBER OPTICS CABLE & COMPONENTS

The OFC Cables run only through DWC HDPE pipe with accessories in trenches and buildings.

The EPC contractor shall design size of OFC in future and also in consideration of OFC redundancy for all buildings.

- Complete installation shall be done in accordance with installation practices for a well structured cabling system, using components from a single vendor to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.
- The contractor shall provide at least 30% extra provision in network racks for future extension after considering all type of access points.
- The contractor shall also take consideration of rack mounted UPS system at the time of selection of network rack according to access points and accessories.

- Devices and services that shall run on the passive network shall include, but not limited to, the following:
    a.) Wired LAN access
    b.) Wireless LAN access
    c.) Voice communications servers and IP/SIP end-points
    d.) IP-based CCTV/Surveillance Cameras
    e.) Access Control System
    f.) Building Management System
    g.) Energy Management System
    h.) Various devices and controllers for AV system
    i.) Video-conferencing equipment
- Cabling installation for data and voice communications shall originate at networking racks and terminate at IOs terminated at wall. (Included in the scope of Building works)
- Installation, termination and identification of wiring between networking distribution rack(s) and main rack (s), shall be considered part of the system provider‘s work.
- All cables and terminations shall be tested, identified, labelled and documented at all locations.
- The system provider carrying out the SITC shall make the system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the scope of work.

Supported Applications, but not limited to:

- IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
- Telecom – BRI, PRI and Digital Subscriber Loop (DSL) Applications
- Voice, Video and ISDN Applications

References & Standards, but not limited to:

- TIA / EIA
- International Electro technical Commission (IEC)
- European Committee for Electro technical Standardization (CENELEC)
- American National Standards Institute (ANSI)
- Institution of Electrical and Electronics Engineers (IEEE)
- Wherever there is reference to multiple standards and/codes, the ones most recent and most stringent shall apply.

It shall be the responsibility of the system integrator and OEM manufacturer to ensure that:

- The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use.
- All Passive Components in the structured cabling distribution network shall meet or exceed the relevant component specification of the EIA/TIA 568-B and EIA/TIA 568-C.2 series and ISO/IEC 11801: 2002 standards; or later version as applicable at the time of installation.
- The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.
- The site will be duly certified by OEM for a period of 25 years from the date of issuance of the registration certificate or installation, whichever is earlier, for which they shall submit detailed performance test reports for every component installed.
- The specifications for items in this section, applies to the following:

a.) Single Mode fiber optic cable and associated components such as distribution shelves, LIUs, pigtails and patch cords
b.) Networking Racks – for termination of networking cables

Installation Guide Line for Fiber Optic Cable:

- This section describes general precautions to be taken when installing fiber optic cable in a building and the safe handling and disposal of optical cable. The methods and instructions provided are intended only as guidelines, as each installation will be influenced by local conditions and user preferences.

- The reader should be experienced in fiber optic cable installation

- Methods used for installing fiber optic cables are very similar to those used for installing standard copper cable. However the qualities and characteristics fiber optic cable can be degraded when it is subjected to:

  - ✓ Excessive pulling.
  - ✓ Excessive tension.
  - ✓ Crushing forces.

Safety Precautions

- It is important to observe the following safety precautions when installing cable in a building and between buildings. These practices may change, or may not be suitable for a specific situation, so are therefore only suggested guidelines. Local safety precautions and practices take precedence over any conflicting recommendations given in this section.

- Caution: Before starting any cable installation, all personnel must be thoroughly familiar with all applicable Occupational Safety and Health regulations, local regulations, and company practices and policies. To minimize hazards to yourself and others in or near the work area, follow all company rules for setting up barricades, ladders, scaffolding, and warning signs. Any material used above the floor should be arranged so that it cannot fall and hit individuals underneath. Observe standard safety precautions. Wear safety headgear, eye protection, gloves, etc., as specified in your company‘s practices.

Pulling Precautions:

- Personnel normally should not remain in an area where a cable is being pulled under tension around a piece of hardware. Personnel can remain in such an area (e.g., to observe the alignment of a cable around a corner block), if he or she stays clear of the hardware under tension and has a clear path to safety.

- If you use a cable lubricant during a pull operation, make provisions to clean up any spilled lubricant to prevent slipping and possible injury. (Care must be taken if using lubricants as they may react with certain cable sheath types.)

Laser Precautions:

- Laser light can damage your eyes. Laser light is invisible. Viewing it directly does not cause pain. The iris of the eye will not close involuntarily as when viewing a bright light. Consequently, serious damage to the retina of the eye is possible. Never look into the end of a fiber, which may have a laser, coupled to it. Should accidental eye exposure to laser light be suspected, arrange for an eye examination immediately.

- Cable Handling Precautions and Specifications

- The following section provides general guidelines for internal installation of fiber optic cable. (This information is based upon standard cable designs). Mechanical specifications, minimum bend radii and cable temperature ranges can be obtained by contacting the OEM.

- Caution: Fiber optic cable is sensitive to excessive pulling, bending, and crushing. Any such damage may alter the cable‘s characteristics to the extent that the cable may have to be replaced. To ensure all specifications are met, consult the specific cable specification sheet for the cable being installed.

- Note: Zip twin and Single Fiber Cables are designed for use as ‒jumpers,‖ ‒patch cords‖ or ―pigtails‖. These cables are not intended for use in installations requiring long or difficult ―pulls‖ or routing between buildings.

- Leave the protective covering on the reel intact until it arrives at the installation site. If the covering has been previously removed, secure the cable end(s) during transit to prevent damage.

- Cable reels should be stored vertically on their flanges, end-to-end in rows and chocked to prevent rolling. Make sure that reels rest edge-to-edge with reels in adjacent rows to prevent damage to cables.

- Before the installation begins, carefully inspect the cable reel for protrusions such as nails and broken flanges which might cause damage to the cable as it is unreeled.

- Take precautions to protect reeled cable from mishaps or other sources of possible damage. Any damage to a section of cable may require replacement of the entire section.

- If the cable must be unreeled during installation, use the ‒figure-eight‖ configuration to prevent kinking or twisting. Do not coil fiber optic cable in a continuous direction except for lengths of 30 m (100 ft.) or less.

- Installation Considerations

- Fiber optic cable can be installed inside buildings using the same methods as coax or twisted pair; however, the following guidelines should be observed:

- Do not deform the cable sheath, specifically when using cable fasteners or ties to secure the cable to a support or hardware

- Do not exceed the cable's maximum pulling tension.

- Do not pull fiber optic cables with copper cables

- Do not pull fiber optic cables over existing cables. The friction could be excessive and cause cable damage. The cables may also become entangled, resulting in damage to the fiber optic cable.

- Do not exceed minimum (installed and long-term) bend radius. (The minimum bend radius varies with the cable diameter. Consult the appropriate Cable specification.)

- Do not pull the cable around sharp corners, such as support brackets.

- Provide additional crush / mechanical protection in high-risk environments.
- Secure the cable to larger permanent cables or available supports when possible. Do not attach the cable to cables that may be removed later or to steam or water lines
- Caution: Installation tension exerted on fiber cables may cause the buffered fibers to assume a sinusoidal ―wave‖ appearance. This effect is caused by installing the cable incorrectly. OEMs generally recommend that all tight-buffered cable pulls employ a grip on the pull end of the cable coupled to the aramid strength member, not the cable jacket.
- Pulling grips should be used regardless of the length or duration of the pull. If the pulling end of the cable has not been connectorised, then a knot can be tied in the pull-end of the cable before attempting the pull. If cables are pulled without coupling to the strength member, the cable jacket will stretch. When the jacket relaxes, it may bunch up the fibers underneath the jacket, which may result in degraded fiber performance.
- Conduit/Inner duct
- Use the following guidelines when installing cable in a rigid conduit:
- Ensure the conduit system does not exceed minimum bend radius.
- Do not pull the cable through pull boxes or junction boxes unless the cable's bend radius can be maintained through the use of conduit or inner duct
- Avoid the use of elbows if possible and use an elbow only if the cable's long-term bend radius can be maintained. Never pull cable "through" an elbow. Pull the cable out of the elbow and ―back-feed‖ it into the conduit exiting the elbow for a second pull.
- Inner duct is semi-rigid plastic tubing commonly used in fiber optic installations to subdivide the duct and to provide for future cable pulls. Proper size and installation of the inner duct is critical for ease of cable installation.
- If additional cables, specifically larger, bulkier cables, are to be installed in the same conduit, install the fiber optic cable inside an inner duct for mechanical protection
- Eliminate sharp edges.
- Tension Monitoring
- Fiber optic cable is subject to damage if the cable‘s specified maximum tensile force is exceeded. Except for short runs or hand pulls, tension must be monitored. Maximum pulling tension varies with the cable fiber count. Refer to cable specification sheets for maximum tension.
- All pulling equipment and hardware which will contact the cable during installation must maintain the cable‘s minimum bend radius.

- Vertical Runs
- Each fiber optic cable in the vertical run needs to be supported by its own support grip at the top of the run. Never use fiber optic cables as support for other cables. Cables that are individually supported may be taped or cable-tied together every 3 meters (10 ft.) for cable management - not support.
- Fiber Optic Cable Disposal
- At the end of the products service life there is the potential to recover and recycle component parts of the cable.
- When handling and disposing of waste fiber optic cable, observe the following guidelines:
- Comply with Local legislation.
- Consider recycling opportunities.
- Fiber waste should be disposed of safely, the use of sharps containers is recommended for waste fiber shards
- ―OEM must provide OTDR, OLTS, Penta scanning or FLUKE test report with 25 years warranty certification.‖
- Proposed OFC connectivity is Building to building and inside the building Rack to rack

Note :The Contractor shall submit Manufacturer Authorization before commencement of work in given proforma.

MANUFACTURER"S AUTHORIZATION (MAF)

MAF Letter Format (On OEM Letter head with seal)

Date: _____

To,
<<< NAME OF CLIENT/ORGANIZATION>>_____
_____
_____

Subject: Manufacturer's Authorization Certificate

Tender Ref.: << PLEASE SPECIFY SPECIFIC TENDER REF.NO.>>

Dear Sirs,

This is with reference to the above mentioned Tender.

We hereby authorize <<NAME AND ADDRESS OF INTEGRATOR>> to offer our range of product in their tender bids. Being authorized <<NAME AND ADDRESS OF INTEGRATOR>> may make techno-commercial and commercial proposal for this tender.

Upon being awarded the work <<NAME AND ADDRESS OF INTEGRATOR>> are authorized to install and commission our range of products falling under <<SECTION/PRODUCT CATEGORY>> of this tender.

We as Original Electronic Manufacturers will provide all the techno-commercial and service support necessary to <<NAME AND ADDRESS OF INTEGRATOR>>for this project during the commissioning phase of the equipments and until hand-over.

We also confirm that the items would be serviceable during the warranty period of 12 months and for at least twenty five years thereafter.

Thanking and assuring best of our services at all times.

Yours faithfully

(Seal & Signature)

1.1 FIBER OPTIC CABLE AND COMPONENTS

Type	Single mode OS2 fiber cabling system and all its components; must be from a single OEM (Cables + Components)
Networks Speeds Supported	1Gbps, 10Gbps and 40Gbps
Standard Compliance	ITU-T G.652A, B, C & D, IEC - 60793-2-50, TIA/EIA 492CAAB
Performance Testing	Must have ETL verified fiber channel compliance to ANSI/TIA568 -C.0 forOS2
Warranty	25-year systems warranty from OEM including OTDR test reports; Warranty to cover bandwidth of the specified and installed cabling system

SPECIFICATIONS FOR SINGLE MODE OPTICAL FIBER CABLE:	
Cable Type	6 / 12 / 24 /144 (12x12) core, ISO 11801 -OS2. Single Mode, Armored, Loose-tube, Gel filled & Multi tube construction cable. Optical fibres in water blocked loose tube, taped, corrugated steel tape armoured (STA) polyethylene (HDPE) outer sheathed embedded with two steel wires on the periphery. The cables are with UV Stabilized PE Jacket and protected from Rodent attacks.
Fiber Type	Single Mode, 9 / 125, 250 micron primary coated buffers.
Fiber core must be	As per Telecordia GR20, ITU-T G652D, IEC-60793-2-50, TIA/EIA 492-CAAB
Cable Construction Type	Loose tube corrugated steel tape armoured cable, provided with FRP or equivalent non-metallic central strength member
Outer Jacket Construction	High density polyethylene, anti - termite, anti - rodent suitable for direct burial application. Jacket must be UV stabilized & Polyethylene (HDPE)
Losses @ 1310nm frequency	< = 0.4 dB/Km
Losses @1550nm frequency	< = 0.3 dB/Km
Operating Temperature	-20 deg C to + 60 deg C

Test Parameters	Must pass the following : -IEC794-1-E1, IEC794-1-E2, IEC794-1-E3, IEC794-1-E4, EIA-455-104, IEC794-1-E7, IEC794-1-E10, IEC794-1-E11, IEC794-1-F5
Multi Channel Capability	The fiber cable must have been designed to provide optimum performance from 1265nm to 1625nm making it suitable for 16 – channel Course Wavelength Division Multiplexing (CWDM) applications.
Cable / Component	All fiber cables and components must be from a single OEM (Including UTP CAT6A Cabling System)

24 Port Rack Mount Fiber LIU Panel	
Features	**Specifications**
Rack Mount	Lockable 19" rack mounted with 1U height, Sliding Drawer Type with 4 Cable entry/exit points (covered with rubber grommets)
Material	Powder coated mild steel
Accommodation and Supports	Accommodation of single mode cable multimode fibres Capable of supporting SC and LC interface - For 24 Port with SC Coupler Configurable. Fits up to four 6 pack plates/Angled 6 pack plates Management rings within system to accommodate excess fibre bend radius.
Compatibility	Labelling for port identification, Fibre Management rings to accommodate excess fibre cordage behind the trough adapters and maintain fibre bend radius
	The front plate of the panel shall be included in the proposal that can support LC-Style Duplex adapters
	Adequate number of Fusion splice holder trays should be included .

Pigtail	
Features	**Specifications**
Type of connectors	SC / LC Jacket - Reduces toxic / corrosive
Length	1.5 Mtrs
Polishing	100% Factory polished, tested and Guaranteed Performance
Standards	ROHS Compliant

SC-LC Single Mode OFC Patch Cords 9/125 Micron	
Features	**Specifications**
Type of connectors	SC or LC Jacket - Reduces toxic / corrosive
Length	Minimum 3 meters
Polishing	100% Factory polished and tested
Insertion Loss	Less than 0.35dB per connector
Attenuation	0.4dB/km over 1310nm to 1625nm
Standards	ROHS Compliant
Jacket colour	Industry Standard Colour - OS1-Yellow, OM3-Aqua, OM2-Grey, OM1-Orange
Make and Type	SC to LC Duplex Fiber Optic Patch Cord 9/125 Micron
Cable Diameter	1.6 mm
Ferrule	Ceramic
Buffer	Tight buffered
Temperature Range	.-20 Degree C to +85 Degree C
Buffer Diameter:	900µm
Primary Coating :	245µm
Strength Member:	Aramid Yarn

SC-SC Single Mode OFC Patch Cords 9/125 Micron	
Features	**Specifications**
Type of connectors	SC or SC Jacket - Reduces toxic / corrosive
Length	Minimum 2 meters
Polishing	100% Factory polished and tested
Insertion Loss	Less than 0.35dB per connector
Attenuation	0.4dB/km over 1310nm to 1625nm
Standards	ROHS Compliant
Jacket colour	Industry Standard Colour - OS1-Yellow, OM3-Aqua, OM2-Grey, OM1-Orange
Make and Type	SC to SC Duplex Fiber Optic Patch Cord 9/125 Micron
Cable Diameter	1.6 mm
Ferrule	Ceramic
Buffer	Tight buffered
Temperature Range	.-20 Degree C to +85 Degree C
Buffer Diameter:	900µm
Primary Coating :	245µm
Strength Member:	Aramid Yarn

LC-LC Single Mode OFC Patch Cords 9/125 Micron	
Features	**Specifications**
Type of connectors	LC Jacket - Reduces toxic / corrosive
Length	Minimum 2 meters
Polishing	100% Factory polished and tested
Insertion Loss	Less than 0.35dB per connector
Attenuation	0.4dB/km over 1310nm to 1625nm
Standards	ROHS Compliant
Jacket colour	Industry Standard Colour - OS1-Yellow, OM3-Aqua, OM2-Grey, OM1-Orange
Make and Type	LC to LC Duplex Fibre Optic Patch Cord 9/125 Micron
Cable Diameter	1.6 mm
Ferrule	Ceramic
Buffer	Tight buffered
Temperature Range	.-20 Degree C to +85 Degree C
Buffer Diameter:	900µm
Primary Coating :	245µm
Strength Member:	Aramid Yarn

24 Port loaded Patch Panel 1U Height	
Features	**Specifications**
Features:-	a) Available in 1U 24 Port and 2U 48 Port density
	b) Each port features the spring-loaded shutter/ Dust Cover
	c) – May prevents incomplete mating
	d) – protects from dust and contaminants
	e) IDC V-shaped contacts that flex not fatigue when terminated
	f) Features pointed IDC towers to speed termination and enhance cable retention
	g) Dual colour-coding allows for 568 A/B wiring configuration

	h) Front and rear port labelling (port sequence 1–480) as well as panel identification label
	i) 24 jack configuration
	j) Individually removable patch panel ports
	k) May be removable cable management shelf(s) ensure bend radius compliance
	l) Available with either ANSI and metric hardware kit
	m) Can be terminated using industry standard punch-down tools
	n) RJ45 port which is RJ-11 compatible
	o) Moulded category identification on each port face as well as optional port identification icons
Rear Cable Manager	Flat type metal with Perforated Rear Cable Manager to hold CAT6 / Cat 6A UTP Cable with Velcro cable ties
Dust Proof	RJ45 Jack should be supplied with Shutter to avoid Dust
RJ45 I/O Compatibility	a. Individual Compatible RJ45 Jack
	b. Pointed IDC Tower on RJ45 Jack for easy termination
Mechanical Characteristics	
Material:	CRS (cold rolled steel)
Thickness:	.060‖ (1.52mm)
Coating:	Grey / Option for Black
Jack Connector	
Plastic Housing:	Thermoplastic UL94V-0 rated or equivalent
Operating Life:	Minimum 750 insertion cycles
Contact Material:	Phosphor Bronze
Contact Plating:	50µ‖ Gold/100µ‖ Nickel
Contact Force:	100g minimum
Plug Retention Force:	11 lbf minimum
IDC Connector	
Plastic Housing:	Thermoplastic UL94V-0 rated or equivalent
Operating Life:	Minimum 20 re-terminations
Contact Material:	Phosphor Bronze
IDC Contact Plating:	Solder Plate (60% tin/40% lead)
Wire Accommodation:	22-24 AWG solid
Electrical Characteristics	
Interface Resistance:	20 milliohms
Initial Contact Resistance:	2.5 milliohms

Insulation Resistance:	>100 Megaohms
Standards	ETL Verified to ANSI/TIA-568-C.2, ISO/IEC 11801 Category 6

CAT6A U/FTP SHIELDEDTWISTED PAIR CABLE	
Characteristic	**Min. Required Specification**
General Features	Category 6A 4 pair U/FTP LS0H cable shall be compliant with TIA/EIA-568-C.2
	Category 6A U/FTP cables shall extend between the work area location and its associated telecommunications closet and consist of 4 pair, 23 AWG, U/FTP LS0H cable jacket.
	Should be ETL verified to TIA/EIA-568-C.2 Category 6A standard for 500MHz (ETL certificate to be enclosed along with the bid)
	Screen: Each individual pair shall be enclosed in laminated Aluminum foil with drain wire.
	Third party report of Full Cat6A Channel/Performance Test should be enclosed along with the technical bid.
	The Category 6A cables shall meet or exceed the following characteristics:
Mechanical Characteristics	Construction: 4 pair U/FTP cable should be constructed of 4 individual screened pairs and drain wire.
	Conductor: Solid Copper
	Conductor Size:23 AWG
	Insulator: Polyolefin
	Jacket/ Sheath Type: LS0H (Low Smoke Zero Halogen)
	NVP:75-77%
	Screen: Each individual pair enclosed in laminated aluminum foil with drain wire.
	Pulling Force: 50 N/mm² max
	Capacitance: 40 pF/m nom. @1 KHz.
	DC Resistance: 72 Ω/Km max.
	Propagation Delay:514 + 36f½ nS/100m max @1-500 MHz
	Propagation Delay Skew: 45 nS/100 max @ 1-500 MHz
	Mean Impedance: 100Ω ± 6 @ 1-500 MHz
	Resistance Unbalance: 2-5% max.
	Coupling Attenuation: 45dB min @30-100 MHz 40-20 Log (f/100) @ 100-500 MHz
	Outer Diameter: 7.0±0.4mm
	Short term. bend radius:8 x OD mm
	Long Term bend radius: 4 x OD mm
	Weight LS0H per 500m reel:30kg

	Max. Temperature:
	Storage: -20˚C to +75˚C Operation: -20˚C to +60˚C

1/2 FACE PLATE	
Characteristic	**Min. Required Specification**
Features	Single Gang square plate, 86mmx86mm, VE10 ABS
	Write on labels in transparent plastic window – supplied with plate
	Screw hole covers – to be supplied with plate
	Plug in Icons – Icon tree – to be supplied with plate
	Should be able to support variety of jacks – UTP, STP, Fiber, Coax etc.
	The face plate should not have shutters as the spring shutter on the face plates
	malfunctions and causes operational issues in patch cords termination & also the face plate should be available 4 colors

CAT6A SHIELDED RJ45 JACK	
Characteristic	**Min. Required Specification**
Features	Category 6A Shielded Jack shall be specifically designed for high-
	speed data transmission and must be compliant with latest ISO/IEC
	11801 A1.1 draft and ratified TIA/EIA 568-B.2-10 for the support of 10G BASE-T.
	All information outlets for 22-24 AWG copper cable shall: Use insulation displacement connectors (IDC)
	Allow for a minimum of 20 re-terminations & minimum 750 insertion without signal degradation below standards compliance limits.
	Be constructed of high impact, flame-retardant thermoplastic and robust die cast zinc alloy housing plated with Nickel/Cu with icon options for better visual identification & the contact plating must be 1.25 Micrometers of Gold/Ni.
	the shutter on the IO must be provided to avoid dust entering the jacks during idle condition.
	IDC posts should have mounts / pointed so that to avoid the untwisting of CAT6A cable at the time of punching / termination.
	568A/B configuration
	Color options in jacks should be available.
	The jack should be UL certified.
Mechanical Characteristic:IDC Connector	Plastic Housing must be Polycarbonate, UL94V-0 rated
	The IDC Contact Plating must have Tin Matte Finish
	Contact Force 100g minimum
	Wire Accommodation: 22-24 AWG solid

CAT6A SHIELDED MOUNTING CORDS (1 Mtr , 2 Mtr& 3 Mtrs)	
Characteristic	**Min. Required Specification**
Features	Category 6A Equipment cords (Length – 1mtr, 2mtr, 3 Mtrs, 5mtr & 10 mtr)
	The work area equipment cords shall, be comply with TIA/EIA- 568-B.2-10 Commercial Building Cabling Standards Transmission Performance Specifications for 4 pair Category 6A Cabling.
	Category 6A modular equipment cords: Shall be round, and consist of eight insulated 26AWG, stranded bare copper conductors, arranged in four color-coded twisted-pairs with aluminium/polyester shield and tinned copper drain wire
	Equipped with modular 8-position modular shielded plugs on both ends, wired straight through with standards compliant wiring.
	ROHS Compliant & should have 50 micro inches of gold plating over nickel contacts.
	CAT6A lockable patch cords must be provided at the server room / hub room as this solution prevents unauthorised changes in patch cable connections within the telecommunication outlet zone or patching zone.
	Modular cords should include a moulded strain relief boot.
	Should be covered by UL certification program.
Mechanical Characteristic: Cable	Conductor size: 26 AWG stranded bare copper
Mechanical Characteristic: Plug	Max O.D.: max 6.1 mm for lockable patch cords & 6.5mm for normal Patch Cords
	Patch Cord Jacket: The jacket of the patch cord must be LSZH
	Temperature range: -20°C to +60°C
	Operating life: Minimum 750 insertion cycles
	The screen material of pair must have aluminum/polyester shield with tinned copper drain wire in case of LSZH Patch cords & in case of Lockable patch cords the braid made must be of 0,08 mm wires
	The Contact plating must be 1.25um Gold & The Contact Material should be Copper alloy
	Plug dimensions & tolerances compliant with FCC Part 68 and IEC 60603-7
Electrical Characteristics:- Plug	Max voltage: 150 VAC (max)
	Max current: 1.5A @ 25 ˚C
	Operating Temperature range: -40 ˚C to +85 ˚C

Category 6A Field Termination Plug	
Characteristic	**Min. Required Specification**
Features	Category 6A field terminable plug is designed to support 10 Gigabit networks and can be easily terminated using parallel jaw pliers
	The termination is accomplished by placing the conductors into the proper wire slots in the wire cap. The termination Jack must be UL listed
	All eight conductors are simultaneously terminated when the wire cap is squeeze
	The IDC is design to accommodate different diameter conductors from 22 AWG-26 AWG Solid Wire.
	The Field Terminable Plug meets TIA-568-C.2 Category 6A component performance. Cat 5e/6 and 6A Direct Attach link and channels.
Mechanical Characteristics	Transmission performance: Cat.6A/Class EA

19 U Network Rack	
Features	**Specifications**
Key Features	a) Confirms to DIN 41494 and EIA 310D standards. b) Adjustable 19‖ mounting at front and rear. c) Fully Recessible 19‖ equipment mounting angle. d) Heights available 19U e) Depth Options – 800mm . f) 600mm wide g) Front Plain glass door. h) Rear Steel door. i) Top and bottom cover with cable entry provision. j) Ventilated top and bottom covers. k) Options – Solid Side panels or Removable Side Panels giving enhanced access. l) Load rating upto 120 kgs. m) Supply fully assembled and configured with the accessories. n) Fan Housing Unit with two fans. o) 1Nos. PDU 6 amp 5 Socket p) 2nos. Cable Manger (Finger duct) with cover
Configured Rack Contents	Frame.
	a) Front Glass Door. b) Rear Steel Door. c) Panel Mount supports (2Pairs) d) Panel Mount angles at front and rear

15 U Network Rack	
Features	**Specifications**
Key Features	a. Confirms to DIN 41494 and EIA 310D standards. b. Fully Recessible 19‖ equipment mounting angle. c. Heights available 15U d. Depth Options – 600mm . e. Width -500mm f. Front Plain glass door. g. Top and bottom cover with cable entry provision. h. Ventilated top and bottom covers. i. Load rating 60kgs. j. Supply fully assembled and configured with the accessories. k. Fan Housing Unit with two fans. l. 1Nos. PDU 6 amp 5 Socket m. 2nos. Cable Manger (Finger duct) with cover
Configured Rack Contents	Frame. • Front Glass Door. • Panel Mount supports (2Pairs)

12 U Network Rack	
Features	**Specifications**
Key Features	a. Confirms to DIN 41494 and EIA 310D standards. b. Fully Recessible 19‖ equipment mounting angle. c. Heights available 12U d. Depth Options – 600mm . e. Width -500mm f. Front Plain glass door. g. Top and bottom cover with cable entry provision. h. Ventilated top and bottom covers. i. Load rating 40kgs. j. Supply fully assembled and configured with the accessories. k. Fan Housing Unit with one fans. l. 1Nos. PDU 6 amp 5 Socket m. 1nos. Cable Manger (Finger duct) with cover
Configured Rack Contents	Frame. • Front Glass Door. • Panel Mount supports (2Pairs)

9 U Network Rack	
Features	**Specifications**
Key Features	a. Confirms to DIN 41494 and EIA 310D standards. b. Adjustable 19‖ mounting at front and rear. c. Fully Recessible 19‖ equipment mounting angle. d. Heights available 9U e. Depth Options – 600mm . f. Width -500mm g. Front Plain glass door. h. Top and bottom cover with cable entry provision. i. Ventilated top and bottom covers. j. Load rating 40kgs. k. Supply fully assembled and configured with the accessories. l. Fan Housing Unit with one fans. m. 1Nos. PDU 6 amp 5 Socket n. 1nos. Cable Manger (Finger duct) with cover
Configured Rack Contents	Frame. • Front Glass Door. • Panel Mount supports (2Pairs)

1U Horizontal Cable Manager - Finger duct with cover	
Features	**Specifications**
Dimensions (hwd / in.)	2 x 5 x 20
	Cold rolled steel with black finish
Product Warranty Period (Worldwide)	5-year warranty
Unit Dimensions (hwd / in.)	1.77 x 3.9 x 19.13
	Required mounting hardware included

Power Distribution Unit 6 amp 5 Socket	
Features	**Specifications**
	PDU 19' Octagonal socket 6 X 5 Amp with 16 Amp MCB & Indicator with 2 MTR cable and Industrial plug.

Power Distribution Unit 16 amp 5 Socket 6 Pin each Socket	
Features	**Specifications**
	PDU 19' Octagonal socket 12 X 5/16 Amp with 32 Amp MCB & Indicator with 3MTR cable and Industrial plug

Technical Specifications for Active Part

The EPC Contractor shall quote Direct OEM TAC Support for IIT Dhanbad for 5 years with 8X 5X NBD SLA, Support shall not be from any Outsourced agency for the entire tenure.

The OEM shall provide Professional services which should include High Level Design Document, Low level design document, Integration with existing Network Controller (Network Provisioning, Automation & Management Platform), Project management, and Complete implementation, Integration, Documentation and Customer training with 30 Days of onsite support & Hands-on training

The EPC Contractor should provide 16 QSFP+ SFP from day 1 to be populated in existing Core Switch, the 40 G SFP should support distance upto 10km

1. **Distribution Switch**

Hardware and Performance

1.1 Switch should be fixed 1RU based configuration to support at least 48*1G & 10G& 25G and 8*40G & 100G Gigabit Ethernet QSFP+ Ports. OR
Switch should be fixed 1RU based configuration to support at least 48*1G & 10G& 25G and 4*40G & 100G Gigabit Ethernet QSFP+ uplink ports along with support for stacking

1.2 The switch should come with 1 QSFP+ ports from day one, The 40G SFP should support distance upto 1km.

1.3 The switch should come with 3 QSFP+ ports from day one, The 40G SFP should support distance upto 10 km

1.4 The switch should come with 20 SFP28 ports from day one, The 25G SFP should support distance upto 10km.

1.5 Switch must have redundant power supplies (1+1) and fans(N+1)
1.6 Switch should have field replaceable power supplies and FAN trays
1.7 Switch should have non-blocking architecture and should support switching bandwidth to have non-blocking architecture if all the ports populated with rated bandwidth. The OEM should provide the calculation for non-blocking architecture.

Operating System

1.1 Shall support modern modular operating system designed for scalability and reliability
1.2 Shall support auto process recovery from failures i.e. during a Process failure the forwarding plane should not be impacted.
OR
Processes can be statefully restarted without taking device down.
1.3 Shall support Health monitoring and self-healing
1.4 Shall support Single Operating System binary image for all switch models proposed as part of the design.
1.5 Shall support Industry standard CLI
1.6 may provide full access to Linux Shell to create Customized scripts
1.7 May support programming in bash, python, C++,GO, Open config for programming the switch.

L2 Feature

1.1 Switch should support Ethernet standards like IEEE802.1p, IEEE802.1Q, Flow control, Jumbo frame, 802.1D, 802.1w, 802.1s, Jumbo frames, 802.3ad, private vlan
1.2 Switch should support vlans based on ports, MAC address, IP-Subnet based vlan
1.3 Switch should support LLDP

L3 Features

1.4 Switch must have routing protocols like BGPv4, OSPFv2/v3 , ISISv4, VXLAN,BFD , PIM, SSM, Policy based routing
1.5 Switch should support VRRP, Should support active-active port channeling mechanism.
1.6 Switch may support Dynamic Load Balancing Feature
1.7 Switch should support EVPN (IPv4 & IPv6) based services for Layer-3 Campus Network

Security

1.8 Switch should support IP Source guard, ARP inspection, DHCP Snooping
1.9 Switch should support real time data collection with sflow/netflow.

QoS features

1.10 Switch should support 8 queues per port
1.11 Switch should support QoS classification and policing
1.12 Switch should support priority queuing, DSCP, traffic shaping
1.13 Switch should support control plane policing to protect switch CPU from DoS attack
1.14 Switch should support IEEE 1588

Management and Troubleshooting

1.15 Switch should support telnet, ssh, https, SNMPv3, configuration rollback feature for ease of management

1.16 Switch may support API Driven configuration and support Netconf and Restconf using YANG data model. It may support automation tool like python

1.17 Switch should support port mirroring based on Inbound & outbound, mirroring based on ports, vlans.

1.18 Platform support automated hitless software upgrades.

1.19 Switches need to be provided with all software license from day-1 as per RFP specification

1.20 Switch should support real-time streaming telemetry from Day 1

2. Access Switch 48-Port

Performance and Scalability

2.1 The switch should have minimum of 48*100M&1G or better Ethernet ports and 4*25G Uplink SFP28 Ports or better in fixed Form Factor. The switch should have minimum of 48 Ethernet Ports. OR

The switch should have minimum of 48*100M&1G or better Ethernet ports and 2*25G Uplink SFP28 Ports or better in fixed Form Factor. The switch should have minimum of 48 Ethernet Ports. The switch should have dedicated stacking ports separate other than uplink ports. All the required accessories (cables, etc.) to be provided to support maximum stacking bandwidth.

2.2 The switch should come with 2 SFP28 ports from day one, The 25G SFP should support distance upto 10km.

2.3 If the solution is without stacking port, The Switch should come with additional 4 SFP28 ports from day one, The 25G SFP should support distance upto 70 Mtr.

2.4 The switch should support minimum of 30W on 36 Ports and 60W on 8 Ports Simultaneously

2.5 Switch should have field replaceable power supplies and FAN trays

2.6 Switch should have non-blocking architecture and should support switching bandwidth to have non-blocking architecture if all the ports populated with rated bandwidth. The OEM should provide the calculation for non-blocking architecture.

Operating System

2.7 Shall support modern modular operating system designed for scalability and reliability

2.8 Shall support auto process recovery from failures i.e. during a Process failure the forwarding plane should not be impacted.

OR

Processes can be statefully restarted without taking device down.

2.9 Shall support Health monitoring and self-healing

2.10 Shall support Single Operating System binary image for all switch models proposed as part of the design.

2.11 Shall support Industry standard CLI

2.12 May provide full access to Linux Shell to create Customized scripts

2.13 May support programming in bash, python, C++,GO, Openconfig for programming the stch.

L2 Feature

2.14 Switch should support Ethernet standards like IEEE802.1p, IEEE802.1Q, Flow control, Jumbo frame, 802.1D, 802.1w, 802.1s, Jumbo frames, 802.3ad, private vlan

2.15 Switch should support vlans based on ports, MAC address, IP-Subnet based vlan

2.16 Switch should support LLDP

2.17 Switch should support IPv4 and IPv6. The Switch should be able to discover (on both IPv4 & IPv6 Network) the neighboring device giving the details about the platform, IP Address, Link connected through etc., thus helping in troubleshooting connectivity problems.

2.18 Switch should support VxLAN based segmentation

Layer-3 Features

2.19 Switch must have routing protocols like BGPv4, OSPFv2/v3 , ISISv4, VXLAN,BFD , PIM, SSM, Policy based routing

2.20 Switch should support VRRP, Should support active-active port channeling mechanism.

2.21 Switch May support Dynamic Load Balancing Feature

2.22 Switch should support EVPN (IPv4 & IPv6) based services for Layer-3 Campus Network

Network security features

2.23 The switch should support IEEE 802.1x providing user authentication, authorization and CoA.

2.24 The switch should support SSHv2, SNMPv3, TACACS+ and RADIUS

2.25 The switch should support MAC address notification to allow administrators to be notified of users added to or removed from the network.

2.26 Switch should support Ingress ACL Scale up to 4k or better.

2.27 Switch should support real time data collection with sflow/netflow.

Quality of Service (QoS) & Control

2.28 The switch should support 8 egress queues per port to enable differentiated management

2.29 The switch should support Standard 802.1p CoS field classification and Differentiated services code point (DSCP) field classification

2.30 The switch should support Rate Limiting function to guarantee bandwidth

2.31 Switch should support In-Band telemetery

2.32 Switch should support IEEE 1588

Operation and Management

2.33 Switch should have dedicated management port and USB ports to upload configuration files and image

2.34 Management and Troubleshooting

2.35 Switch should support telnet, ssh, https, SNMPv3, IPFIX, configuration rollback feature for ease of management

2.36 Switch may support API Driven configuration and support Netconf and Restconf using YANG data model. It may support automation tool like python.

2.37 Switch should support port mirroring based on Inbound & outbound, mirroring based on ports, vlans.

2.38 Platform support automated hitless software upgrades

2.39 OR

Mechanism to upgrade and downgrade the software image by segregating the Control plane and Data Plane update to reduce overall downtime The Management platform should notify if any update is available for the switches.

2.40 Switches need to be provided with all software license from day-1 as per RFP specification

2.41 Switch should support real-time streaming telemetry from Day 1

3. Access Switch 24-Port

Performance and Scalability

3.1 The switch should have minimum of 24*100M&1G Ethernet Ports or better and 4*25G or better Uplink Ports in fixed Form Factor

OR

The switch should have minimum of 24*100M&1G Ethernet Ports or better and 2*25G or better Uplink Ports in fixed Form Factor. The switch should have dedicated stacking ports other than uplink ports. All the required accessories (cables, etc.) to be provided to support maximum stacking bandwidth.

3.2 Switch should have non-blocking architecture and should support switching bandwidth to have non-blocking architecture if all the ports populated with rated bandwidth. The OEM should provide the calculation for non-blocking architecture.

3.3 The switch should come with 2 SFP28 ports from day one, The 25G SFP should support distance upto 10km.

3.4 If the solution is without stacking port, The Switch should come with additional 4 SFP28 ports from day one, The 25G SFP should support distance upto 70 Mtr.

3.5 The switch should support minimum of 30W on 16 Ports and 60W on 8 Ports simultaneously.

3.6 Switch should have field replaceable power supplies and FAN trays

Operating System

3.7 Shall support modern modular operating system designed for scalability and reliability

3.8 Shall support auto process recovery from failures i.e. during a Process failure the forwarding plane should not be impacted.

OR

Processes can be statefully restarted without taking device down.

3.9 Shall support Health monitoring and self-healing

3.10 Shall support Single Operating System binary image for all switch models proposed as part of the design.

3.11 Shall support Industry standard CLI

3.12 may provide full access to Linux Shell to create Customized scripts

3.13 May support programming in bash, python, C++,GO, Openconfig for programming the switch.

L2 Feature

3.14 Switch should support Ethernet standards like IEEE802.1p, IEEE802.1Q, Flow control, Jumbo frame, 802.1D, 802.1w, 802.1s, 802.3ad, private vlan

3.15 Switch should support vlans based on ports, MAC address, IP-Subnet based vlan

3.16 Switch should support LLDP

3.17 Switch should support IPv4 and IPv6. The Switch should be able to discover (on both IPv4 & IPv6 Network) the neighboring device giving the details about the platform, IP Address, Link connected through etc, thus helping in troubleshooting connectivity problems.

3.18 Switch should support VxLAN based segmentation

Layer-3 Features

3.19 Switch must have routing protocols like BGPv4, OSPFv2/v3 , ISISv4, VXLAN,BFD , PIM, SSM, Policy based routing

3.20 Switch should support VRRP, Should support active-active port channeling mechanism.

3.21 Switch may support Dynamic Load Balancing Feature

3.22 Switch should support EVPN (IPv4 & IPv6) based services for Layer-3 Campus Network

Network security features

3.23 The switch should support IEEE 802.1x providing user authentication, authorization and CoA.

3.24 The switch should support SSHv2, SNMPv3, TACACS+ and RADIUS

3.25 The switch should support MAC address notification to allow administrators to be notified of users added to or removed from the network.

3.26 Switch should support Ingress ACL Scale of 4k or better.

3.27 Switch should support real time data collection with sflow/netflow.

Quality of Service (QoS) & Control

3.28 The switch should support 8 egress queues per port to enable differentiated management

3.29 The switch should support Standard 802.1p CoS field classification and Differentiated services code point (DSCP) field classification

3.30 The switch should support Rate Limiting function to guarantee bandwidth

3.31 Switch should support In-Band telemetery.

3.32 Switch should support IEEE 1588

Operation and Management

3.33 Switch should have dedicated management port and USB ports to upload configuration files and image

3.34 Management and Troubleshooting

3.35 Switch should support telnet, ssh, https, SNMPv3, IPFIX, configuration rollback feature for ease of management

3.36 Switch may support API Driven configuration and support Netconf and Restconf using YANG data model. It may support automation tool like python

3.37 Switch should support port mirroring based on Inbound & outbound, mirroring based on ports, vlans.

3.38 Platform support automated hitless software upgrades

OR

Mechanism to upgrade and downgrade the software image by segregating the Control plane and Data Plane update to reduce overall downtime The Management platform should notify if any update is available for the switches.

3.39 Switches need to be provided with all software license from day-1 as per RFP specification

3.40 Switch should support real-time streaming telemetry from Day 1.

Technical Specification for WiFi Components

Technical Specifications

1. **Solution Architecture**
   - 1.1 The System Architecture enlists the expectation from the "Total Solution‖ that are common to Wi-Fi services including, but not limited to, Access, WIDS and WIPS.
   - 1.2 The proposed Wi-Fi controller(s) can be software based or Hardware based solution. Software controller should be compatible to run as a virtual image on various Hypervisors like VMWARE/ KVM/Virtual-box etc.
   - 1.3 Solution must support an independent (No dependency on hardware controller) intelligent edge architecture for Wi-Fi access. In case of non-reachability of the controller, all WLAN services should be delivered at the edge.
   - 1.4 All Wi-Fi, WIDS, WIPS & RRM (Radio resource management) services should be functional if the link between AP/Sensor and its management controller goes down. It must also be possible to on-board new clients in such a scenario.
   - 1.5 The solution should support 100% redundancy for primary controller i.e. N: N for hardware as well as all Licenses.
   - 1.6 Vendor should provide necessary hardware and VM software licenses for hosting the on-prem Wi-Fi controllers.
   - 1.7 The solution (controller and Wi-Fi AP) device should support dual stack for IPV4 and IPV6.
   - 1.8 The solution must facilitate Control and Provisioning of Wireless Access Point devices and ensure data encryption between access point devices and controllers across remote WAN/LAN links
   - 1.9 The solution should support deployment of set policies across the WiFi AP devices placed on different network segments over LAN and WAN.
   - 1.10 Wi-Fi controller should be integrated with existing Wi-Fi management solution to provide unified Management Dashboard for the entire IIT Dhanbad Wi-Fi Campus Infrastructure.
2. **Management Controller**
   - 2.1 The Controller must provide centralized Wi-Fi and WIPS management system
   - 2.2 The Controller should have the capability to control minimum 500 numbers of AP &
   - 2.3 Sensor devices. Quote should include all required licenses to support 500 Access point and sensor (IPS) devices along with HA.
   - 2.4 The controller must have AP Group based policy management and administration.
   - 2.5 The Controller should have role based admin rights to manage the controller.
   - 2.6 The controller should support open API's for integration with 3rd party configuration management, inventory management, performance management, process automation, reporting, WLAN monitoring tools etc.

2.7 The controller should enable application visibility and control. It should display list of applications with their data usage for a specific SSID.

2.8 The Solution should allow blocking traffic based on IP address, port, URL, hostname, application etc. and QoS (for example: bandwidth restriction for the SSID, QoS tagging of special traffic like Voice) at the edge (AP).

2.9 The solution should locate wireless devices (APs and Clients) on floor maps

2.10 The solution must provide location tracking of a DoS attacker

2.11 Controller should support SNMP v1, v2c, v3

2.12 The controller should provide remote packet capture for troubleshooting

2.13 The system should support remote packet captures on AP radio and Ethernet ports without disrupting the client connectivity of any of the APs.

2.14 The solution should maintain controller user action logs which should include all activities performed by the user like login, any configuration changes made on the system, device deletion, device authorization, log out etc., for at least 90 days.

2.15 The solution should enable wireless client association analytics logs which should record client MAC address, AP connected to, data transfer, data rate, session duration, content - domain (http, https, IP address), for at least 30 days

2.16 The solution must allow VLAN segmentation at the edge or tunneling to WLAN controller/Switch for L3 roaming

2.17 Time Schedules - the solution must allow configuration of time schedules when WLAN is /isn't available (For example: SSIDs can be active from 9 am to 5 pm and then automatically disabled)

2.18 Solution should support External Splash Page

2.19 The solution should support RADIUS and OTP-based authentication mechanisms (SMS gateway to be provided by Customer in case of OTP based authentication) for Guest users

2.20 Solution should support ‒Walled Garden‖ or equivalent feature for Guest Network

2.21 Solution should support URL redirection

3. Management and Monitoring

3.1 The solution must provide hierarchical alerts wherein sub-events are correlated under parent

3.2 incident alert thereby enabling event correlation.

3.3 The solution should have all locations consolidated dashboard and location-specific dashboard as well.

3.4 The solution must send notifications based on location and alarm type

3.5 Client Fingerprinting - The solution should detect and identify all types of Wi-Fi enabled client devices.

3.6 The solution must provide a device summary (for APs, and clients) report per location

3.7 The solution must allow automatic schedules for report generation and distribution of reports to Specific users via email

3.8 The solution should provide alerts for impact on WLAN performance such as:

3.8.1 High client associations
3.8.2 Excessive frame re-transmissions
3.8.3 Low average data rate for a client
3.8.4 Drop in Signal of an access point
3.8.5 Inadequate coverage depicted by excessive probe requests / responses

3.9 The controller and Wi-Fi AP devices management should support command line (ssh / telnet) and as well as web based (https) administration

3.10 The solution shall support Location tracking of any particular client and AP

3.11 The solution should support automated root cause analysis of WiFi issues such as low RSSI, low data rate, Authentication related issue.

3.12 The solution should highlight client connection failures during association, authentication and network entry. It should also identify the cause of failure.

4. Software & System Management

4.1 The system should support manual and scheduled automatic system backup.

4.2 The controller and AP can be on different software versions.

4.3 The controller should be able to rollback all APs/group of APs to previous version.

4.4 The Controller Upgrade should not disrupt Wi-Fi and WIPS services.

4.5 The AP Upgrade to controller version should be flexible and be scheduled on per AP/AP group or site basis as required.

4.6 For management and monitoring operations, the controller must provide a web interface, command-line interface, and APIs.

4.7 The Solution shall support Hitless AP upgrade feature

5. WIPS

5.1 The Threat detection in the solution must be based on behavioral model and should be independent on signatures and threshold tuning (resilience against Zero-day attacks)

5.2 The solution must auto-classify APs precisely in different categories as managed / authorized (ie. managed device connected to the networks), external (i.e. un-managed APs not connected to the networks, e.g. neighbors), and rogue APs (un-managed AP connected to the networks)

5.3 The solution must have the capability of auto classifying Wi-Fi clients as authorized (managed clients connecting to the network), guest, rogue

5.4 (unmanaged client attempting connection to the network) or external (unmanaged

5.5 not connecting to the network eg. neighbor), in addition to manual classification

5.6 The solution must be able to detect and automatically prevent all types of Rogue (unauthorized APs connected to the network) APs, such as:

5.6.1 APs such as Bridge and NAT
5.6.2 MAC-adjacent Open/Encrypted Wi-Fi routers
5.6.3 Non-MAC-adjacent OPEN Wi-Fi routers
5.6.4 Virtual APs on network connected laptops (e.g., Connectivity software on Windows 7/10)
5.6.5 Non-MAC adjacent APs having MAC ACLs

5.7 The solution must detect mis-configured authorized APs and automatically prevent them.

5.8 The solution must detect Honey Pot attacks including its advanced variants such as Multiport

5.9 attack. It should be able to prevent the authorized client from connecting to a honeypot AP.

5.10 The WIPS solution should NOT affect the operation of an external (i.e. neighbors) or a man-aged access point while preventing a rogue AP on the same channel.

5.11 A single device should simultaneously block multiple threats on multiple channels

5.12 The solution must be able to detect wireless Denial of Service (DoS) attacks

5.13 The solution must provide forensic data aggregated for major threat vectors like Rogue AP, Honeypot AP, Mis-Configured AP, DoS, Unauthorized Association, Ad Hoc Networks, Bridging/ICS Client, Mis-Association.

6. Guest Management

6.1 The solution should include web based guest user creation by front office users

6.2 The solution should support self-registration by guest users and admin users can approve the registration.

6.3 The solution should allow blocking of guest user for specific time frame between two association sessions.

6.4 The solution should support restricted wireless connectivity (e.g., Internet only) to guest clients using portal page.

6.5 The solution should support portal page that can be used to display the terms and conditions of accessing the guest network as well as any other information as needed.

6.6 The solution should support for Login Timeout, Blackout Time, Redirect to URL and walled garden settings.

6.7 The solution should support multiple custom portals - separate portals can be configured for each SSID.

6.8 The solution should support authentication using social plugins - guest users can access WiFi using their social media account credentials.

6.9 The solution should support authentication using private guest book account.

6.10 The solution should support creating a custom portal for click-through access, portal page can also be created to ask user to fill some basic information like name, age, email to provide access to WiFi.

6.11 The solution should support SMS OTP-based authentication support.

6.12 Dashboard and Analytics

6.13 The solution should support a dashboard that provides daily, weekly and monthly overview of the statistics related to demographic data about visitors using guest Wi-Fi, demographic data of visitors using guest Wi-Fi, dwell time.

6.14 The solution should display graphs representing the visitor distribution by days and locations, and visitor dwell time by days and locations.

6.15 The solution should provide graphical visualization of data received, transmitted, and total data exchange by days and location.

- **AP – Features**

6.16 AP should support IEEE Wi-Fi 802.11ax/ac/a/n/b/g

6.17 Wi-Fi AP devices and the solution must support the following protocols: IEEE 802.11a/b/g, IEEE 802.11n, IEEE 802.11ac (WAVE 2), IEEE 802.11h, IEEE 802.11d, 802.11i, 802.11 r/k/v

6.18 The AP must support the following authentication methods: WPA3, WPA2-AES, PSK, authentication and AES encryption and 802.1x/EAP and unauthenticated (open) mode.

6.19 Wi-Fi APs and the system must support Fast Handoff between APs.

6.20 Wi-Fi APs and the system should have ability to set SSIDs as bridge or NAT.

6.21 Wi-Fi APs and the system should have support for 802.1Q VLANs.

6.22 Supply should include ceiling/wall mountable units equal to the no. of APs quoted.

6.23 AP should support client emulation for on-demand or scheduled remote testing without disturbing the connected clients.

6.24 APs shall be compliant with all applicable national regulations.

6.25 AP must support SSH & SNMP protocol for local or remote access to device through CLI or GUI.

6.26 At least 8 SSIDs shall be supported in each of the 2.4GHz and 5GHz bands, with the ability to map each SSID to a separate VLAN.

6.27 The SSID profiles/configurations of 2.4GHz and 5GHz radios should be independent.

6.28 APs shall support Hotspot Release 1.0 and 2.0.

6.29 The device must be capable of providing Wi-Fi access with 24/7 wireless intrusion prevention (WIPS) in a single device both operating simultaneously.

6.30 The device should be remotely upgradeable from the controller, so that new features / upgrades can be added.

6.31 AP must have WPC Equipment Type Approval.

6.32 AP must be WFA certified.

6.33 Wi-Fi AP device should support dual stack for IPV4 and IPV6.

6.34 AP should be able to tunnel traffic to remote location without the need of controller using protocols like EoGRE/L2TP/VxLAN

6.35 The AP must be capable of receiving IP address via DHCP for IPv4/IPv6 and SLAAC for IPv6.

6.36 AP shall support up to 800 Mbps for 2.4 GHz radio and 1.7 Gbps on 5GHz radio –For India, the following frequencies must be supported: 2.4-2.4835 GHz, 5.15-5.25 GHz; (UNII-1), 5.25-5.35 GHz, 5.47-5.6 GHz, 5.650-5.725 GHz (UNII-2), 5.725-5.85 GHz (UNII-3)"

6.37 AP Should support 2 X 5G Ethernet Ports with power redundancy

6.38 AP must support link aggregation (LACP) between the Ethernet ports.

6.39 AP must support minimum 8X8 antenna configuration in 5GHz and 4x4 configuration in 2.4GHz band.
6.40 AP must support 12 spatial streams.
6.41 AP must support for UL/DL OFDMA
6.42 AP must support for UL/DL MU-MIMO
6.43 AP must support simultaneous 802.11ax operation on both 2.4GHz and 5GHz radios.
6.44 AP shall support minimum 1.4 Gbps on 2.4 GHz radio and 4.8 Gbps on 5GHz radio.
6.45 AP shall support 20/40/80 MHz channel width in 5GHz band.
6.46 AP shall support 20/40 MHz channel width in 2.4GHz band.
6.47 Must support 802.11 dynamic frequency selection (DFS).
6.48 The AP shall support operating temperature of 0° C to +40° C.
6.49 Rx sensitivity of AP shall be minimum -95 dBm or better at MCS0 and 20MHz channel bandwidth.
6.50 AP must able to handle RF interference from other WiFi and non-WiFi sources and automatically assign channel and power so as to deliver high performance and reliable communication.
6.51 AP must support continuous scanning of all 2.4 GHz and 5 GHz channels to assist in RF optimization and client handling without impairing the user experience.
6.52 AP must support cellular interference mitigation (picocells, femtocells, microcells).
6.53 The AP should support 802.1q VLAN tagging.
6.54 AP must support AP load-balance between 2.4GHz and 5GHz band.
6.55 The AP must support at least 8 BSSID per Radio, with the ability to map each SSID to a separate VLAN.
6.56 Must support SSH for local or remote access to device through CLI or GUI.
6.57 AP shall support self-healing wireless mesh networking.
6.58 Must be able to operate with both 802.3bt and 802.3at to power up the AP.

7. License, Warranty and Support

7.1 The Total solution should come with all required feature licenses from first day of installation
7.2 The Total solution should have 5 years hardware/Software/Licenses warranty for AP's, controller, Adapters and every item supplied as a part of solution
7.3 The Total solution should have technical support for Hardware, Software, Software upgrades, all license cost from the OEM for first 5 years.
7.4 The Total solution should come with the latest and updated version available at no extra cost
7.5 Any new release of firmware and software must be updated regularly within 5 years warranty term.
7.6 Should Provide TAC support direct from OEM not from outsourced TAC

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

SPECIAL CONDITIONS OF CONTRACT

1.0 SCOPE :

The scope of all items in ICT systems (OFC Backbone with active and passive components) is SITC – Supply, Installation, Testing and Commissioning.

The agency that is bidding for the total project shall be called as ―ICT System Integrator‖.

All and entire responsibility towards the successful execution of the ICT Systems of the project shall remain with the ICT System Integrator.

The passive components of networking – fiber optics cabling system and their components, options and accessories shall be from a single manufacturer / make / brand.

The passive networking system consisting of fiber optics cabling system shall be duly certified with test reports submitted by the manufacturer or their authorized partners for a period of 25 years minimum.

At the time of taking over of installation, for all equipment that are covered in SITC, the integrator shall transfer all warranties and guaranties from OEM – original equipment manufacturer – to the client.

The System Integrator is advised to provide technical datasheets and specification sheets for approval for all items prior to initiating any supply. Any items having deviations, in absence of specific approval from Engineer-in-Charge shall be returned whether installed or uninstalled at the risk, liability and expense of the System Integrator.

The ICT System Integrator is advised to specifically use items only from the make list and provide information on compliance of performance specifications.

Make of components required to be used by ICT System Integrator to complete the installation, if not mentioned anywhere, shall be required to be GET APPROVED from Engineer-in-Charge in writing before installation.

a. after the award of the Contract, the Contractor shall furnish for the approval of the WAPCOS, two sets of detailed shop drawings of all equipment and materials including Equipment installation drawings giving complete details of the entire equipment, ICT networking System drawings for the ICT networking showing cable sizes, equipment capacities, control components, control wiring etc. required to complete the project as per Specifications.

If the WAPCOS makes any amendments in the above drawings, the Contractor shall supply two fresh setsof drawings with the amendments duly incorporated, along with the drawings on which corrections were made. After final approval has been obtained from the WAPCOS, the Contractor shall submit a

further six sets of shop drawings for the exclusive use of and retention by the WAPCOS. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawings for the particular material or equipment.

b. The shop drawings shall be submitted for approval sufficiently in advance of planned delivery and installation of any material, to allow WAPCOS / Client ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved CPM charts.

c. Samples, drawings, specifications, catalogues, pamphlets, and other documents submitted for approval shall be in quadruplicate, each item in each set shall be properly labeled, indicating the specific service for which material or equipment is to be used, giving reference to the governing section and clause number of Specifications; clearly identifying in ink the items and the operating characteristics data of a general nature shall not be accepted.

d. Approval rendered on shop drawings shall not be considered as a guarantee of measurements or of building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail nor does it in any way relieve the contractor from his responsibility or necessity of furnishing material or performing work as required thereof, shall be prepared by the Contractor at his own cost and approved by the WAPCOS.

e. Where the work of the Contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make satisfactory adjustments. If so directed by the WAPCOS, the contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

i. All Passive Components should be from the same OEM.
ii. The OEM should be ISO 9001:2015 & QS: 9000 Certified. In the changing needs of the global resources if the company has environmental management systems in place like ISO 14001 accreditation the same shall be added advantage.
iii. The cabling should be certified to have application support warranty for next 25 years.

Note : Full copper channel link 4 connector test report with minimum 3 dB NEXT headroom. This is applicable for site test report after the installation of cables.

PART E-6

UPS SYSTEM

GENERAL COMMERCIAL & TECHNICAL CONDITIONS:

1.0 All the relevant electrical works shall be carried out as per CPWD General specification for Electrical Works, Part-I (Internal) 2013 & Part-II (External) 1994, amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable, amended up to date.

2.0 The contractor is advised to visit the site of work to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

3.0 **Rates:**

The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including works contract tax, if any), duties, and levies etc. and all charges for items contingent to the work, such as packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials (including those supplied by the department, if any) for the work at site etc

4.0 **Mobilization Advance:**

No mobilization advance shall be paid for the work, unless otherwise stipulated in tender papers for any individual works/ composite work.

5.0 **Completeness of Tender:**

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

6.0 Works to be arranged by the department:

Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department:

(i) Supply of materials to the contractor if stipulated in the tender documents.

7.0 Works to be done by the contractor:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

(i) Hanging support for equipments and components where required, including nut-bolts.

(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubical switchboard etc. Damages to

finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.

(v) Testing and commissioning of completed installation.

(vi) Storage space for all equipments, components and materials for the work

8.0 **Storage and Custody of Materials:**

The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra payment will be made on this account.

The main contractor shall arrange for proper storage of the electrical equipment at site and that double lock system shall be arranged for the equipments after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

9.0 **Electric Power Supply and Water Supply:**

Power and water supply will be arranged by the contractor at the site for installation purpose.

However, for final testing purpose after complete installation of the electrical items, electricity supply will be made available free of cost to the contractor. Contractor will take due care to ensure safety of electrical installation during execution of work.

10.0 **Tools for handling and Erecting:**

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

11.0 **Co-ordination with other agencies:**

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

12. **Care of buildings:**

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

13.0 Structural Alterations to Buildings:

(i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-n-charge.

(ii) Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these required modifications, or fresh provisions are required to be made, such contingent works shall be carried out by the contract at his cost.

(iii) All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

14.0 **Addition to an installation:**

Any addition, temporary or permanent, to the existing installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

15.0 Drawings:

(i) The work shall be carried out in accordance with the drawings and the tender documents and also in accordance with modification thereto from time to time as approved by the Engineer-in-charge.

(ii) All wiring diagrams shall indicate the main switch board, the distribution boards (with circuit numbers controlled by them), the runs of various mains and sub mains and the position of all points with their controls.

(iii) All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which they are electrically connected.

(iv) After award of the work, the firm will be required to submit the drawings for the proposed work including layout plan, conduit routes etc. Work will be carried out as per the approved drawings.

16.0 **Conformity to IE act, IE Rules, and standards:**

16.1. All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise). List of rules of particular importance to electrical installations under these General Specifications is given in Appendix C for reference.

17.0 **General requirements of components:**

17.1. **Quality of material:** All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

18.0 **Inspection of materials and equipments:**

18.1. Materials and equipments to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:

(i) Inspection of materials / equipments to be witnessed at the Manufacturer‘s premises in accordance with relevant BIS /Agreement Inspection Procedure.

(ii) To receive materials at site with Manufacturer‘s Test Certificate(s)

(iii) To inspect materials at the authorized dealer‘s go downs to ensure delivery of genuine materials at site.

(iv) To receive materials after physical inspection at site.

18.2. Adequate care to ensure that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall ensure that:

(i) Material will be ordered & delivered at site only with the prior approval of the department to ensure timely delivery.

(ii) As and when the order is placed for the fittings/ fixtures, cables, switchgears, poles, rising main, other main items etc, its copy shall be endorsed to the WAPCOS Engineer-in-charge.

(iii) The firm will be required to procure material directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the contractor before installation at site to the Engineer in Charge or his Authorized representative & Client.

(iv) Inspection at factory or at godown of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the fittings shall have to provided duly signed by the manufacturer‘s officer not below the rank of Regional Manager.

(v) Delivery of material shall be taken up only with the consent of department, after clearance of the material.

(vi) Department shall reserve the right to waive inspection in lieu of suitable test certificate, at its discretion.

18.3. Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.

19.0 **Ratings of components:**

19.1. All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.

19.2. All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

20.0 **Conformity to standards:**

20.1. All components shall confirm to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.

20.2. Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

21.0 **Interchangeability:**

Similar parts of all switches, lamp holders, distribution fuse boards, Switch gears, ceiling roses, brackets, pendants, fans and all other fittings of the same type shall be interchangeable in each installation.

22.0 **Workmanship:**

22.1. Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall confirm to sound engineering practice.

22.2. Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

22.3. Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.

22.4. Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.

23.0 **Testing:**

All testes prescribed in this General Specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

24.0 **Commissioning on completion:**

After the work is completed, it shall be ensured that the installation is tested and commissioned.

25.0 **Completion plan and completion certificate:**

25.1. For all works, completion certificate & drawing after completion of work shall be submitted to the Engineer-in-charge. O&M manuals for equipments shall also be submitted to the department.

25.2. Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.

(i) General layout of all equipments.

(ii) Cable routes.

26.0 Guarantee

1. The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee of material from the manufacturer to the department. AMC of lifts during the defect liability period will be in the contractor scope, nothing extra payable for AMC during defect liability period.
2. Sufficient trained and experienced staff shall be made available to meet any exigency of work during the **guarantee period of three years** from the date of handing over of the installation.

The maintenance, routine as well as preventive for three years from the date of handing over the installation as per manufacturer‘s recommendation shall be carried out and the record of the same shall have to be maintained.

PART-1: GENERAL

1.1 SCOPE

The scope of the work includes **Supply, installation, testing, integration & commissioning of True On-line, double conversion, IGBT Technology , Fully Microprocessor controlled UPS systems with inbuilt isolation galvanic transformer working N + 1 "Parallel redundant configuration**.

Rack mounted UPS shall be provided for all Network Racks.

The specification shall include design, manufacture, fabrication, assembly, proper packing for transportation delivery at site, unloading, storage, erection, integration with related equipments, and putting all UPS Systems together with all accessories and auxiliaries as specified hereinafter in a fully operational condition acceptable to the owner. The offered system shall be fully in compliance with the requirements stated herein.

The Contractor shall be responsible for engineering and providing all materials, equipments and services specified or otherwise, which are required to fulfil the intent of ensuring operability, maintainability, completeness and reliability of the total work covered under this specification within his quoted price.

The design manufacture, inspection, testing and installation of the UPS System covered under this specification shall conform to the latest international standards such as:

EN 62040-1 - General Safety Regulations.

EN 62040-2 - EMC Regulations

Central UPS power shall be planned to support critical services such as Security systems, Building automation system, Fire detection & alarm system, Public Address System, Data networking, workstation computers, printers. It is proposed to provide centralized modular UPS in N+1 configuratio to support the above services.

The UPS shall be planned for Emergency Lighting for various buildings are as follows:-

S. No.	Building Description	Minimum Capacity of UPS
1)	Centenary building	80KVA(FOR AUDITORIUM) 70 KVA(FOR LECTURE HALL)

The tenderer shall verify these minimum ratings and Quantities. The higher ratings required as per detailed design shall be provided. Each UPS shall have 90-minute battery backup. The following parameter shall be considered during UPS and Battery Backup design.

1.2 SCOPE OF SUPPLY:

a) Each UPS module must have the following built in parts / features:

- IGBT PWM Rectifier based input charger (float cum equalizing)
- IGBT /technology based Inverter.
- Automatic Bi-directional Static switch
- Inbuilt Manual Bypass Switch.
- Galvanic inverter output isolation transformer (inbuilt / External).
- Fully Microprocessor Controlled Circuitry.
- Input phase reversal protection (The system should run in mains operation in spite of phase sequence reversal) & same should be shown is SLD.

- Provision for separate Input for rectifier and for Bypass
- Event Monitoring & Diagnostics: Last 100 events with exact date & time should be monitored from the front LCD panel of the UPS & upto 900 events from UPS system memory using Laptop.
- The input voltage window must be from 320 V to 480 V

b. Rack Mounted External Battery Bank Sealed Maintenance Free (12V SMF,VRLA) Lead Acid Battery Bank suitable for 15 min backup with each module & on full load. Battery Sizing needs to be submitted with Proposal **& minimum VAH required with each UPS.**

1.3 REFERENCES

A. General:
The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced publications shall be the latest date as of the date of the Contract Documents, unless otherwise specified.

B. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
ANSI/IEEE C62.41, "Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits" (copyrighted by IEEE, ANSI approved).

C. International Organization for Standardization (ISO):
ISO 9001, "Quality Management Systems - Requirements."
D. European UPS Standards:
CEI EN 62040-1: 2008
CEI EN 62040-2: 2006
CEI EN 62040-3: 2012

Following the provisions of the Directives:
2004/108/CE
2006/95/CE

1.4 OPERATING PRINCIPLES

A. System Typology:
Each single-UPS unit shall operate in double-conversion mode (also called on-line mode); it shall be a VFI-type UPS (as per standard IEC 62040-2), made up of the following components, de-scribed in detail in this specification.

B. **Normal operation** (normal AC source available):
The rectifier supplies the inverter with DC current while the charger simultaneously float charges the battery. The load is continuously supplied with dependable electrical power by the inverter.

C. **Operation on battery power** (normal AC source not available or outside tolerances):

Upon failure or excessive deterioration of the normal AC source, the inverter shall continue to supply the load from battery power without interruption or disturbance, within the limits imposed by the specified battery backup time.

D. **Battery recharge** (normal AC source restored):
When the normal AC source is restored, the rectifier shall again power the inverter, without interruption or disturbance to the load, while the charger automatically recharges the battery. The UPS system shall ensure equal sharing of the total load between the various parallel-connected units.

E. Parallel operation and redundancy

1. With redundancy:

a. The units shall operate in parallel with redundancy, with the load shared equally between the units.

b. Redundancy shall be of the "n+1" (or n+2) type, i.e. "1" (or 2) units shall be redundant in the total of n units. If a major fault occurs on a unit, it shall automatically disconnect.

c. If the remaining unit(s) are sufficient to supply the load, it/they shall remain in operation.

d. If the total available power is insufficient, the load shall be automatically transferred, with-out interruption, to the bypass AC source, if it is within tolerances.

F. Transfer to bypass AC source:

1. In the event of an overload exceeding system capabilities (short-circuits, heavy inrush currents, etc.) the load shall be automatically transferred, instantaneously and without interruption, to the bypass AC source, on the condition that bypass power is available and within tolerances.
2. To that end, synchronization of each inverter in phase and frequency with the bypass source shall be automatic. Transfer of the load back to the UPS-unit outputs shall be automatic or manual. During transfer, the load shall not suffer an outage or disturbance in the supply of power.
3. To ensure transfer in complete safety, the system shall simultaneously control the static switches.
4. On request, the UPS system may automatically transfer the load with a micro interruption if a major fault occurs on the UPS system and if synchronization with the bypass source has not been established.

G. UPS maintenance:

1. For maintenance purposes, all electronic components shall be accessible from the front and from the sides of the UPS.
2. In addition, a built-in manually-operated mechanical bypass system shall be:

a. Installed in each UPS unit; **(for a system with 2 or more UPS units with active redundancy)**

b. Possibility to install separately in an external bypass enclosure or cubicle **(other cases)**.

3. For personnel safety during servicing or testing, this system shall be designed to isolate the UPS units while continuing to supply power to the load from the bypass AC source. Transfer to the manual bypass mode and back shall be possible without interruption to the load.
4. The UPS shall also include a device making it possible to isolate the rectifiers and the chargers from the normal AC source.

PART 2 - SYSTEM DESCRIPTION

2.1 Technical Characteristics

A. UPS Design Requirements:

1. **Output Power Continuous Rating:** The continuous output power rating of the UPS shall be 30 kVA at PF=0.9 lagging power factor.

2. **Rectifier Input Voltage:** 415 volts AC, -20 percent +15 percent, three-phase, 5 wires 3Ph +N + PE.
400 volts standard.

3. **Bypass line Input Voltage:** 415 volts AC, -20 percent +15 percent, three-phase, 5 wires 3Ph +N + PE.
400 volts standard

4. **Output Voltage:** 415 volts AC, three-phase, 3 wires plus Neutral plus ground.
400 volts standard.

5. **Battery Autonomy:** Each UPS shall be capable of operating at 100% load for 30 minutes at 0.9 PF output at a temperature of 25 °C on battery power.

6. **Battery Type:** Valve regulated sealed lead acid (VRLA).

B. AC Input Characteristics:

1. **Voltage (Rectifier and Bypass line):415** volts AC, -20 percent +15 percent, three-phase, 5 wires 3Ph +N + PE.

2. **Frequency:** 50 hertz, ±10%.

3. **Power Factor:** Greater than 0.99 lagging.

4. **Total Harmonic Distortion:** Less than 3% at 100% load.

C. AC Output Characteristics:

Voltage: 380/400/415V AC (adjustable from front panel ± 10%, 15%, 20%, 25%, etc.), ±1 percent steady state variation phase-to-phase voltage volts AC, three-phase, 5 wires.

- **Frequency:** 50 hertz, ±2 percent 50/60 (adjustable from front panel ± 1%, 2%, 3%, ..., 10% etc) with ±0,1% Inverter Synch with Mains; 50 hertz, ±0.01 percent when free running.

- **Voltage Stability:** ±1.0 percent for balanced load, ±2.0 percent for unbalanced load.

- **Voltage Distortion:** Maximum 2 percent total (THD) linear loads, maximum 5 percent total (THD) not linear loads.

- **Power Factor:** 0.9 lag to unity at the rated volt amperes (VA).

- **Inverter Overload Capability:** 110 percent of rated load for 30 minutes, 150 percent of rated load **for 1 min.**

D. Battery:

- Number of Cell: as per OEM design
- **Battery Voltage:**
  +/-320 volts DC minimum before cut-off;
  +/-360 volts volts DC nominal;
  +/-404 volts floating voltage at 25°C.

- The battery charger is equipped with a temperature probe to enable temperature compensated charging.

E. Environmental Requirements:

1. The UPS shall operate under the following environmental conditions:

a. Temperature:

1) UPS Module Operating: 0 °C to 40 °C.
2) Non-Operating (Storage): -10 °C to 60 °C.

b. **Relative Humidity (Operating and Storage):** 0 percent to 95 percent non-condensing.

c. **Barometric Pressure:** Up to 1000 meters above sea level.

d. Audible Noise: 60 dBA at 1 m.

2.2 MODES OF OPERATION

A. UPS module shall be designed to operate as a double conversion, on-line reverse transfer system in the following modes.

Normal: The inverter shall continuously supply power to the critical load. The PFC rectifier shall derive power from the utility AC source and supply DC power to the inverter while simultaneously float charging the battery.

Emergency: Upon failure of the utility AC power source, the critical load shall be supplied by the inverter, which, without any interruption, shall obtain its power from the battery.

Recharge: Upon restoration of the utility AC power source (prior to complete battery discharge), the PFC rectifier shall power the inverter and simultaneously recharge the battery.

Bypass Mode: The static bypass transfer switch shall be used to transfer the load to the bypass without interruption to the critical power load. This shall be accomplished by turning the inverter off. Automatic re-transfer or forward transfer of the load shall be accomplished by turning the inverter on.

2.3 COMPONENT DESCRIPTION

A. **PFC Rectifier and Battery Charger:** Incoming AC power shall be converted to a regulated DC output voltage by an IGBT (insulated gate bipolar transistor) power factor correction (PFC) rectifier. The PFC rectifier shall provide high quality DC power to charge the batteries and power the inverter and shall have the following characteristics:

Input Power Factor Correction (PFC): The PFC rectifier shall be power factor corrected so as to maintain an input power factor of 0.99 lagging to unity at 75 percent or above load levels to ensure generator compatibility and avoid reflected harmonics from disturbing loads sharing the utility power.

- **Input Harmonic Current Suppression:** The PFC rectifier shall produce a sinusoidal input AC current on each phase with low harmonic content, limiting THD on the UPS input to below 3 percent.

- **Temperature Compensated Charging:** The battery charger shall be equipped with a temperature probe to enable temperature compensated charging and shall adjust the battery float voltage to compensate for the ambient temperature.

B. **Inverter:** The UPS output shall be derived from a variable frequency Pulse Width Modulated (PWM) 3 Level IGBT inverter design. The inverter shall be capable of providing the specified precise output power characteristics while operating over the battery voltage range.

C. **Static Bypass - 100 Percent Rated, Continuous Duty:** The static bypass transfer switch shall be solid state, rated for 100 percent continuous duty without mechanical contactor device in parallel for higher reliability and consistent response time and shall operate under the following conditions:

1. **Uninterrupted Transfer:** The static bypass transfer switch shall automatically cause the bypass source to assume the critical load without interruption after the logic senses one of the following conditions:
   a. Inverter overload exceeds unit's rating.
   b. Battery protection period expired and bypass current is available.
   c. Inverter failure.

2. **Interrupted Transfer:** If the bypass source is beyond the conditions stated below, the UPS shall make an interrupted transfer (not less than 100 milliseconds in duration).
   a. Bypass voltage greater than +10 percent, -10 percent from the UPS rated output voltage.
   b. Bypass frequency greater than ±1-±5 hertz (programmable) from the UPS rated output frequency.

3. **Automatic Uninterrupted Forward Transfer:** The static bypass transfer switch shall automatically forward transfer power, without interruption, after the UPS inverter is turned on after an

instantaneous overload-induced reverse transfer has occurred and the load current returns the UPS‘s nominal rating or less.

4. **Manual Transfer:** A manual static transfer shall be initiated from the UPS control panel by turning the UPS inverter off.
5. **Overload Ratings:** The static bypass transfer switch shall have the following overload characteristics:
   a. 1000 percent of UPS output rating for one cycle
   b. 150 percent continuous.
   In addition the UPS must be able to

- Operate with a inbuilt Galvanic isolation transformer to provide at output of the UPS.

2.4 SYSTEM CONTROLS AND INDICATORS

A. DSP Microprocessor-Controlled Logic:

1. The full UPS operation shall be provided through the use of DSP microprocessor-controlled logic. Operation and parameters shall be firmware-controlled, thus eliminating the need for manual adjustments or potentiometers. The logic shall include, but shall not be limited to, a self-test and diagnostic circuitry such that a fault shall be isolated down to the printed circuit assembly or plug-in power assembly level. Every printed circuit assembly or plug-in power assembly shall be monitored. Diagnostics shall be performed via a PC through the local diagnostics port on the UPS. UPS shall be DSP microprocessor-controlled.

2. The UPS shall include, but shall not be limited to, a standard easy-to-use control and indicator panel. Included shall be a graphic colour touch screen and status light.

3. Display shall facilitate operation by offering the functions listed below:
   a. Operating information supplied on the screens.
   b. The display shall assist the Owner by providing step-by-step help in the Owner's language.
   c. Graphic mimic diagram on the 3.5‖ touch screen. The mimic diagram shall enable display of installation parameters, configuration, operating status and alarms and indication of operator instructions for switching operations (i.e., bypass).
   d. It shall be possible to display the following measurements:

   INPUT
   Voltage (Vac), per phase
   Current (Aac), per phase
   Frequency (Hz)

   OUTPUT (INVERTER)
   Voltage (Vac), per phase
   Current (Aac), per phase
   Frequency (Hz)
   Power (kVA), per phase
   Power (kW), per phase
   Load (%), per phase
   Power Factor (load), per phase

BYPASS
Voltage (Vac), per phase
Frequency (Hz)

BATTERY
DC Bus Voltage (±Vdc)
Battery Voltage (±Vdc)
Charge/Decharge Current (±Adc)
Temperature (°C)
Autonomy (minute)

f. Additional information shall be provided in view of accelerating servicing of the system.

g. Log of time-stamped events. This function shall store in memory and make available, for automatic or manually initiated recall, time-stamped logs of important status changes, faults, and malfunctions, complete with an analysis and display of troubleshooting procedures.

B. **Front Panel Touch screen Display:** The UPS control panel shall provide touch screen with choice of several operating languages for indication of UPS status, metering, battery status, alarm/event log, and advanced operational features.

1. **Access:** The display shall provide access to:
   a. Mimic diagram indicating UPS power flow.
   b. Measurements, status indications, and events.
   c. Event log with time.
   d. Password protected adjustments for voltage, frequency and service
   e. Access to measurements.
   f. Dry contact alarm adjustments

C. **LED Status Indicators:** The UPS control panel shall provide three LEDs that shall signal the following status conditions:

Green LED: Load protected, Normal operation, no alarm, ECO Mode

Yellow LED: Battery Run, UPS on Bypass, Maintenance Mode, Minor fault (The load is supplied by UPS but an alarm is active, control is required).

Red LED: Major fault, load not protected.

D. **Audible Alarm Reset:** The UPS shall provide an audible alarm that can be stopped using the touch screen. If a new alarm is sensed after the original alarm has been silenced, it shall reactivate the audible alarm.

E. **Remote Emergency Power Off (REPO):** The UPS shall be equipped with provisions for remote emergency power off and dry contact input that shall be used to command UPS shutdown remotely.

F. **RS232:** One RS232 connector with serial output shall be provided for field diagnostics.

G. Dry Contacts:
4 dry contact sockets on the Interface Board which can be programmable from the display with following signals:
General Alarm
Input failure
Battery failure
Output failure
High temperature

2. The contacts shall be normally open and shall change state to indicate the operating status. The contacts shall be rated at 42 VAC voltage 16A current, 50 VDC voltage 1A current resistive load.

2.5 MECHANICAL DESIGN AND VENTILATION

A. **Enclosure:** The UPS shall be housed in a freestanding enclosure with dead front construction. The mechanical structure of the UPS shall be sufficiently strong and rigid to withstand handling and installation operations without risk. The sheet metal elements in the structure shall be protected against corrosion by a suitable treatment, such as zinc electroplating, bi-chromating, epoxy paint, or an equivalent.

B. **Cable Access:** The standard UPS available shall accommodate bottom entry cables.

C. **Ventilation and Heat Rejection:** The UPS shall be designed for forced air cooling.

2.6 BATTERY

A. **General:** The UPS module shall use a valve-regulated sealed lead acid heavy duty industrial battery, designed for auxiliary power service in an UPS application for backup of as per mentioned in DBR min on each UPS. The primary battery shall be furnished with impact-resistant plastic cases and housed internally to the UPS module.

2.7 UPS DELIVERY SUBMITTALS

Submittal upon UPS delivery shall include one instruction manual. Manual shall include a functional description of the equipment with block diagrams, safety precautions, instructions, step-by-step operating procedures and routine maintenance guidelines, including illustrations.

2.8 WARRANTY

The manufacturer shall warrant all the supplied items against defects in materials and workmanship for 36 Months after initial start-up & handing over to the owner.

2.9 QUALITY ASSURANCE

2.9.1 MANUFACTURER QUALIFICATIONS

The UPS equipment vendors quoting for the job should have a minimum of four year‘s first-hand experience in the design, manufacturing, and testing of solid-state UPS systems. Besides credentials of

having supplied done more than 5 similar or bigger jobs, the firm should have ISO 9001, UL / CE certifications. The copies of the certificates must be submitted with offer.

2.9.2 FACTORY TESTING

Before dispatch, the manufacturer shall fully and completely test the system in India to ensure compliance with the major specifications.

2.10(a) **PRODUCT**

2.10.1 FABRICATION

MATERIALS

All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing.

2.10.2 CONSTRUCTION AND MOUNTING

The UPS unit, comprised of input isolator, rectifier/charger, inverter, static transfer switch, maintenance bypass switch, and static bypass input switch shall be housed in a free-standing steel enclosure with key-lockable doors. Front access only shall be required for expedient servicing, adjustments, and installation. The enclosure will be built to comply with IP20 when the doors are closed. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer‘s standard colour. The UPS shall be constructed of replaceable subassemblies. Printed circuit assemblies shall be plug-in. Like assemblies and like components shall be interchangeable.

2.10.3 COOLING

Cooling of the UPS shall be forced-air. Low velocity fans shall be used to minimize audible noise output. Fan power shall be provided by the UPS output. Temperature will be monitored by thermal sensors.

2.10(b) **COMPONENTS**

2.10.1 RECTIFIER/CHARGER

A. GENERAL

The Rectifier cum Charger Unit should be of Three Phase, Fully controlled, (IGBT based Rectifier) . The Input Power Factor should be (>0.99) and the Input Current Harmonic Distortion (THDi) should be <3%. The Rectifiers should have Input and DC Current Limiting Circuitry. It should be capable of giving charging current upto maximum of (10%) of the Battery AH Capacity, while simultaneously supplying full load current to inverter.

B. INPUT CURRENT WALK-IN

The rectifier/charger shall contain a timed walk-in circuit that causes the unit to gradually assume the load over a 5 to 30 second time interval after input voltage is applied.

C. DC FILTER

The rectifier/charger shall have an output filter to minimise ripple voltage into the battery. The Ripple voltage should be less than 2%.

D. BATTERY RECHARGE

In addition to supplying power for the inverter load, the rectifier/charger shall be capable of providing battery charging current to recharge the battery properly (upto 20% of Battery AH Capacity). After the battery is recharged the rectifier/charger shall maintain the battery at full charge until the next emergency operation. The charging shall be an automatic cycle i.e boost to floating charge switching, with current measuring criteria and control during recharge. Both float and recharge voltages shall be adjustable. The charge voltage can also be manually controlled. Dynamic Temperature compensated Charging Facility should be there. The Rectifiers/Chargers should automatically increase the DC End-of-Discharge voltage level sensing lesser loads, in order to protect the batteries from over discharge beyond their AH Capacities.

2.10.2 <u>INVERTER</u>

A. GENERAL

The Inverter should be Fully Microprocessor controlled Sine wave IGBT / PWM based employing High Switching Frequency, consisting of IGBT‘s.

B. OVERLOAD CAPABILITY

The inverter shall be capable of supplying current and voltage for overload of or mentioned earlier for 1 minute. A status indicator and audible alarm shall indicate overload operation. The UPS shall switch off its inverter output static switch when its overload capacity is exceeded.

C. FAULT CLEARING AND CURRENT LIMIT

Without bypass supply available to the inverter shall be capable of supplying an overload current of 200% of its full-load rating in excess of five Seconds. For greater currents or longer time duration, the inverter shall have electronic greater currents or longer time duration, the inverter shall have electronic current-limiting protection to prevent damage to components. The inverter shall be self-protecting against any magnitude of connected output overload (Vce Trip). Inverter control logic shall sense and disconnect the inverter from the critical AC load without the requirement to clear protective fuses.

D. OUTPUT FREQUENCY

The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall hold the inverter output frequency to +/- 0 .01% for steady state and transient conditions.

E. ISOLATION TRANSFORMER:

To isolate the input disturbances from the output side a double wound delta-zigzag transformer to galvanically isolate the input from output is mandatory to be included in the design at the output of the inverter.. The isolation transformer will be connected. The combination of the

inverter and Output isolation txr shall form a separately derived source wherein the Input neutral and the three Phases are completely isolated from the output neutral and the three phases.

2.10.3 DISPLAY AND CONTROLS

A. MONITORING AND CONTROL

The UPS shall be provided with a microprocessor based unit status display and controls section designed for convenient and reliable user operation. A system controls section designed for convenient and reliable user operation. A system power flow diagram, a percentage load and battery time remaining display shall be provided as part of the monitoring and controls sections which depicts a single line diagram of the UPS. Illuminated visual indicators shall be of the long life light emitting diode (LED) type. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, and alarms shall be displayed on an alphanumeric LCD display. Additional features of the monitoring system shall include:

- Event Monitoring & Diagnostics: Last 100 events with exact date & time should be monitored from the front LCD panel of the UPS.

B. METERING

THE FOLLOWING PARAMETERS SHALL BE DISPLAYED:

- DC Voltage
- Battery voltage
- Battery charge & discharge current
- Input voltage and frequency
- Output AC voltage line-to-line and line to neutral and % load used of nominal
- Output AC current for each phase and neutral
- Output frequency
- Active Power (kW) Apparent Power (kVA)
- Temperature - Ambient, battery, inverter and transformer

C. WARNING AND ALARM MESSAGES

- Normal Operation Input breaker open
- Output breaker open Rect. breaker open
- Battery breaker open On Manual bypass
- Bypass absent Bypass over limits
- Bypass under limits Bypass freq. over limit
- Bypass Phase Rotation Bypass SCR fail

- Bypass inhibit Local Bypass inhibit remote
- Load on bypass On bypass due to over temp
- Rectifier off Local Rect. off remotely
- Rectifier Block Rectifier overload
- Rectifier over temp Rectifier Fuse fail
- Inverter off local Invert. off remotely
- Inverter block Inverter overload
- Inverter over temp Inverter out of sync
- Inverter over voltage Inverter under volts
- Inverter fuse fail D.C Volts High
- D.C Volts low Inverter no voltage
- Inverter Peak Volts low Battery under test
- Battery test fail Discharge battery
- Battery E.O.D. Boost Charge
- DC Bus over volts Battery Low
- Battery Fuse Fail Bat. Fast over volt
- Bypass overuse Cut-off overload
- Cut-off over temp Cut-off emergency stop
- Overload Cut-off max overload

D. CONTROLS

Four pushbuttons shall be located on the operator control panel.

- Enter
- Escape
- Up
- Down

The push buttons shall permit the operator either to select options from a menu for display on the LCD winder or to change the value of some parameters. One push-button - alarm silence switch.

E. POWER STATUS DIAGRAM

A mimic panel shall be provided to depict a single line diagram of the UPS.

Indicating lights shall be integrated within the single line diagram to illustrate the status of the UPS. The three LEDs shall indicate the following status.

- Bypass voltage OK

- Load on bypass
- Load on inverter

Power status diagram shall be an LED bar graph indicating % load with amber overload indication. Also an LED bar graph indicating % battery time remaining shall be included.

F. COMMUNICATION FEATURES

Each UPS should have RS-232 interface port for serial port communicability, MODBUS for BMS Connectivity.

2.1.4 STATIC TRANSFER SWITCH

A. GENERAL

A static transfer switch and bypass circuit shall be provided as an integral part of the UPS. The static switch shall be naturally commutated high-speed static (SCR type) device rated to conduct upto 100% of full load current, continuously. Such Switch should be connected at both the Static Bypass as well as the Inverter Output to enable the critical load to be connected to the inverter output or bypass power source. the static transfer switch control logic shall contain an automatic transfer control circuit that senses the status of the inverter logic signals, and operating and alarm conditions. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits specified herein, when an overload or malfunction occurs within the UPS, or for bypassing the UPS for maintenance.

B. UNINTERRUPTED TRANSFER

The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic senses any of the following conditions:

- Inverter overload capacity exceeded
- Critical AC load overvoltage or under-voltage
- UPS fault condition.

The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present:

- Inverter/bypass voltage difference exceeding pre-set limits
- Bypass frequency out of limits
- Bypass out-of-synchronization range with inverter output.

C. UNINTERRUPTED RETRANSFER

Retransfer of the critical AC load from the bypass source to the invert output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following condition exists:

- Bypass out of synchronisation range with inverter output

- Inverter/bypass voltage difference exceeding pre-set limits
- Overload condition exists in excess of inverter full load rating
- UPS fault condition present.

2.10.5 MAINTENANCE BYPASS ISOLATOR

A. GENERAL

A manually operated maintenance bypass isolator shall be incorporated into the UPS cabinet to directly connect the critical load to the input AC power source, bypassing the rectifier/charger, inverter, and static transfer switch. Transfer from Inverter to the Manual Bypass should be possible without any interruption to the Loads.

B. MAINTENANCE CAPABILITY

With the critical load powered from the maintenance bypass circuit, it shall be possible to freely check out the operation of the rectifier/charger, invert, battery, and static transfer switch.

2.10.6 BYPASS LINE INDUCTANCES

A. GENERAL

An Inductance shall be incorporated into each UPS cabinet in the Bypass path connecting the critical load to the input AC power source, so as to equalize the currents shared by the Bypass paths of each UPS.

B. LOAD SHARING BY BYPASS OF EACH UPS

The inductances of all the UPS‘s should be identical having matching impedance. They should be 100% rated.

2.10.7 ISOLATION TRANSFORMER AT OUTPUT OF INVERTER (INBUILT / EXTERNAL)

Each UPS should have double wound galvanic Isolation Transformer at the output of its Inverter ensuring that at no point of time there is any electrical connection of the phase wires between the Input Supply going into the UPS and the Output Supply coming out of the UPS.

2.10.8 BATTERY PATH PROTECTION

A suitable Amp rated MCCB should be provided with each UPS for connection between the UPS and its Battery Bank. The MCCB should be physically placed near the Battery Bank and should have thermal, magnetic as well as automatic remote tripping mechanism. In the event of any fire or emergency, it should be possible to immediately make the outputs of Rectifiers, Inverters and the battery banks devoid of electrical Potential by pressing the Emergency Stop button from UPS Front Panel.

2.10.9 INTERCONNECTING CABLES

Vendor shall provide all the interconnecting cables between Incoming MCCB Panel, the UPS Systems, the Battery banks and the Outgoing MCCB Panel.

2.10.10 PRODUCT STANDARDS

The UPS should be designed & manufactured in accordance to and as per the following international Standards:

ISO 9001, CE Certification / UL Certification.

2.10.11 FIELD ENGINEERING SUPPORT

The UPS manufacturer shall directly employ a national field service network staffed by factory trained field service engineers to provide start-up, maintenance and repair of the UPS equipment.

RACK MOUNTED UPS

Scope of work : SITC of Rack mounted UPS of given specifications in all type of network racks.

The main parameters of the UPS including the battery charge level and faults, are displayed on the LCD screen on the front panel. The integrated communication software not only controls the UPS and its switch-off if there is a malfunction and enables the user to test the main functions remotely, communicate via SNMP/Internet/network adaptor and access the functions of the UPS via the Internet, but can also send the user a SMS if specific events occur. The internal extension connector enables a WEB/SNMP card or a relay interface to be installed which provides insulated contacts for applications on industrial control panels or remote alarm panels. If there is an electronic fault, overload, overheating or for scheduled maintenance operations, the automatic or manual (optional) bypass ensures continuity of the power supply for critical loads. A bypass switch is available for maintenance.

General characteristics	
Nominal power (VA)	2000
Active power (W)	1800
Technology	On-line double conversion VFI-SS-111
Waveform	Sinusoidal
Architecture	Convertible tower and 19" rack
Input characteristics	
Input voltage	230 V
Input frequency	50-60 Hz ± 5% autosensing
Input voltage range	176V - 280V at full load
THD of input current	< 3%
Input power factor	> 0.99
Output characteristics	

General characteristics	
Output voltage	230 V ± 1%
Output frequency (nominal)	50/60 Hz (configurable via LCD panel) +/- 0.1%
Efficiency	up to 90%
Peak factor	1:3
THD of output voltage	< 3% with linear load
Output voltage tolerance	± 1%
Internal automatic bypass	-
External maintenance bypass	optional
Batteries	
Backup time extension	Yes
Backup time (min)	15 min.
Communication and management	
Screen and signalling	Four buttons and five LEDs for real-time control of the status and the main parameters of the UPS
Communication ports	RS232 and USB serial ports
Connector for network interface	SNMP
Back feed protection	-
Emergency power off (EPO)	-
Ambient conditions	
Operating temperature (°C)	0 - 40°C
Protection index	IP 21
Relative humidity (%)	20 to 80%
Noise at 1 m (dBA)	< 50
Heat dissipation (BTU/h)	490 / 650
Certifications	
Reference product standards	EN 62040-1, EN 62040-2, EN 62040-3

Quality Assurance

The manufacturer shall have quality assurance program with check on incoming parts and final products. A final test procedure for product shall include a check of all performance specifications and a minimum 24 hour running.

Installation Drawing

After the receipt of order a minimum two sets of installation drawings showing outline dimension, weights and connections and a one line drawing of the UPS shall be sent to the purchaser to be used in planning the installation of the system.

Product Documentation

Manufacturer shall supply a comprehensive set of product documentation for:

1. Installation

2. Operation

3. Maintenance

This should include complete outline and external connection drawings and schematic and physical wiring diagrams as well as parts list and parts layout down to the smallest components level. It should include startup and service manuals with complete privation and remedial maintenance and trouble showing instructions. This should include all ancillary equipment and accessories.

Training

It is important that at least -2 personnel who are to be responsible for operation and maintenance of UPS be trained at the manufacturer site.

Spare Parts

The recommended spare parts for 5 years of maintenance are to be listed and should be quoted along with main modules.

Material and Workmanship

1) Workmanship shall be first class in every respect.

2) All material shall be new and of best commercial grade.

3) Brackets and securing hardware shall be electroplated with corrosion resistance material.

4) Internal wiring conductors shall be combined into cable or bundles and shall be tied securely together and numbered or coded to correspond with documentation.

Storage Battery

The storage battery shall be furnished with racks connecting hardware and standard service resistance material accessories. The battery shall be delivered charged and filled ready for service.

Service Report

Assigned field service report describing start-up and on site testing shall be furnished.

Maintenance

If the battery is taken out of service for maintenance by manually opening battery disconnect switch the UPS shall continue to function and meet all the performance criteria specified except.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment. WAPCOS has decided to implement this policy.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-7

CCTV SYSTEM

GENERAL TERMS & CONDITIONS AND TECHNICAL SPECIFICATIONS FOR CCTV SYSTEM

General Terms & Conditions

1. Introduction

These conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancy between the General Conditions and these Special Conditions, the more stringent shall apply.

2. Scope of Work :

The general character and the scope of work to be carried out under this contract is illustrated in Specifications. The brief scope of work is SITC of CCTV SECURITY System including Video Management system -Recording, CCTV Client Workstation, Analytics and Failover Server as, Video Storage – 300 TB Minimum usable per detailed specifications including planning and designing by incorporating stipulated specifications, all E&M works related services on design, built and handover basis including all works as per scope for Work and user requirement, all complete including defect liability period for three years from the date of handing over as per direction of Engineerin Charge.

A. Centenary Building(G+4)

External Area, Roads, footpath, garden, landscape and other specified area also covered.

If less/ excess area is executed recovery / payment shall be made on pro rata basis from/ to the EPC contractor.

Quantities for SITC of CCTV cameras are as following :

1. **Dome Type : (As per site requirment)**
2. **Bullet Type :** (As per site requirment).
3. **PTZ Type : (As per site requirment).**
4. **Fish eye Type :** (As per site requirment).

Samples of materials to be used at work shall be brought to site for approval of Engineer in Charge in consultation with committee before placing order.

The Contractor shall as a System Integrator for providing an end to end Solution for the above, including but not limited to design, supply of the required CCTV equipments and installation, performance testing, commissioning, warranty, etc. The bidders have to ensure the planning and smooth execution of the project. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer in charge. The contractor shall furnish all labours, materials and equipment as listed and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system through as described in the Specifications.

3. Location

The work shall be executed for Centenary Building **at IIT (ISM) Dhanbad.**

4. Related Documents

These additional specifications are to be read in conjunction with the specification given in the tender. In case any item/ items or part thereof are not covered under these specifications, the same shall be carried out as per relevant part of the CPWD General Specification for Electrical Works Part-I Internal -2013, Part –II External -1994, amended upto dates, relevant electricity act BIS/IEC and as per direction of Engineer –in - Charge. These additional specifications are to be read in conjunction with above and in case of variations; specifications given in this additional condition shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions, as the same are to be read along with schedule of quantities for the work. In case of discrepancy among the specifications/conditions as mentioned above the precedence given in general condition of contract shall be followed.

5. Site Information

The work shall be executed for Centenary Building **at IIT (ISM) Dhanbad..** The tenderer should, in his own interest, visit the site and familiarize himself with the site conditions before tendering.

6. Safety Codes and Labour Regulations

i) In respect of all labour employed directly or indirectly on the work for the performance of contractor‘s part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory

provision, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty for Rs. 2000/- for each violation. In addition the Engineer-in- charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost form the contractor.

ii) The contractor shall provide necessary barriers, signals and other safety measures while executing the installation or wherever necessary so as to avoid accident. He shall also indemnify WAPCOS against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there form during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

7. Works to be done by the contractor

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost- whether specifically indicated in the schedule of work or not: -

i) Complete wiring.

ii) Making good all damages caused to the structure during installation and restoring the same to their original finish.

iii) Minor building work necessary for installation of equipments, making opening in the wall/floors/slabs/tables or modifications in the existing openings wherever provided and restoring the same to their original condition/ finish and necessary grouting etc. as required. Opening in the slab/retaining walls/brick wall etc. shall be made by means of core cutting machines only.

iv) Sealing of all floor slab/wall openings provided by the Department or made by the contractor for laying cables from fire safety points of view.

v) Suspenders, brackets and floor/wall supports for suspending/supporting cable tray, cables etc.

vi) Removal & disposal of the all the malba/ debris occurs during the execution of work from the site.

8. Rates

The rate quoted by bidder, shall be firm and inclusive of all taxes (including GST etc.), duties and levies and all charges for packing, forwarding insurance, freight and delivery, installation, testing, commissioning etc. at site including temporary constructional storage, risks, overhead charges, general liabilities/obligation etc.

9. Acceptable Makes

The acceptable makes of the various equipments/ components/ accessories have been indicated in list of ―Acceptable Makes‖ annexed with this document. The bidders shall work out the cost of the offers on this basis. Alternate make/ model is not acceptable.

10. Machinery for Erection

All tools and tackles required for unloading/ handling of equipments and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

11. Completeness of the Tender, Submission of Programme, Approval of Drawings and commencement of work

i) Completeness of the tender:-

All sundry equipments, fittings, assemblies, accessories, hardware items, foundation blots, supports, termination lugs for electrical connections connecting wires/ cables, cable glands, junction boxes and all other items which are useful and necessary for proper assembly and efficient working of the various equipments and components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender or not.

iii) Submission of program:-

The successful tenderer, after receipt of the letter of award, shall submit his program for submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in –charge.

iii) Commencement of Work

The contractor shall submit the complete scheme and drawings etc. of the complete system and shall commence work as soon as the drawings submitted by him are approved either in full or in part as the case may be.

12. Dispatch of Materials to Site and their Safe Custody

The contactor shall dispatch material to site in consultation with the Engineer-in-Charge. The arrangement to make it lockable/secure by means of partitions, locks etc. shall be responsibility of the contractor. Watch and ward however, shall be the responsibility of contractor. Program of dispatch of material shall be framed keeping in view the safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contactor till final taking over by the department.

13. Extent of Work

The work shall comprises of entire labour including supervision and all material necessary to meet a complete installation and such tests and adjustment and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by the specification but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in detail in the tender documents in connection with this contract. Further, it is clarified that nothing extra will be paid on account of following works which are required for completion of work.

a. All cable terminations eg. VGA, HDMI, sound, etc. The rate quoted by the tenderer for equipment/cable/ accessories shall include this.
b. Making opening in false ceiling/ wall panelling/ furniture and repairing the same for fixing of

cameras, LED Display & connected accessories, etc.

c. Making arrangement for watch & ward of CCTV installation till its handing over to client department.
d. All adjustment pertaining to CCTV installation shall be the responsibility of the contractor.
e. Contractor has to provide technical assistance as and when required for approval.
f. Program chart showing all activities and its progress should be provided within 15 days after award ofwork and updated on weekly basis.

g. To make complete system compatible for CCTV surveillance i/c cost of connector etc. shall lie within the quoted rates.

14. Compliance with Regulations and Indian Standards:

i. All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:
   i) Factories Act.
   ii) Indian Electricity Rules.
   iii) B.I.S. & other standards as applicable.
   iv) Workmen‘s compensation Act.
   v) Statutory norms prescribed by local bodies like CEA, Power Supply Co., etc.

ii. Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

iii. Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs. 50/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

15. Indemnity:

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer on account of the above.

16. Co-Ordination with other Agencies

The contractor during the execution of the works shall co-ordinate with other agencies associated work with the project and shall work in harmony with them without causing any hindrance or obstruction on the progress of work in any way.

17. Insurance and Storage :

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

18. Verification of Correctness of Equipment at Destination:

The contractor shall have to produce all the relevant records to certify that the genuine equipments from the manufacturers has been supplied and erected.

19. Painting:

This shall include cost of painting of the entire installation. The agency shall be required to do only touching to the damages caused to the painting during transportation, handling & installation at site, if there is no major damage to the painting. All iron works shall be painted at the work before dispatch to the site with two coats of anti-corrosive primer paint. One coat of final finishing of approved colour may be done at the factory before dispatch if considered necessary by the tenderer on such components, which will not need removal of such parts at site during assembly/erection work. Marking of identification of each equipment as per direction of engineer-in-charge shall be got done.

20. Quality of Materials and Workmanship

a. The components of the installation shall be such design so as to satisfactorily function under all conditions of operation.

b. The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.
c. All equipments and material to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.
d. All equipments and materials to be used in the work shall be brand new having its date of manufacturing not more than 6 month old from the date of delivery at site with manufacturer‘s certificates, warrantee cards, technical catalogues, instructions, manuals and wiring diagrams etc.
e. In order to ensure genuineness of equipments/materials, copy of invoice of each equipments/materials, custom clearance paper in case of imported materials duly authenticated by bidder shall be invariably produce to engineer-in-charge.

21. Care of the Building

Care shall be taken by the contractor during execution of the work to avoid damage to the building. Care shall also be taken by the contractor to avoid the damage to any of these existing service/service lines, any part of the building etc. If any damage is caused to any of the existing services/service lines, or any part of the building the same shall be repaired/rectified and made functional or restored so its original finish by the contractor immediately at his own expenses failing which the same shall be repaired/ rectified and made functional by department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

22. Inspection and Testing

a. Initial Inspection and testing

i) Initial inspection of material and equipments at manufacturer‘s works in India may be done by the Engineer-in-Charge or his representative, if so desired. For item/ equipment which require initial inspection at manufacturer‘s works, the contractor will intimate the date of testing of equipments at the manufacturer‘s works before dispatch. The contractor shall give sufficient advance notice of minimum two weeks regarding the dates proposed for such tests to the department‘s representative(s) facilitate his presence during testing. The Engineer-in-Charge at his discretion may witness such testing. Equipments will be inspected at the manufacturer/ authorized dealer‘s premises, before dispatch to the site by the contactor. The manufacturer‘s works implies the manufacturer of respective items mentioned in the list of acceptable makes.

ii) The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same.

iii) The materials duly inspected by Engineer-in-Charge or his authorized representative shall be dispatched to site by the contractor.

iv) Copies of all documents of routine and type test certificates of the equipments carried out at the manufacturer works shall be furnished to Engineer-in-charge and consignee.

v) No additional payment shall be made to the contractor for initial inspection/testing at the manufacturer‘s works by the representative of the Engineer-in-Charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

b. Final Inspection and Testing

Upon completion of work the performance test shall demonstrate the following among other things:-

i) Equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

ii) All items operate efficiently and quietly to meet the specified requirements as per the warranty /guaranty.

iii) All circuits are correctly protected /modify as per the site protective devices are properly coordinated.

iv) All non-current carrying metal parts are properly and safely grounded in accordance with the specifications and appropriate codes of practice.

v) The contractor shall provide all necessary instruments and labour for testing. He shall make adequate records of test procedures and readings and shall repeat any tests requested by the Engineer in charge. Test certificate duly signed by authorized person shall be submitted for scrutiny.

vi) If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification and retesting of the same as called for by the Engineer in charge. All tests shall be carried out in the presence of representative of Engineer in charge.

vii) The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Engineer in charge.

viii) The system shall be tested in the presence of Engineer in charge‘s representative at Supplier‘s works in accordance with latest prevailing standards and codes. The successful passing of any such tests will not however prejudice the right of Purchaser to reject the system and its accessories, if they do not comply with specifications when erected or perform complete satisfactory operation as intended.

ix) Final Inspection and testing will be done by the Engineer-in-Charge or his representative as per details indicated in relevant section of Technical Specifications.

c. Safety Measures

All equipments shall incorporate suitable safety provision to ensure safety of the operating personnel at all

times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

23. Guarantee

i) The contactor shall guarantee the complete system to maintain the specified conditions under all conditions of ambient temperature.

ii) All equipments shall be guaranteed for a period of 36 months i/c annual comprehensive maintenance during DLP from the date of acceptance and taking over of the installation by the department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contactor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of Engineer-in-Charge in this regard shall be final.

iii) Completion drawings

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of four sets of CD‘s and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate following:

i) Location and details of each item

ii) Complete wiring diagram, as installed and scheduled showing all connections in the complete electrical system.

24. After Sales Services

The contractor shall ensure adequate and prompt after sales service free of cost during guarantee period, and against payment after guarantee period is over, in the form of maintenance, spares and personal as and when required during normal life span of the equipments and shall minimize the breakdown period. In case of equipment supplied by other manufacturers, the firm shall submit the guarantee from manufacturer for the same before the entire installation is taken over.

25. The contractor shall submit at the time of approval of association, an undertaking from the OEM regarding:-

a) Authorization Certificate from OEM of all the major Equipments.
b) An undertaking from OEM of all the major equipments that
   i) The OEM shall unconditionally support the lowest tenderer technically throughout the execution of contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of system, and
   ii) OEM shall provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment.

26. The Contractor shall use same make of all items of CCTV system such as Dome Cameras, Bullet

Cameras, and PTZ Cameras etc. for better compatibility.

27. The items supplied by the contractor should have specifications compatible with each other required for satisfactory operation of the system.

28. Liaisoning and Co-operation with other agencies:

a. The successful tenderer shall co-ordinate with other contractors and agencies engaged in the operation and maintenance of the building so as to make the execution of this works contract smooth. If any unreasonable hindrance is caused to other agencies / damage is caused to the existing installation resulting in loss of work or disruption in services during the course of work, such expenditure incurred upon restoration and loss of work shall be recovered from the successful tenderer. Water proofing of pits shall not be damaged under any circumstances.

29. Verification of correctness of Equipment at Destination :

All the materials are to be purchased from OEM / Authorised Distributor / dealer of OEM only. The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected. They have to submit proof like copy of bill / P.O. etc. in support.

Scope of Work :

1. Video surveillance systems play a vital role in acting as a deterrent for safety and security in the building.
2. IP based Closed Circuit Surveillance system is proposed to monitor the activities at critical areas. The video is continuously transported to IIT server, using IP cameras.
3. At common areas like stilt floor lift lobbies, peripheral of the buildings and at strategic locations CCTV cameras will be provided
4. The central monitoring of all CCTV cameras is done in the centralized Control room.
5. The system components are,
    - IP based Indoor / outdoor Cameras
    - Cat 6 Cable
    - 24 Port Patch Panel (Compatible to Cat 6 & Cat 6A Cable)
    - 1/2 mtr. Cat 6 Patch Cord.
6. CCTV Camera locations,

    Following are the location where CCTV cameras are proposed,
    - Main Entrances
    - Lift Lobbies
    - Inside Lifts
    - Corridors
    - 100 % Area coverage in centenary buildings except toilets.

- 100% External Area by PTZ coverage.

7. For basic scheme refer respective Tender DRAWINGS.
8. The whole CCTV system shall have compatibility to existing VMS system and shall have seamless integration with existing VMS system.
9. Fish eye camera shall be installed in every building entrance hall and junction point.
10. Video wall shall be installed as directed by IIT/WAPCOS.
11. Control / Monitor Room for CCTV network system shall be installed as directed by IIT/WAPCOS.
12. The EPC Contractor shall redesign CCTV camera location as per the site requirement and as per the instruction of Eng-in-charge.
13. The Contractor shall provide VMS System along with minimum Video Storage – 300 TB usable at least for two months as given specifications.
14. The Contractor shall also provide 1Nos. 55 inch video wall as per given specifications.
15. The contractor shall also provide minimum 1 No. CCTV client work station as per given specifications.
16. The contractor shall also provide minimum 1 No. Video Management, Recording, Analytics and Failover Server as per given specifications.

Technical Specifications of CCTV System

	1. Dome Surveillance Camera	
S. No	**Features**	**Specifications**
1	Form Factor	Dome IP Surveillance Camera
2	Image Sensor	1/3‖ CMOS or better
3	Day/Night Operation	Yes, with IR Cut Filter
4	Minimum Illumination	B/W - 0.05 lx and 0 Lux with IR
5	Lens	3-10 mm
6	Electronic Shutter	1/3 to 1/10,000 s or better
7	Image Resolution	2 MP or better

8	Compression	H.264/H.265, MJPEG
9	Compression profile	Should support H.264/H.265 baseline, Main profile and high profile
10	Frame Rate and Resolution	2 MP (1920 X 1080) @ 25/30 FPS
11	Simultaneous Stream	Minimum 2 streams should be configurable at 1920 X 1080 @ 25 fps simultaneously
12	White Balance	Auto / Manual / ATW / One Push
13	GOV Length	It should be possible to vary the GOV length in the camera setting.
14	Noise Reduction	Digital Noise Reduction 2D / 3D DNR
15	Zoom	4x Digital Zoom or better
16	Digital PTZ	Camera should support digital PTZ(Optional)
17	Video Streams	Quad Stream supportable, each stream should be H.264/H.265 configurable at different resolutions
18	Video quality view	Video compression type (H.264/H.265/MJPEG) and bit rate of each stream should be viewable at home screen in web browser
19	Image Setting	Saturation, Brightness, Contrast, Sharpness, Hue adjustable
20	Two-way audio	Line in / Line Out
21	Audio Compression	G.711 / G.726 / AAC / LPCM
22	Iris	P/DC iris
23	Wide Dynamic Range	85 dB or better
24	IR	30 mtr IR distance or better
25	Alarm	1 x Input / 1 x output
26	Video Content Analytics	Edge/Server Based Camera must have edge/server base analytics Viz; Enter / leave field, Loitering, Line Crossing, Follow route, Idle / removed object, Counting, Occupancy, Crowd density estimation. Bidder to ensure minimum 8 Different types of analytics shall run simultaneously in each Camera and to consider all the analytics mentioned for each camera
27	Storage backup on network failure	Camera should support network failure detection, Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down
28	Edge Storage	Built in SD card slot with minimum support 512 GB SD card
29	Network Interface	RJ-45, 10/100Mbps Ethernet
30	Edge Storage	Built in SD card slot with support up to 512 GB SD card

31	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, UPnP, IGMP, SNMP, QoS, ONVIF
32	Text Overlay	Date & time, and a customer-specific text etc
33	Privacy masks	Support up to 5 privacy masks
34	Security	HTTPS, IP Filter, IEEE 802.1X
35	Firmware Upgrade	The firmware upgrade shall be done though web interface,
36	Audio Transmission mode	Full Duplex / Half Duplex / Simplex
37	Vandal Resistant	IK 10
38	Power	POE / 12 V DC /24 V AC
39	Operating Temperature	-30°C to 60°C {-30 °C to 50 °C is acceptable. (Temperature range will be acceptable as long as it will as per Dhanbad Weather Condition and it applies to all cameras.)}
40	Operating Humidity	Humidity 10%–90% No Condensation
41	Certification	UL, CE, FCC
42	ONVIF	ONVIF Profile S & G
43	Supported Web Browser	Internet Explorer (7.0+) / Firefox / Safari/Chrome

	2. Bullet Surveillance Camera	
S. No	Feature	Specifications
1	Form Factor	Bullet IP Surveillance Camera
2	Image Sensor	1/3‖ CMOS or better
3	Day/ Night Operation	Yes, with IR Cut Filter
4	Minimum Illumination	B/W - 0.05 lx and 0 Lux with IR
5	Lens	P/DC Iris with 2.8 to 8.5 mm or better (3-10.5 mm is acceptable. The Intension is to specify a range.)
6	Electronic Shutter	1/3 to 1/10000s
7	Image Resolution	2 MP or better
8	Compression	H.264/H.265, MJPEG
9	Compression profile	Should support H.264/H.265 baseline, Main profile and high profile

10	Frame Rate and Resolution	2 MP (1920 X 1080) @ 25/30FPS
11	Simultaneous Stream	Minimum 2 streams should be configurable at 1920 X 1080 @ 25 fps simultaneously
12	White Balance	Auto / Manual / ATW / One Push
13	GOV Length	It should be possible to vary the GOV length in the camera setting.
14	Noise Reduction	Digital Noise Reduction 2D / 3D DNR
15	Zoom	4x Digital Zoom or better
16	Field of View	45 º to 84 º Or Better
17	Digital PTZ	Camera should support digital PTZ(optional)
18	Video Streams	Quad Stream supportable, each stream should be H.264/H.265 configurable at different resolutions
19	Video quality view	Video compression type (H.264/H.265/MJPEG) and bit rate of each stream should be viewable at home screen on web browser
20	Image Setting	Saturation, Brightness, Contrast, Sharpness, Hue adjustable
21	Two-way audio	Line in / Line Out
22	Audio Compression	G.711 / G.726 / AAC / LPCM
23	Iris	P / DC iris
24	Wide Dynamic Range	85 dB or better
25	IR	Up to 40Mtr IR distance
26	Alarm	1 x Input / 1 x output
27	Video Content Analytics	Edge/Server Based Camera must have edge/server base analytics Viz; Enter / leave field, Loitering, Line Crossing, Follow route, Idle / removed object, Counting, Occupancy, Crowd density estimation. Bidder to ensure minimum 8 Different types of analytics shall run simultaneously in each Camera and to consider all the analytics mentioned for each camera
28	Storage backup on network failure	Camera should support network failure detection, Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down

29	Edge Storage	Built in SD card slot with support upto 512 GB SD card
30	Network Interface	RJ-45, 10/100Mbps Ethernet
31	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, PPPoE, UPnP, IGMP, SNMP, QoS, ONVIF
32	Text Overlay	Date & time, and a customer-specific text etc
33	Security	HTTPS / IP Filter / IEEE 802.1X
34	Firmware Upgrade	The firmware upgrade shall be done though web interface, the firmware shall be available free of cost
35	Image Rotation	Normal, Mirror, 90 deg clockwise, 90 deg anti clockwise, 180 deg rotate
36	Privacy Masks	Up to 5 privacy masks
37	Audio Transmission mode	Full Duplex / Half Duplex / Simplex
38	Enclosure	IP 67/IP 66 weather proof, IK 10
39	Power	POE / 12 V DC /24 V AC
40	Operating Temperature	-30 °C to 60 °C
41	Operating Humidity	Humidity 10%–90% No Condensation
42	Certification	UL, CE, FCC
43	ONVIF	ONVIF Profile S and G
44	Supported Web Browser	Internet Explorer (7.0+) / Firefox / Safari / Google Chrome

	3. PTZ Surveillance Camera	
S. No	**Features**	**Specifications**
1	Certifications	UL, CE, FCC
2	Compatibility	ONVIF profile S, G
3	Sensor	1/3" CMOS
4	Resolution	2 MP (1920 X 1080) or better
5	Multiple Stream	Quad Stream

6	Frame Rate	up to 60 fps @ 2 MP , 60fps @720p
7	Focal Length	Minimum 4.3- 129 mm or better
8	Field Of view	58.9° - 2.4 ° or better
9	Optical Zoom	30X
10	Digital Zoom	12X or better
11	Focus	Auto / Manual
12	WDR	90 dB
13	Noise Reduction	2D / 3D
14	Shutter Speed	1/1 ~ 1/10000 sec.
15	IR	Inbuilt IR, IR distance minimum 150 Mtr
16	Illumination Adjustment	0.05 @ F1.6 (Color), 0 (B/W) @ F1.6 or better OR Color (125 ms) 0.07 lux, Mono (125 ms) 0.02 lux, Mono with IR 0 lux
17	Day & Night	IR Cut filter
18	Min Illumination	0.05 @ F1.6 (Color), 0 (B/W) @ F1.6 or better
19	Iris	DC Iris
20	Storage backup on network failure	Camera should support network failure detection, Camera should have the capability to start the recording automatically on SD card in case of connectivity between camera and NVR/Storage device goes down
21	Edge Storage	Built in SD card slot with support upto512 GB SD card
22	Video Compression	H.264/H.265
23	Privacy Mask	Up to 16 or better privacy zones
24	PTZ	TCP/ IP Protocol Support
25	Audio	2 Way audio
26	Audio Compression	G.711 / G.726 / AAC
27	PAN	Manual speed 0.1° ~ 210°/s or better, preset speed 240°/s or better OR 360° continuous pan rotation, Manual Pan/Tilt Speeds Pan 0.1° to 100°/sec manual operation Tilt 0.1° to 50°/sec manual operation Preset Pan Speed 300°/Sec Preset tilt Speed 145°/Sec
28	Tilt	0 to 180 degree / Auto flip or -20 to 90 degree / Auto flip as the tilt Angle
29	Presets	256
30	PTZ Operation	8 sequence, 8 cruise (Optional)

31	Speed by zoom	On / Off (Pan and tilt speed proportional to zoom ratio)
32	Home Function	Preset, Sequence, Auto pan, Cruise
33	Calibration	Auto (On/Off)
34	Resume after power loss	Supported zero downtime power switching
35	Protocols	IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP, UPnP, IGMP, SNMP, QoS, ONVIF, ARP
36	Security	HTTPS / IP Filter / IEEE 802.1x
37	Alarm	2 Input / 1 Output or better
38	Alarm response	Preset / Sequence / Auto Pan / Cruise
39	Ethernet Interface	1 X RJ 45
40	Supported Web browser	Internet Explorer (10.0+) / Firefox / Safari / Google Chrome
41	Weather Proof	IP 66 or better
42	Operating Temperature with IR	-35°C ~ 55°C Or better
43	Power Supply	802.3at (PoE+) 4-Pair 60W / AC 24V ± 20% / DC 12V
44	Power Consumption	45W or less

4. Cat 6 4 Pair UTP Cable		
S.No.	**Features**	**Specifications**
1	Type	Unshielded twisted pair cabling system, TIA / EIA 568-C.2 Category 6 Cabling system
2	Network support	Supports ultrahigh speed data networks such as Gigabit Ethernet (1000 Base-T and 1000 Base-TX) and beyond.
3	TIA / EIA 568-B.1	ETL /3P Verified, UL Listed and UL channel verified- All three Certificates are mandatory
4	IEEE 802.3ab	Zero-bit Error, ETL /3P verified
5	Warranty	25-year systems warranty; Warranty to cover Bandwidth of the specified and installed cabling system, and the installation costs. Site certificate must be issued by OEM

6	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel
7	Manufacturer	All passive cabling must be from same OEM (UTP and Fiber)
8	Conductors	23 AWG solid bare copper
9	Insulation	Polyethylene
10	Approvals	May have UL Listed and UL Channel verified ETL/3P verified to TIA / EIA Cat 6
11	Frequency tested up to	450 MHz or better
12	Packing	Box of 305 meters
13	Impedance	100 Ohms + / - 15 ohms
14	Performance characteristics to be provided along with bid	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR
15	Delay Skew:	45ns Max
16	Impedance:	100 ± 15 Ohms
17	Current Rating:	1.5 A Max
18	Conductor DC Resistance:	66.5Ω/km
19	Voltage:	150VAC
20	Propagation delay:	535ns/100m @250MHz
21	Mutual Capacitance:	5.6nF/100m Nominal
22	Insulation Resistance:	500 MΩ Minimum
23	Dielectric Strength:	1000 V RMS
24	Contact Resistance:	10 mΩ Max

5. Cat 6 Patch cord(1/2 Mtr)		
S.No.	**Features**	**Specifications**
1	Type	Cat 6 U/UTP End-to-End Solution and are designed to support data networks for 1000BASE-T applications.
2	Conductor size:	24 AWG stranded copper wire
3	Nom. O.D.:	5.9mm
4	Sheath:	Standard
5	Bend radius:	4X O.D.
6	Boots	Transparent Plug with anti-snag slip on boots
7	RJ45 Plug Standard	ISO/IEC 60606-7-4 and FCC 47 Part 68
8	Sheath Standards	Fire Propagation compliant with CSA FTI, IEC 60332-1, IEC 61034

9	Operating temperature range:	-20°C to 50°C
10	MIN operating life	: 750 insertion cycles
11	RJ45 plug and boot material:	Clear polycarbonate
12	Contact material:	0.35mm thick copper alloy
13	Contact plating:	Selective gold
14	RJ45 plug dimensions compliant with:	ISO/IEC 60603-7-4 and FCC 47 Part 68
15	Commercial Standards	ISO/IEC 11801:2002/Amd 2:2010 Cat 6-, TIA-568-C.2 Cat 6 , ETL Verified/3p Tested
16	Length	Minimum 1 meters

	6. Fish Eye Surveillance Camera	
Reno	Features	Specifications
1	Form factor	Fish eye IP Surveillance Camera
2	Certifications	UL,CE,FCC
3	Compatibility	ONVIF profile S & G
4	Sensor	1/3" Progressive CMOS Sensor
5	Resolution	5 Mega Pixel or better
6	Video Compression	H.264/H.265/MJPEG
7	Day/Night Operation	ICR
8	IR LED	Without IR LED or with Inbuilt / External IR LED , Working distance 5 mtr
9	Shutter Speed	1 ~ 1/10000 sec.
10	Lens	1.19 mm or better fixed focal , F 2.0 , 180 °/360 ° @ full resolution
11	Lens Mounting	M 12/F 2.0 or equivalent
12	Audio Compression	G.711 / G.726 / AAC / LPCM
13	Bit Rate	G.726 : 16Kbps /24Kbps /32Kbps/ 40Kbps, G.711 : uLAW(64Kbps)/ALAW(64Kbps), AAC:128,Kbps, PCM: 128Kbps/256Kbps/384Kbps/768Kbps
14	BLC , WDR	Yes
15	Image Settings	Brightness , Contrast , Sharpness , Saturation , Hue
16	White Balance	Manual, AWB , ATW, One Push
17	Noise Reduction	3DNR / 2DNR / Color NR

18	Zoom	Digital Zoom
19	IR	IR threshold adjustable or equivalent
20	Events	Motion Detection , Tampering Alarm , Network failure detection
21	Event settings	On/Off/By schedule
22	Streaming	Quad Stream Support or better
23	Frame Rate	15 fps or better
24	ePTZ	yes
25	Protocol	ARP, IPv4/v6, TCP/IP, UDP, RTP, RTSP, HTTP, HTTPS, ICMP, FTP, SMTP, DHCP,UPnP, IGMP, SNMP, QoS, ONVIF
26	Security	HTTPS / IP Filter / IEEE 802.1X
27	Network Interface	1 X RJ 45
28	Edge recording	Support SD / Micro SD card of upto 512 GB
29	Event Notification	HTTP / FTP / SMTP
30	Authentication	Password authentication (User and Administrator)
31	Weather Protection	IP 66 or better
32	Operating Temperature	Temp. range (-10°C to 50°C) or better
33	Power Source	PoE / DC 12V
34	Vandal Resistant	IK 10

Sr.No	**Video Wall**	
A	LCD Size	55‖ inch
B	Light Source	LED
C	Resolution	1920*1080P
D	Interface	HDMI IN, DVI IN, VGA IN, PC Audio IN, YPBPR IN(BNC), S-VIDEO IN(BNC), Video IN (BNC),AUDIO IN(RCA),USB, Video Output(BNC)
E		AUDIO Output(RCA)
F	Make	LG/Samsung/Panasonic/BenQ/ViewSonic/Barco/NEC/SPEKTRON

Video Management, Recording, Analytics and Failover Server Specifications

S.No.	Parameter	Specifications
1	OEM PQ	Server OEM should be featured in leader‘s quadrant of Gartner‘s Modular Server Infrastructure twice in last three published year‘s reports.
2	Processor	2x Intel Silver 4110 processor 8 Core 2.1 Ghz 11MB L3 cache
3	Memory	Provide minimum 32 GB RDIMM DDR4 upgradable upto 512 GB.
4	Disk Drive Bay	Front drive bays: Up to 10 x 2.5‖ SAS/SATA (HDD/SSD) with up to 4 NVMe SSD max 48TB or up to 4 x 3.5 SAS/SATA HDD max 56TB
5	HDD Capacity	OS & Application: 2x 600GB 10K RPM SAS Drives in RAID1 configuration. Disk should be in KYD (Keep your Disk) warranty Support
6	RAID Controllers	12 Gbps Hardware 2GB Cache RAID Controller (RAID 0, 1, 5, 10)
7	Network Ports	Minimum 2x 1GE ports. Provide additional 2x 1GE or 2x 10GE SFP+ or 2 x 10GE BaseT basis on solution requirement.
8	Interface	Front ports: Video, 1 x USB 2.0, dedicated remote access controller Direct USB Rear ports: Video, serial, 2 x USB 3.0, dedicated remote access controller network port
9	Power Supply	Server should be provided with Redundant hot plug Power supplies. The Power supplies should be FCC class A certified
10	Optical Drive	The supplied DVD Drive may be internal or external with all necessary cables and accessories
11	Form Factor	1U Rack
12	Operating System	Microsoft Windows 2016 64 bit or Linux
13	Security	TPM 1.2/2.0, Cryptographically signed firmware, Hardware root of trust, Secure Boot, System Lockdown and System Erase
14	Remote Management capabilities	It shall be possible to manage the server hardware and software components remotely.
15		It shall be possible to power on/off and boot the system

		remotely;
16	Server Management Software	The Systems Management software should provide Role-based security. Should provide Pre-failure warning for CPU, Memory and HDD.
17	Warranty	5 Years 24 x 7 Telephonic Support & Part Replacement on Next Business Day

CCTV Workstation Specifications

Sno	Component	Description
1	OEM Prequalification	The OEM should be in top 3 of latest IDC report.
2	Processor	8th generation Intel Core i7 Processor
3	Memory	16GB (2x8GB) 2666MHz DDR4 Memory
4	DIMM Slots	4 DIMM Slots; Up to 64GB 2666Mhz Non-ECC & ECC DDR4 Memory
5	Chipset	Intel® C246 Chipset
6	Hard Drive	2x 2 TB 7200 RPM 3.5" SATA Drives in RAID1 to be offered. Support for up to (1) M.2 PCIe SSD on motherboard slot and Up to (3) 3.5‖ SATA or (4) 2.5‖ SATA.
7	Storage Controller	Integrated Storage Controller supporting SATA 6Gb/s and host based RAID 0/1/5/10
8	Network Ports	Integrated Intel Ethernet Connection I219-LM 10/100/1000
9	Graphics Card	2GB NVIDIA Quadro Graphics Card
10	Operating System	Windows 10 Pro (64bit) English
11	Keyboard and mouse	Yes
12	Optical Drive	DVD+/-RW Optical Disk Drive
13	I/O Ports	1 Microphone and 1 Headphone port in front 4 USB Ports in front 6 USB Ports in rear 1 Audio Line Out in rear
14	Security	Trusted Platform Module TPM 2.0, Microsoft Windows Bitlocker, Local HDD data wipe via BIOS (—Secure Erase‖), Encryption - SED HDD (Opal FIPS), Chassis lock slot support, Chassis Intrusion switch, Setup/BIOS Password
15	Warranty	5 Years 24 x 7 Telephonic Support & Part Replacement on Next Business Day

Video Storage Specifications

S.No.	Parameter	Specifications
1	OEM PQ	The Storage System OEM should be listed in the Top5 of IDC/Gartner latest Report.
2	Storage Capacity	**Minimum 300 TB Usable storage** capacity to be offered
3	Storage Type	Block Storage System with iSCSI and Fibre Channel protocols
4	Controller	Dual redundant Active-Active Controllers. Each Controller shall have minimum dual core 2.2 GHz CPU.
5	Cache	16 GB memory spread across both controllers. SSDs will not be considered as Cache.
6	RAID	Storage System to be configured with RAID6 protection and Global Hot Spares.
7	HDD	Proposed Storage System should be configured with **Minimum 300 TB Usable Capacity** using 4TB/ 8TB/ 10TB/ 12TB NL-SAS 7200 RPM HDDs.
8	Scalability	Proposed Solution should be scalable to 3PB raw capacity in the same Storage Array without upgrading the controllers.
9	Host Connectivity per Controller	Storage should support minimum 4 ports 10Gb iSCSI BaseT/ 4 ports 10Gb iSCSI SFP+/ 4 ports 16Gbps FC/ 4 ports 12Gbps SAS per controller. Bidder to offer any one of these type of connectivity depending upon solution requirement.
10	Backend Connectivity	12Gbps SAS
11	Total Aggregate Storage Bandwidth	Proposed Storage System should ensure a minimum total aggregate bandwidth of 3000 Mbps and1500 IOPS on a 90% Write & 10% Read Video Management Application Workload.
12	Storage Software Licenses	All the following licenses should be provided for entire supported storage capacity of the proposed Array. 1. Thin Provisioning 2. ADAPT- Distributed RAID Groups 3. SSD Read Cache 4. IP Remote Replication 5. FC Remote Replication 6. Snapshots 7. 3 level Tiering 8. Volume Copy 9. SED Encryption
13	Storage Management	Web based management- 1. HTML5, 2. Single-array intuitive element manager, 3. Use common management tasks from convenient locations, 4. Manage storage profiles, network connections, alerts etc.
14	Power Supply	Dual Redundant Power Supply

Specification (VMS)
1. Video Management System General Description
A. The video management system (VMS) specified is an enterprise-class client/server based IP video security solution that provides seamless management of digital video, audio and data across an IP network. The video management system is designed to work with ONVIF compliant 3rd party products as part of a total video security management system to provide full virtual matrix switching and control capability. The video management system consists of the following software modules: management server, recording services, configuration client and operator clients. Video from other sites may be viewed from single or numerous workstations simultaneously at any time. Cameras, recorders, and viewing stations may be placed anywhere in the IP network.
B. The VMS shall support the following recording services:
a) Video Recording Manager
b) Local Storage and Direct-to-iSCSI recording
C. VMS should be delivered with the required hardware/Operating System/Software Components.
VMS should be delivered with capability to archive minimum 30 days of recording from all Cameras.
D. The Client software for Operator should be provided.
E. The VMS shall support cameras compliant to ONVIF Profile S. It shall be possible to scan the network for ONVIF cameras.
F. It shall be possible to use the events provided by an ONVIF camera to trigger events and alarms in the Video Management System. When the events of specific ONVIF camera model are mapped to the camera Events (event mapping) in the VMS, it shall be possible to apply this mapping to all cameras of the same camera model in the system.
G. It shall be possible to export and import the event mapping of ONVIF cameras for the purpose of using the same event mapping on other installed systems.
H. It shall be possible for operator to access live streams and to control PTZ functionality.
I. It shall be possible to record ONVIF compliant cameras.
J. It shall be possible to view the connection status of ONVIF compliant cameras in the Operator Client.
K. It shall be possible to display ONVIF compliant cameras in live view on a digital monitor wall connected to a PC or a video decoder.
L. It shall be possible to connect to cameras and/or other video sources via RTSP stream or MJPEG to the video management system.
M. It shall be possible to record the RTSP stream of cameras and/or other video sources that are connected to the video management system.
N. The control of the playback (camera selection, replay speed, pause etc.) shall be done through the RTSP URL.

O. The VMS may provide a transcoding service for supporting iPad and iPhone devices or html5 based web clients or both as mobile video clients
P. The VMS may provide access to the system by means of Mobile video clients.
Q. The web client shall provide means to search for text data in the logbook and access the corresponding video recordings directly from the results.
R. The web client shall provide means to trigger relays configured in the VMS.
S. The web client shall provide means to trigger video export. The export shall be executed on the central management server of the video management system.
2.01 Video Management System
A. The video management system (VMS) specified shall be a centrally managed, scalable client/server based architecture that allows full virtual matrix switching and control systems.
B. The VMS shall be designed to use a facility‘s existing IT infrastructure and require no special cabling.
C. The VMS shall be capable to be deployed in Local Area Networks (LAN) as well as in Wide Area Networks (WAN). For establishing remote connections across WAN, it shall be possible to route all network traffic between the operator client and other system components through an SSH tunnel, which is using a single port and is secured.
D. The VMS shall allow an operator client to control and view live and playback streams of cameras allocated to the VRM (or equivalent) , VSG (or equivalent) and DVRs (or equivalent) from a remote site (across WAN). This includes ONVIF cameras connected to the VSG.
E. The VMS may provide the possibility to the operator to view transcoded video streams (live and playback) in order view high quality images, when the remote operator client accesses the camera via a low bandwidth connection. On selection, there shall be an indication in the image pane of the operator client to indicate, that the stream is being transcoded.
F. Transcoding may be dynamic
G. The transcoding feature may be able to assess the network link quality and speed and provide the most usable image according to the available network link quality.
H. The transcoding feature may apply to live and to playback as well.
I. It is optional that the VMS shall interface with the Intelligent Video Analysis (IVA) techniques of the IP encoders and IP cameras to provide advanced motion detection that analyzes object size, direction, and speed as well as detecting objects entering or leaving designated areas. The VMS shall also support the detection of fire supported in the Intelligent Video Analysis in the near future.
J. The VMS shall support configuring the IVA parameters from the configuration client.
K. The VMS shall react to events triggered by the IVA of the encoders or IP cameras.
L. The VMS workstations may be connected to up to 4 monitors where each monitor may be configured to display live streaming video, playback video, site maps, or alarms.
M. The VMS may support Lightweight Directory Access Protocol (LDAP) that allows integration with enterprise user management systems such as Microsoft Active Directory.

N. LDAP may also be available for an Enterprise Management System. LDAP shall be configurable in an Enterprise user group.
O. The VMS shall export video and audio data optionally in ASF or MOV or MP4 or CVA or Virtual clip format to a CD/DVD drive, a network drive, or a USB drive. The exported data in ASF or MOV or MP4 or CVA or Virtual clip format may be played back using standard software such as Windows Media Player.
P. The VMS shall export video and audio data optionally in its native recording format to a CD/DVD drive, a network drive, or a direct attached drive. The exported data in native recording format shall include all associated metadata. Viewer software shall be included with the export. Once installed, the viewer software allows playback of the streams on any compatible Windows PC.
Q. It shall be possible to password protect the video export. The export can then only be opened and viewed when the corresponding password is entered.
R. The VMS shall ensure, that Recording is not affected in any way by server downtimes.
S. The operator client shall indicate its connection status to the management server.
T. The VMS may be highly resilient to failure. Even in a concurrent failure of all Management server(s),VRM(s) and iSCSI storage, the operators shall still be able to view & control cameras as well as playing back the video from cameras with a memory card.
U. When the failed system components are back online, no special user or administrator action shall be required for the system to be back to a nominal working mode.
V. The video management system shall support to enable an encrypted communication between the management server and a camera, between the Operator Client and the cameras and between the Video Recording Manager and the cameras. If enabling the encrypted communication, the video management system shall utilize HTTPS (TLS) to encrypt all control communication and video payload via the encryption engine in the device. When utilizing TLS, all HTTPS control communication and video payload shall be encrypted with an AES encryption key up to 256 bits in length.
W. The video management system shall support to confirm the authenticity of recorded video data. The video management system shall support to check hash values against recorded video data of cameras, which provide a recording stream with hash values signed by its certificates.
2.02 Video Management System Components
A. The management server software shall provide management, monitoring, and control of the entire system. The management server software should typically be installed on a server-class computer, but may be installed, with all the other video management software modules on one workstation. The management server shall also maintain data stream management, alarm management, priority management, central logbook, central configuration and user management.
B. Software updates to the operator client and configuration client shall be automatically deployed from the management server.
C. Configuration client software shall provide the user interface for system configuration and management.
D. Operator client software shall provide the user interface for system monitoring and operation. The operator client maintains live monitoring, storage retrieval, and alarm handling.

E. Operators should still be able to login in the operator client software even if the management server is down or not available.
2.03 Video Recording Manager (VRM)
A. The VMR shall be an optional package of the installation program of the VMS.
B. The video management system shall be capable of managing multiple VRMs.
C. The VRM shall be configured from the VMS configuration client. It shall be possible to assign encoders and IP cameras to it.
D. The recording parameters shall be configured in the recording tables of the VMS configuration program. These settings will be replicated into the devices from the management server.
E. The VRM shall manage exclusively the encoders, IP-Cameras, and the supported iSCSI storage systems. It shall offer system wide recording monitoring and management of iSCSI storage, video servers and cameras.
F. The VRM shall support the encoders and cameras to directly stream the data to the iSCSI storage. The VRM shall not be involved in the processing of the data.
G. The VRM shall manage all disk arrays in the system as a single virtual common pool of storage. It shall dynamically assign portions of that pool to the encoders and IP-Cameras.
H. The transfer rate of the data from the encoder or IP-Camera is limited by network speed and the iSCSI data throughput rate.
I. The VRM shall provide redundancy for storage provisioning and failover design for central recording management service.
J. It shall be possible to configure a secondary VRM recording for a selection of camera. Cameras thus record on a different recording target (dual recording). It shall be possible to configure different quality settings for the secondary VRM.
K. It shall be possible to configure a mirrored recording mode where the secondary VRM automatically contains the same devices and quality settings as the primary VRM. Hence, when cameras are added to the primary VRM, they are automatically recorded on the secondary VRM as well. Retention time of the primary and secondary VRM may differ though.
L. It shall be possible to configure failover VRMs for primary and secondary VRMs. In the event of a master VMR failing, the secondary VRM takes over the tasks of VRM that failed.
M. The VRM shall be able to restore a lost recording database from data on the iSCSI storages.
N. The VRM shall provide flexible retrieval of recordings. It shall be able to determine on which iSCSI disk array data from each camera or encoder has been stored.
O. It shall be possible to secure the access to the VRM software with a password. This shall be done in the configuration client.
P. The VRM software shall provide status monitoring information as a web interface. The following information shall be provided:

a) Uptime of the VRM software
b) Bit rate information for the recorded data
c) Retention times per camera
d) Status on recording and storage
Q. The video management system shall allow configuring if playback of recordings is streamed through the VRM or is streamed directly from the iSCSI storage.
R. The video management system shall support to retrieve the playback information, i.e. from which iSCSI storages to retrieve the video, audio and meta-data, either from the Video Recording Manager or directly from the IP encoder or camera. Playback information directly from the IP encoder or camera is limited in time and should be used while the VRM is not available to increase the reliability of the video management system.
2.04 Support of Monitor Walls
A. The VMS shall support analog monitors connected to IP decoders as well as monitor walls.
B. It shall be possible to configure analog monitors in full screen mode or quad mode. When in quad mode, the VMS shall be able to select video and control cameras in any quadrant.
C. It shall be possible to group analog monitors into Analog Monitor Groups (AMGs). An AMG shall specify a monitor arrangement of rows and columns.
D. It shall be possible to restrict access to AMGs to specified operator client workstations.
E. The VMS shall support a monitor wall for an Enterprise System, i.e. an Enterprise Operator Client shall be able to call up and view cameras of the various subsystems on a central monitor wall.
F. The VMS shall support a monitor wall supporting connection of up to two HD monitors via HDMI to display asymmetrical layouts. It shall also support H264 and HD.
G. The VMS shall support the display of IP cameras on the Barco Transform N series with up to 64 cameras and asymmetrical layouts. It shall be possible to select cameras in a special control within the operator client to show them on the Barco Monitor Wall.
2.05 Alarm Management Capability
A. The video management system shall provide the capability to allow alarms to be schedule-dependent.
B. The video management system shall allow alarms to be individually allocated to specific user groups for processing.
C. The video management system shall support replication of events such that a single physical event causes multiple system events. These multiple events shall be independently configurable to allow independent handling of the alarms by multiple operator groups, or to be handled differently according to different schedules.

D. The video management system shall be programmable to selectively, per alarm and per user group, automatically pop-up the alarm video.
E. The video management system shall support display of alarm video in a special Alarm Image Window so users do not have to search their display screens to find the alarm images.
F.The video management system may display alarm video in rows of Alarm Image Panes, with one row per alarm, and with up to 5 Image Panes per row. the row and column arrangement of analog monitor groups
G. The video management system's Alarm Image Panes shall be configurable to display live video, playback video, text documents, site maps, HTML files, or web sites (URLs). Per alarm one playback video and one site map can be configured.
H. The operator client shall be able to display up to 10.000 hotspots simultaneously, spread over up to 20 different maps.
I. The video management system's Alarm Image Pane rows shall be displayed in order of their priority, with rows for higher priority alarms always displayed above lower priority alarm rows. The display order for equal priority alarms shall be selectable between new alarms displayed above existing alarms, or new alarms displayed below existing alarms.
J. The video management system shall provide an alarm reaction time of maximum 2 seconds when sufficient network bandwidth is available.
K. The video management system shall distribute alarm notifications, via entries in the alarm list of the operator user interface, to all members of the user groups to which the alarm is assigned. The alarms shall appear in all said users' alarm lists.
L. The video management system shall operate as follows: when an alarm is accepted by a user, it shall be removed from the other users' alarm lists.
M. The video management system shall allow a user to un-accept an alarm he has previously accepted. In this case, the alarm shall re-appear in the alarm lists of all members of the user groups assigned to this alarm.
N. The video management system shall support the association of workflows with alarms. Workflows shall consist of action plans and comment boxes. An action plan shall display a text document, HTML page, or web site that typically contains instructions for handling the alarm. Comments entered in the comment boxes shall be logged in the system logbook.
O. The video management system shall be configurable to force an alarm workflow. In this case, the alarm cannot be cleared until the workflow is processed.
P. The video management system shall offer the possibility to automatically clear alarms when the originating event condition is no longer true.
Q. The video management system shall allow alarms to be configured to send PTZ cameras to prepositions or to execute camera Aux commands on occurrence.
R. The video management system shall be configurable to put any IPconnected camera into alarm recording mode on alarm occurrence.
S. The video management system shall be configurable to send an e-mail or SMS message in response to an alarm.

T. The VMS shall be capable of displaying video on analog monitors connected to video decoders in response to alarms.
U. The VMS alarm response may take advantage of the row and column arrangement of analog monitor groups by associating a row of analog monitors with each active alarm. Each alarm may display video on multiple monitors, limited by the number of columns in the analog monitor group.
V.As new alarms are received, alarm rows may stack in priority order on the analog monitors.
W. The VMS shall support for alarms to display video on multiple analog monitor groups, with configurable assignment of individual assignment of alarms to monitor groups.
X. In an Enterprise System, the management server of the subsystem, which triggered the alarm shall be indicated.
2.06 Matrix Switch Connection
A. The video management system shall interface with Allegiant family of video matrix switches. Video Encoders shall be connected to one or more monitor outputs of the matrix switcher to provide the video interface.
B. The video management system shall automatically import the camera names from the matrix switch.
C. Matrix switch cameras shall behave the same as IP cameras in the video management system operator client, with the following exceptions:
D. The video management system shall receive and process events from the matrix switch, including alarm events and video loss events.
E. The video management system shall support switching of cameras on the matrix switch monitors via context menus on the Allegiant cameras in the video management system logical tree.
F. It shall be possible to configure the system to use the Matrix Switch PTZ connections to control PTZ cameras when the video is looped from the Matrix Switch inputs to video encoders. The configuration interface shall allow specification of the logical camera numbers in the Matrix Switch, then the video management system shall route PTZ commands for corresponding cameras to the Matrix Switch.
2.07 Pre-Programmed Camera sequences
A. The video management system shall support pre-programmed camera sequences. These sequences will allow cameras to be automatically displayed on the computer image panes and/or analog monitors connected to decoders. The sequences shall support simultaneous display on multiple image panes or monitors. The sequences shall also support camera prepositions for each PTZ camera on each sequence step. The system shall be configurable such that operators can select these sequences from the logical tree or a site map.
B. Pre-programmed camera sequences can be displayed in operator client and on Analog Monitor Groups.
2.08 SDK

A. The video management system shall provide a documented Software Development Kit (SDK) to allow integration to and integration from third party software.
B. The SDK shall expose all functionality of the command scripts, including, but not limited to:
C. SDK functionality shall require authentication to the system.
D. The SDK shall be accessible from all .Net programming languages.
E. A SDK shall be available which allows for programming 3rd party operator clients.
F. A Remote Client SDK shall be available which allows for programming an interface between a running VMS operator client and a 3rd party management system.
2.09 Configuration Changes
A. Configuration changes made in the VMS configuration client shall modify a working copy of the configuration, and shall not affect the active operating configuration.
B. It shall be possible to activate the working copy through a user action in the configuration client, at which point the working becomes the new active operating configuration.
C. It shall be possible to set a date and time in the future at which the working copy becomes active.
D. It shall be possible to view a list of all configuration activations that have been applied to the system. It shall be possible to select any of the activated configurations, and have the system "roll back" to an earlier configuration.
E. It shall be possible to activate a configuration and leave it to the operator to refresh the configuration locally instantly or at a later point in time. It shall be possible to enforce a configuration activation for every operator client connected to the management server.
F. It shall be possible to create and export a reports of the current configuration in CSV-format for the purpose of documentation. There shall be reports for the following configurations:
a) Recording schedules
b) Task schedules
c) Cameras and Recording Parameters
d) Stream and Quality Settings
e) Event Settings
f) Compound Event Settings
g) Alarm Settings

h) Configured Users
i) User Groups and Accounts
j) Device Permissions
k) Operating Permissions
2.10 Operator Client
A. An operator client user logging on to an Enterprise Management Server shall be able to simultaneously access the devices of up to 10 subsystems and a total number of 10000 encoders/cameras. If each subsystem contains less than 100 cameras, the video management system shall support up to 30 subsystems for simultaneous access to the devices.
B. If an operator client loses its connection to the management server, the user shall nevertheless be able to continue working with the connected devices, accessing live and playback and be able to PTZ Dom cameras.
C. The video management system shall provide an administrator-configured Logical Tree. The logical tree shall be freely configurable with any tree structure, with nodes consisting of folders or maps, and leaves consisting of devices (cameras, inputs, and relays), sequences, documents, URLs, or command scripts. Each user group shall only see items in the logical tree for which the administrator has granted access.
D. The logical tree of an Enterprise operator client displays the available device for each configured management server of a subsystem and their connection status.
E. The user shall be able to search the logical tree for item names.
F. The VMS shall provide a user-dependent bookmark Tree. The bookmark tree shall allow saving a time period or a single point in time for later investigation and export. Bookmarks shall be available both for live mode and for playback mode.
G. The VMS shall provide a user-dependent Favorites Tree. The favorites tree shall allow maps, folders, and devices and complete views (image pane patterns with camera assignments) to be configured by each user in a user defined structure. The user's favorite tree shall be available irrespective of the computer with which he logs on to the system.
H. The video management system shall provide an Image Window that displays a collection of Image Panes. The layout shall be optimized for standard and widescreen monitors. With standard monitors the number of image panes per image window shall be variable between 1 (a single full window video) and 25, arranged in a 5x5 grid. A slider shall be available allowing the grid size to be changed from 1x1, 2x2, 3x3, 4x4, and 5x5. With widescreen monitors the number of image panes per image windows shall be variable between 1 and 30, arranged in grids of 1x1, 3x2, 4x3, 5x4, and 6x5. The VMS shall allow image panes to be enlarged or decreased in size within the grid. E.g., in a 5x5 grid, a single image pane can be enlarged to use 4 of the grid elements, creating a larger image within the grid.
I. The video management system shall provide the user of the operator client a flexible image pane, allowing the operator to view video in any pattern created within the grid structure. The operator shall not be restricted to preconfigured layouts, but shall be able to resize the image panes by clicking and dragging on the border of an image pane to drag the border horizontally or vertically or by clicking on a corner of an image pane to drag the corner diagonally to the desired size. Above feature is (optional).
J. The video management shall implement the concept of a selected image pane. The selected image pane shall be highlighted. There shall always be a selected image pane in the operator client application. The selected image pane is always used for control commands, e.g. PTZ control, instant playback control, and audio replay.

K. The video management system shall provide the user of the operator client to be able to select the video stream offered by a camera displayed on an image pane. For cameras configured to use two different streams for live view and for recording, operator shall be able to manually switch between the higher resolution stream and the lower resolution stream for a particular camera.
L. The video management system shall provide the user of the operator client an option to enable an automatic switching between a high and a low resolution stream. The video management system shall automatically switch to a low resolution stream, if the user of the operator client opens multiple cameras on a monitor. The video management system shall automatically switch to a high resolution stream, when the user of the operator client maximizes a camera on the monitor or if he user of the operator client zooms in to see more details. The video management system shall support the audio channels of the encoders and IP cameras. It shall be possible to assign audio sources to cameras. In the operator client it shall be possible to turn on/off the replay of the audio per camera.
M. The video management system shall support two different audio modes, single source audio and multisource audio.
In single source audio mode only the audio source assigned to the camera in the selected image pane is replayed.
In multi-source audio mode all audio sources of the cameras displayed in the client application are replayed.
N. The video management system shall support site maps with hot-spot icons for devices (cameras, relays, inputs but also the Management Server and the Video Recording Manager), command script initiation, camera sequence initiation, and links to other site maps. The site maps shall be capable of being zoomed.
O. The hot-spot icons shall be configurable to optionally display the device name or link title.
P. The status of the devices is visually shown on the corresponding hot-spot icon on the map.
Q. It shall be possible to configure, that the importance of the occurrence of a certain event of a device is especially highlighted. When the selected event occurs, a defined background color will appear at the corresponding hot-spot icon on the map.
R. In addition to the background color, it shall be possible to configure, that the background color is blinking to further highlight the importance of the occurring event.
S. It shall be possible to configure the priority of the events of devices to ensure, that only one event per hot-spot icon is visualized on the map when several events occur simultaneously.
T. The VMS shall provide a thumbnail of the live video, when the mouse is hovered over the camera icon on the map.
U. It shall be possible to select the presets of a Dom camera from the context menu of a hot-spot icon of a camera on the map.
V. It shall be possible to accept and clear alarms of triggered by a certain camera from the context menu of the hot-spot icon of that camera on the map.
W. The operator client shall display live streams from encoders. For IP cameras and encoders it shall be possible to configure per workstation and individually per camera which encoding stream (Stream 1 or Stream 2) of these devices shall be displayed.

X. The operator client shall support the display of the live stream of an ultra HD camera in multiple image panes without the impact on the CPU-load of the operator client. It shall be possible to adapt the different views per image pane using E-PTZ and to save the multi-view as a favorite. When selecting the favorite, the customized live view including the ultra HD views of the same camera are called up on screen. The
Y. Operator Client shall support dewormed panoramic views for displaying 360° cameras. When operator is using E-PTZ in the image pane, an overlay shall indicate his position for better orientation.
Z. The Operator Client shall provide dewormed playback for video recorded with a 360° lens.
AA. It shall be possible for the operator to pick an object in a live stream and trigger the camera to focus and follow that particular object automatically.
BB. The video management system shall support automatic sequencing. It shall be possible for users to multiple-select cameras (control-click or shift click), and drag the multiple-selection to an image pane or a graphic representing an analog monitor connected to a decoder. All of the cameras in the selection shall then sequence in the image pane or monitor at a user selectable rate. It shall also be possible to drag a folder to an image pane or analog monitor. In this case, all of the cameras contained within the folder shall sequence.
CC. The video management system shall support PTZ control with a dedicated graphical joystick control, supporting Pan, Tilt, Zoom, Iris, Focus and Aux Command operations. It shall also support PTZ control via clicking the mouse in the image panes. For PTZ cameras, the cursor shall change to indicate the Pan/Tilt direction when hovering over the corresponding image pane. The Pan/Tilt speed shall increase as the cursor moves farther from the center of the image pane. An area in the center of the image pane shall be used for zoom-in/zoom-out control. Once zoom is initiated, the zoom speed shall increase as the cursor is moved farther from the center of the image pane.
T. The VMS shall provide a thumbnail of the live video, when the mouse is hovered over the camera icon on the map.
U. It shall be possible to select the presets of a Dom camera from the context menu of a hot-spot icon of a camera on the map.
V. It shall be possible to accept and clear alarms of triggered by a certain camera from the context menu of the hot-spot icon of that camera on the map.
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DD. The video management system shall support digital zoom of any image pane. A dedicated graphical control shall be provided in the user interface for this purpose. In addition, the mouse wheel shall control digital zoom when the mouse cursor is hovering over a selected image pane.
EE. The video management system shall provide an Instant Playback function that displays recorded images on one or multiple image panes. Recorded images from a single camera may also be played back on multiple panes. Instant playback supports pause, play forward, play reverse, single step forward, single step reverse, fast-forward, and fast-reverse.
FF. The video management system shall support a timeline that provides a graphical overview of video stored on the disk. The timeline shall display a timescale that can be adjusted from at least 15-minutes per division to 1 month per division. For each camera displayed in playback mode, the timeline shall provide a line that depicts the video storage for that camera. The line shall be color-coded to show if video is recorded for the displayed time period, and if so, if it is normal recording, motion recording, or alarm recording. The line shall be cross-hatched if the video is protected from deletion. The line shall also indicate if associated audio is recorded during the displayed time period.
For VRM and Local Storage recordings color coding is limited to protection and audio indication.
GG. The video management system shall support to configure an alarm whenever video recording is manually deleted.
HH. The video management system shall support simultaneous time synchronous playback. Playback shall support single-step forward and backwards; play normal speed forward and backwards; play high-speed forward and backwards; and play slow-speed forward and backwards.
II. The video management system shall deploy smart methods to improve the playback user experience at high speeds, mitigating workstation performance limitations.
JJ. The video management system shall support search of recorded video for motion in user-specified areas of a camera image.
KK. The video management system shall support search of recorded video with at least the following criteria: object size, object color, direction, and speed as well as detecting objects entering or leaving designated areas. This Intelligent Video Analysis (IVA) based post-recording search will work for cameras recorded by VRM and Local Storage.
LL. The video management system shall optionally display the information of the video analytics such as cells with detected motion, object masks, and trajectories in live and playback.

MM. The video management system shall support searching based on any combination of time/date-rage, event type(s), alarm priority, alarm state, and device(s). It shall be possible to save and recall search parameters.
NN. The video management system shall support search for text data retrieved from ATMs, point of sales, barcode readers or other applications. The search shall be performed in the logbook using a wildcard search. The search results shall appear in a list and selection of a result shall directly call up the exact video images recorded with the text data.
OO. The text data shall be displayed in the image pane of the corresponding camera in live and playback. It shall thus be possible to simultaneously display text data of multiple cameras. The operator shall furthermore be able to choose whether the text data is displayed on the right side or below the image pane.
PP. The video management system shall graphically display device states on its icons in the logical tree structure and on sitemaps. For cameras, the states shown shall include: loss of the analog video signal, network connection loss, video recording, video signal too noisy, video signal too bright, video signal too dark, video de-adjusted, and video includes associated audio. For relays and contact inputs, the open or close state shall be indicated.
QQ. The video management system shall support switching of cameras to analog monitors connected to decoders. The cameras shall be selectable via drag and drop from the logical tree or from the sitemaps.
RR. The video management system shall support an indication for the operator client regarding the connection state to the management server. This shall include connected, disconnected, and configuration out-of sync between management server and operator client. The connection state of the management server shall be indicated on the icon of the device tree.
SS. The operator client shall support a configurable inactivity logoff for security reasons. The operator client will logoff automatically when no activity is detected from the operator in a configured period of time.
TT. The video management system shall support a centrally stored user profile to store settings individual for each operator. These settings shall include but are not limited to sequence dwell times, instant playback replay time and image pane ratio settings (16:9 or 4:3) individually per monitor. These settings shall be available independently of the physical workstation to the operator.
UU. For security reasons, it shall be possible to configure that the concurrent logon of the same user on different Operator clients is being omitted.
VV. It shall be possible for the operator client to utilize one or multiple graphical processing unit(s) to decode h.264 encoded video streams.
WW. It shall be possible for the operator client to connect to a management server using an SSH tunnel. The SSH tunnel shall be used for all communication between the operator client and other system components.
XX. The operator client shall be able to display four UHD cameras simultaneously smoothly using hardware accelerated decoding.
YY. For security reasons it shall be possible to enforce a secure password policy for the password user define to log on to the operator clients. When secure password policies are enforced, the Operator client will only accept passwords with
a) A minimum length of 8 digits
b) At least one capital letter

c) At least one capital letter
2.11 Audio Intercom Functionality
A. The video management system shall support bidirectional audio intercom functionality. Audio intercom streams audio data from an operator client Workstation to the audio output of the encoders.
B. The audio intercom function shall be activated by a button in the operator client Workstation. When the button is pressed the operator shall be able to speak into a microphone on the client computer. The audio shall be transmitted to the audio source which is assigned to the currently selected camera.
2.12 CCTV Keyboard Control
A. The system shall allow system control via the keyboards.
B. The keyboards shall support an Enterprise System, i.e. with a keyboard connected to an Enterprise operator client the desired subsystem‘s management server shall be selectable.
C. Keyboard connections shall be possible to operator client Workstations.
D. When CCTV Keyboards are connected to decoders, it shall be possible to control the analog monitor groups in the system via the CCTV keyboard.
E. When CCTV Keyboards are connected to decoders, it shall be possible to control PTZ operation of the selected camera using the keyboard joystick.
F. When CCTV Keyboards are connected to decoders, it shall be possible to control set and call-up -PTZ prepositions of the selected camera using the keyboard. Above features is (optional).
G. When CCTV Keyboards are connected to decoders, it shall be possible to execute PTZ and Aux-commands of PTZ Cameras on the selected camera using the keyboard. Above features is (optional)
H. When CCTV Keyboards are connected to operator client Workstations; it shall be possible to control the current Image Pane selection using the keyboard joystick.
I. When CCTV Keyboards are connected to operator client Workstations, it shall be possible to control the analog monitor groups in the system or control any Image Pane on the connected operator client Workstation, using the CCTV keyboard.
J. When CCTV Keyboards are connected to operator client Workstations; it shall be possible to control PTZ operation of the selected cameras using the keyboard joystick.
K. When CCTV Keyboards are connected to operator client Workstations; it shall be possible to control set and call-up PTZ prepositions of the selected camera using the keyboard.
L. When CCTV Keyboards are connected to operator client Workstations; it shall be possible to execute PTZ and Aux-commands of the selected Auto dome camera using the keyboard.

M. When CCTV Keyboards are connected to operator client Workstations, it shall be possible to control playback of video, including both Instant Playback and Playback-mode synchronous playback, using the CCTV keyboard.
N. When CCTV Keyboards are connected to operator client Workstations; playback control should include jog-shuttle emulation using the Keyboard Joystick.
O. When in Jog-shuttle emulation mode:
a) Rotating the Keyboard joystick will control forward and reverse playback, with playback speed proportional to the amount of joystick rotation.
b) Moving the joystick up shall set the video into slow forward playback mode. Additional upward movements shall incrementally increase forward playback speed
c) Moving the joystick down shall set the video into slow backward playback mode. Additional downward movements shall incrementally increase backward playback speed.
d) Moving the joystick right shall set the video into pause mode. Additional rightward movements shall step the video one frame forward.
e) Moving the joystick left shall set the video into pause mode. Additional leftward movements shall step the video one frame backward.
2.13 Integration with Intrusion panel
A. The video management system shall be able to connect to UL-approved intrusion panels and browse the areas and devices configured in the panel in the Configuration Client.
B. The video management system shall be able to connect to 20 intrusion panels.
C. The video management system shall be able to map the events of the intrusion panel to events in the video management system in order to use these events in the event and alarm engine of the video management system.
D. The video management system shall be able to use the events of the intrusion panel to create compound events to trigger actions.
E. The Operator Client shall indicate the connection and authentication state of the intrusion panels by means of icons.
F. The video management system shall support the following devices from the intrusion panel:
a) Areas
b) Doors
c) Outputs
d) Points

G. The states of these intrusion devices shall be shown on the icons in the device tree of the operator client as well as on the hot-spot icons of the map. The states that should show are:
H. The user of an Operator Client shall be able to execute the following operations from the context menu of the intrusion device icons in the device tree as well as from the context menu on the corresponding hotspot icons on the map:
a) Arm, force arm and disarm areas of an intrusion panels
b) Silence areas of the intrusion panel
c) Open and close outputs
d) Unlock, secure and cycle doors
e) Bypass and un-bypass points
I. All the user actions of the operator with regards to the intrusion devices in the video management system shall be logged
J. The video management system shall provide separate user permissions for the above mentioned operations per user group.
2.14 Provision of server based analytics
A. The video management system shall provide an integration with a server based analytics platform which allows to use analytics from many different vendors.
B. On connection with the management server of the video management system, the analytics platform shall retrieve the list of configured cameras into the analytics platform to prevent manual setup of the cameras
C. It shall be possible to configure which video stream (stream 1 or stream 2) provided by the cameras shall be used for the analytics
D. The system should allow the use of a pool of video analytic algorithm on any cameras without limitations. It should be very easy to change an algorithm from a camera to another.
E. The video analytic processing should be able to run on top of a server or to be virtualized using leading virtualization technologies (vmWare, Hyper-V)
F. The video analytic processing should be able to scale seamlessly by adding servers.
G. The video analytic processing should be able to be redundant. Server failure should not impact the functionality of the system, as the analytics on this server failover to another automatically and in a very short time.
H. The system shall offer, at minimum the following video analytic:
a Crowd/people management (For all Camera's)
i. Panic
ii. Loitering

iii. Tracking People
iv. Fall
vi. Covered Faces
b Vehicle Management (Minimum 2)
i. License plate (LPR/ANPR)
c Being able to cover (Minimum 8)
ii. Traffic Management
iii. Vehicle Counting
iv. Wrong way
v. Speed Vehicle
vi. Stationary Vehicle
d Perimeter, security & safety (For all camera's)
i. Perimeter and Intrusion
ii. Lost objects
iii. Stolen Objects
iv. Object Tracking
v. Graffiti
vi. Tampering
vii. Fire and Smoke
viii. Temperature
I. It shall be possible to setup several –lists‖ in the database of the analytics platform. A list contains License plates or faces and related data.
J. The analytics platform shall detect license plates or faces in the live stream provided by the cameras and shall match them against the license plates and faces stored in data-base of the analytics platform
K. When there is a match an event shall be send to the video management system. Additional data such as the camera and the time of detection shall be included in the event provided to the video management system.
L. When the event provided by the analytics platform triggers an alarm in the Operator Client of the video management system, the following content shall show in a separate Analytics Viewer:
a. The original image of the live camera where the license plate of the face has been detected
b. A cropped extract of the original image just the extracted license plate or face

c. The corresponding face or license plate taken from the database of the analytics platform to allow the operator to compare the captured image with the reference image from data-base
d. Additional data related to the face or license plate stored in the data-base of the analytics platform (e.g. name of person etc.)
M. All events and meta-data shall be stored in the logbook of the video management system to allow to search for a license plate or person that triggered an alarm.
2.15 Support of video fire detection
A. The VMS shall support Video Fire Detection by integrating a Network camera with integrated video-based fire detection and simultaneous intelligent video analysis.
B. Videos shall be processed and analyzed within the camera itself, with no extra hardware required.
C. The video-based fire detection shall offer a fast detection and high false alarm robustness with best picture quality even at challenging light conditions.
D. The video-resolution shall be up to HD with activated video-based fire detection.
E. The video-based fire detection shall detect uncovered flames with minimum 1.6% of the picture width.
F. Uncovered uprising smoke shall be detected with minimum 2.3% of the picture width.
G. The detection shall detect test fires TF1 to TF8 according to EN54.
H. For the detection of flames and smoke a minimum illumination level of 7 Lux shall be sufficient.
I. Results of the video-based fire detection and Intelligent Video Analysis have to be available as metadata in addition to the video data transmitted for alerting, storage and forensic search.
J. In the occurrence of an event triggered by the camera due to fire or smoke detection, the specific alarm shall appear in the Operator Client, indicating, that this alarm is triggered by a fire or smoke detection.
2.16 Video Content Analytics
Cameras shall be provided with edge based Embedded VCA(Video Content Analysis)
The software offered shall support built-in tamper monitoring to detect camera hooding/masking, blinding, defocusing and repositioning. Image stabilization to remove jitter from shaking video sources such as cameras mounted on poles or simple vibrations.
Shall have broad range of detecting tasks and object filters available
Shall support automatic classification of person, bike, car, truck
The following tasks shall be available:
• Detect objects within, entering, or leaving an area
• Detect multiple line crossing from single line up to three lines combined in a logical row

• Detect loitering in an area related to radius and time
• Detect objects which are idle for a predefined time span
• Detect removed objects
• Detect objects who‘s properties such as size, speed, direction, and aspect ratio change within a configured time span according to specification (for example something falling down)
• Count objects crossing a virtual line or entering a certain area
• Detect a certain crowd level in a predefined field
• Detect specified motion direction and speed even in crowds (for example a person moving the wrong way in a one-way gate)
• Combine tasks using scripts

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum localcontent of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labourcomponent.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-8
HVAC

Conditions and Specifications for HVAC System

Scope of work:

This part involves design, supply, installation, testing and commissioning of HVAC system in Centenary Buildings as per suitability, functional requirement, CPWD specifications. Liabilities for rectification of defects shall be for Three year.

The buildings which are to be air conditioned are detailed as below:

Sl. No.	Name of the Building	No. of Floors	Type of air conditioning
01.	Centenary Building (Auditorium& lecture hall)	G+4	Central air conditioning & Heating system (chilled / Hot water)

COMMERCIAL & ADDITIONAL CONDITIONS

1.0. GENERAL

This specification covers manufacturer, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installation, final testing, commissioning, putting into operation of plant including one year guarantee period complete for the following work.

The work shall be executed as per CPWD General Specifications for Air Conditioning Works-2017, relevant IE rules, relevant IS and as per directions of Engineer-in-Charge. These additional specifications & conditions are to be read in conjunction above and in case of variations the specifications given in the Additional Specifications & Conditions shall apply. However, nothing extra shall be paid on account of these as the same are to be read along schedule of quantities for the work.

Any specifications which are not mentioned in this document shall be as per CPWD guidelines and approval of IIT(ISM)/WAPCOS engineer-in-charge.

2.0 LOCATION

The work is to be executed at **IIT(ISM) Campus,** JHARKHAND**.** The contractor is advised to visit the site before submission of their tender and ensure that equipment being offered by them shall be accommodated in the space available. No T & P shall be issued by department and nothing extra shall be paid on this account.

3.0. Running in Period, Guarantee and Payment Terms.

3.1 Running in Period & Date of Acceptance.

After the installation work has been completed by the contractor, he will conduct tests and make adjustments as may be necessary to satisfy himself that the plant is capable of continuous running. There after he will offer to the department a running-in period of 30 days subject to a minimum aggregate of 300 hrs at his cost. All the equipment shall be run by rotation. The equipment will be operated and a log book of all parameters will be maintained during this the period. The contractor will be free to carry out necessary adjustment during this period out stopping the plant. The equipment will be said to have successfully completed the running–in-period, if no break down or abnormal/unsatisfactory operation of any machinery occurs during this period. After this the equipment will be made available for beneficial use.

After the equipment has operated without any major breakdown/trouble for the above specified running-in-period it shall be taken over by the department subject to guarantee clause mentioned below. This date of taking over of equipment after trouble free operation during the running-in-period shall be the date of acceptance.

Any loss of refrigerant or oil during the running in period shall be made good by the contractor free of charge.

Capacity test of chiller and other major equipment may be carried out as and when outside conditions become stabilized.

4.0 Seasonal testing may be carried out as & when outside conditions become suitable.

5.0 Guarantee.

5.1 The contractor shall guarantee the complete system to maintain the specified conditions under all conditions of ambience and internal loads. Also the inlet/outlet temperatures at the specified flow of water in the chiller unit shall be guaranteed.

5.2 All equipments shall be guaranteed for a period of 36 months from the date of acceptance and taking over of the installation by the Department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk & cost of the contractor. The decision of Engineer-in-charge in this regard shall be final.

5.3 Annual comprehensive maintenance is also in the scope of contractor during the defect liability period of three year.

5.4 Any leakage of refrigerant and/or oil due to defective design, manufacture, workmanship or installation during the guarantee period shall be make good by the contractor free of charge.

5.5 When the first major seasonal test cannot be carried out on commissioning of the installation due to any reason not attributable to the contractor, the installation will be handed over to the Department for beneficial use after completion of successful running in test of 7 days subject to a minimum aggregate of 120 hours. The balance payment shall be released to the contractor on his furnishing a bank guarantee shall be valid for a period of 6 months. However it will be extended till the successful completion of the major seasonal test. This bank guarantee shall be independent of the one, if furnished for performance guarantee.

5.6 The summer or Monsoon Test shall be considered major seasonal tests for the purpose of the above payment terms.

5.7 The following shall be considered major seasonal test for the purpose of the above payment terms:

- Air-conditioning system : Summer or Monsoon
- Heating : Winter

6.0 Power Supply.

6.1. Power Supply shall be arranged by contractor and shall make his own arrangement.

6.2 The power supply for testing and commissioning of the complete installation shall be arranged by contractor. For this purpose, the power supply shall be given at the main incomer units of the main electrical panel rough U. G. Cable, or bus trunking arrangement in the AC Plant Room, AHU‘s & FCU. Power supply for testing or individual component during installation is the scope of contractor.

6.3 All arrangement of connecting main panel or power distribution to the various equipments as indicated in scope of work shall be done by the contractor.

6.4 The contractor shall not use the power supply for any other purpose than that for which it is intended for. No major fabrication work shall be done at site. Power shall be used only for welding/cutting works etc. required for execution of work. The power supply shall be disconnected in case of such default.

7.0 Water Supply and Drainage

7.1 Water supply shall be arranged by the contractor.

8.0 Data Manual and Drawings to be furnished by the tenderer.

8.1 The tenderer shall furnish along the Technical Bid, detailed technical literature, pamphlets and performance data for appraisal and evaluation of the offer. Computerized selection of chilling unit and blowers shall be furnished.

9.0 After award of work.

The successful tenderer would be required to submit the drawing as per Pare 1.18.2 of CPWD Specification HVAC Works below schedule within 90 days of award of work for approval before commencement of installation.

The successful tenderer shall furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance i/c preventive maintenance & trouble shooting together h all the relevant data sheets, spare parts catalogue and workshop procedure for repairs, assembly and adjustment etc. all in triplicate.

10.0 Extent of work.

10.1 The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation all layout charts whether or not those have been mentioned in details in the tender document in connection this contract.

10.2 All building works necessary for installation of equipment, foundation, making of opening in floors and restoring to their original condition, finish and necessary grouting etc. as required.

10.3 Operation & maintenance (Routine & Preventive) for one year from date of completion.

10.4 The work is turnkey Project. Any item required for completion of project but left inadvertently shall be executed in the quoted rates.

11.0 **Inspection and testing:**

Initial inspection at work and final inspection and testing at site shall be carried out as per chapter 17 of CPWD General Specification of HVAC work 2017. If desired, the department shall be free to carry out any Sample Test of the material like GSS sheet etc at the approved lab as decided by the department. The material should conform to the relevant BIS. The Contractor should submit the

Sample of all such material in advance so that it should not create any hindrance in the progress of work.

12.0 **Compliance Regulations and Indian Standards, Indemnity & Insurance**.

12.1 **Conformity statutory Acts, Rules, Standards and Codes**.

i) All components shall conform to relevant Indian Standard Specifications, wherever existing, amended to date.

ii) All electrical works shall be carried out in accordance with relevant regulation, both statutory & those specified by the provisions of Indian Electricity Act, 2003 and Indian Electricity Rules, 1956 amended up to date. They shall also conform to CPWD General Specifications for Electrical Works, Part-I: Internal, 2005 and Part-II: External, 1994 and Part IV (Sub-Station) 1983 and HVAC 2017 as amended to date.

12.2 Safety Codes and Labour Regulations.

i) All relevant safety procedures outlined in the safety codes as specified in CPWD Specification for HVAC Work & Other CPWD Specification shall be complied.

ii) In respect of all labour employed directly or indirectly on the work for the performance of the air conditioning contractor‘s part of the work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provisions, B.I.S. recommendations, factory act, workman‘s compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty of Rs.2000/- for each violation. In addition the Engineer-in-Charge, shall be at liberty to make arrangements and provide facilities as aforesaid to recover the cost f

iii) rom the contractor.

iv) The contractor shall provide necessary barriers, warning signals and others safety measures while laying pipe lines, ducts etc. or wherever necessary so as to avoid accident. He shall also indemnify WAPCOS against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian Law and regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there from during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

13.0 **Verification of correctness of Equipment at Destination.**

The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected.

14.0 The contract value shall be inclusive of custom duty, CVD etc. on imported equipments if any & also inclusive of GST on indigenous equipments/materials and inclusive if octroi duty, service tax or any duties free of fees levied by government or any public or local bodies .

15.0 The contractor shall provide all equipments, instruments, labour and such other assistance required by the Engineer-in-Charge for measurement of the works, materials etc.

16.0 Ventilation and pressurization arrangements shall be applicable as per code or requirement

17.0 All roofs of air conditioned areas shall be insulated with under deck insulation.

Equipment installation layout and accessories shall be as per good engineering practice, latest ISHRAE Hand book and approval of engineer in charge.

18. IMPORTED EQUIPMENT

The successful tenderer shall submit upon award the following to facilitate the department in their application for concessional duty for equipment/material proposed to be directly purchased and imported by them.

a. Four copies of proforma invoice from Manufacturer/Supplier drawn in the name of department identifying FOB price from the country of origin and Freight cum Insurance upto site.

b. Four sets of Technical .Literature, high lighting model number and all technical details of the actual equipment/material offered by them.

B. Successful bidder shall indicate packing specification for imported equipment / material.

d. Successful bidder shall furnish undertaking from local agents for all imported equipment that they will provide all technical data & engineering information on the product through their principles, all back-up services during detailed engineering testing and commissioning and service during and after the defects liability period.

e. Computerized equipment selection print outs.

19.0 BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

20.0 DRAWINGS

The HVAC Drawings listed under which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment, controls, grilles and diffusers.

The contractor shall follow the tender drawings in preparation of his GFC drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed. HVAC contractor shall prepare co-ordinated services drawings to satisfy false ceiling heights and reflected ceiling plans as required by status of work. Soft copies of other services shall be forwarded to HVAC contractor for co-ordination. In case of routing conflict, HVAC contractor shall indicate suitable modification in routing for other services. HVAC contractor shall clearly indicate false ceiling trap door requirement for suspended HVAC equipment in time otherwise any rework in false ceiling to provide trap door shall be at HVAC contractor‘s cost.

Maximum headroom and space conditions shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify to department before proceeding with the installation.

In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the department any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the department without additional cost to the department. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

21.0 SHOP DRAWINGS

21.1 All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer‘s Drawings. All heat load calculations shall be done using latest version of E-20 or Trace 600 only. Within three weeks of stipulated date of start, contractor shall furnish, for the approval of the department, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, AHU rooms, fan rooms, cooling towers, fan coil units, ventilation fans; detailed ducting drawings showing exact location of supports, flanges, bends, tee connections, reducers, guide vanes, silencers, distribution grids, volume control dampers, collars, grilles, diffusers; detailed piping drawings showing exact location and type of supports, valves, fittings etc; acoustic lining and external insulation details for ducts, pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the department. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings. Minimum 6 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers. When the department makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the department for the exclusive use by the department and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

21.2 Shop drawings shall be submitted for approval three weeks in advance of planned delivery and installation of any material to allow department ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved programme.

21.3 Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

21.4 Samples of all materials like grilles, diffusers, controls, insulation, premoulded pipe section, control wires etc shall be submitted to the department prior to procurement. These will be submitted in two sets for approval and retention by department and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.

21.5 Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

21.6 Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the department. Any delay on such account shall be at the cost of and consequence of the Contractor.

21.7 HVAC Contractor shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, Plumbing & Low Voltage Contractors to ensure adequate clearances are available for installation of services for each trade.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the department, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the department.

21.8 Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to department for acceptance of anticipated variation in contract amounts and also advise department to initiate action for procurement of spare parts and tools at the completion of project.

22.0 QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the department. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the specified dB / NC levels.

23.0 ACCESSIBILITY

The Contractor shall verify the sufficiency of the size of the shaft openings, clearances in cavity walls and suspended ceilings for proper installation of his ducting and piping. His failure to communicate insufficiency of any of the above, shall constitute his acceptance of sufficiency of the same**.** The Contractor shall locate all equipment which must be serviced, operated or maintained in

fully accessible positions. The exact location and size of all access panels, required for each concealed control damper, valve or other devices requiring attendance, shall be finalized and communicated in sufficient time, to be provided in the normal course of work. Failing this, the Contractor shall make all the necessary repairs and changes at his own expense. Access panel shall be standardised for each piece of equipment / device / accessory and shall be clearly nomenclature / marked.

24.0 MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be strictly in conformity with list of approved manufacturers.

25.0 MANUFACTURERS INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

26.0 ELECTRICAL INSTALLATION

The electrical work related to air conditioning services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the department. All air conditioning equipment shall be connected and tested in the presence of an authorised representative of the contractor.

The air conditioning system shall be commissioned only after the contractor has certified in writing that the electrical installation work for air conditioning services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturers instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for air conditioning services, lies solely with the contractor**.**

27.0 COMPLETION CERTIFICATE

On completion of the Electrical installation for air conditioning, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire electrical installation for air conditioning system duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

28.0 BALANCING, TESTING AND COMMISSIONING

Balancing of all air and water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season.

The results for summer, monsoon and winter air conditioning in quadruplicate, shall be submitted for scrutiny. Four copies of the certified manufacturers performance curves for each piece of equipment, high lighting operational parameters for the project, shall be submitted along with the test certificates. Contractor shall also provide four copies of record of all safety and automatic control settings for the entire installation.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the department. All tests shall be carried out in the presence of the representatives of the department.

29.0 COMPLETION DRAWINGS

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of two sets of CD‘s and four portfolios (A-1 or A-0 size) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate complete plant room layouts, ducting and piping layouts, location of wiring and sequencing of automatic controls, location of all concealed piping, valves, controls, dampers, wiring and other services. Each portfolio shall also contain consolidated control diagrams and technical literature on all controls. The contractor shall frame under glass, in the air conditioning plant room, one set of these consolidated control diagrams. Diagrams shall include GA & SLD of HVAC MCC, schematic piping drawing and HVAC plant room layout.

30.0 OPERATING INSTRUCTION & MAINTENANCE MANUAL

Upon completion and commissioning of part HVAC system **t**he contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer‘s operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by department and two for department‘s Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment.

31.0 ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labour and helpers for operating the entire installation for a period of fifteen (15) working days of ten (10) hours each, to enable the department‘s staff to get acquainted with the operation of the system. During this period, the contractor shall train the department‘s personnel in the operation, adjustment and maintenance of all equipment installed**.**

32.0 UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive log book containing tables for daily record of all temperatures, pressures, humidity, power consumption.

starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the department‘s review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.

The renderer shall include a list of other projects where such an Operation Assistance has been provided.

33.0 Order of Precedence:

In case of any contradiction in conditions, nomenclature or any other parameter, the following order of precedence shall be observed.

1. Technical/ Commercial terms and conditions.
2. CPWD specifications.
3. National Building Code-2016.
4. I. S. Codes.
5. State PWD Codes.
6. Any other standard.
7. Sound Engineering Practices

TECHNICAL SPECIFICATIONS

Water Cooled Screw Chilling Machine with VFD

Scope of Work

The scope of work not limited to the following shall be:-

a) Chilling machines specified in this section are of the water cooled, screw chillers with single / double compressor on 415 V motor, VSD Capacity control mechanism and Air-cooled VSD starter chiller mounted / free standing with active harmonic filters so as to meet IEEE 519 Guidelines.

b) Manufacture, assemble, test at works and deliver to site, install, test and commission to the entire satisfaction of Engineer-in- Charge at site.

c) Manufacturer‘s factory representative to be provided for coordination, start-up and testing supervision of the chillers at site.

d) Performance will be certified & witnessed in accordance with ARI Standard 550/590. Necessary documentation for factory & site testing of chillers along with tools for maintenance & operation shall be provided.

e) VSD starter should be air-cooled IP 54(NEMA 12) enclosure type with active harmonic filter to reduce harmonic distortions. The chiller should have THDi (current) less than 5% at equipment level. The VSD panel should display the current distortion so that low THDv (voltage) is achieved at PCC (Point of common coupling) at grid level. Manufacturer to provide PC based software for communication with the VSD, fault logging and analysis

Codes & Standards

The design, materials, manufacture, inspection, testing & performance of Water Cooled Screw chilling machine shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed. Following codes & standards (Not Limited To) shall be followed:-

ARI 550/590 - Air Conditioning and Refrigeration Institute. Standard for Screw Water Chilling Packages (General Specifications, Testing and Rating).

ARI 575	-	Air Conditioning and Refrigeration Institute. Standard Method of Measuring Machinery Sound Within Equipment Rooms (Basis of all data presented or field testing of equipment, with relation to sound requirements).
ASME CODE	-	American Society of Mechanical Engineers. Code for Unfired Pressure Vessels - Section VIII (Design, construction, testing and certification of pressure vessels).
ANSI-B9.1	-	American National Standards Institute. Safety Code for Mechanical Refrigeration (overall general safety Requirements, relief device sizing, etc.)
ANSI-B31.5	-	American National Standards Institute. Code for Refrigerant Piping
TEMA	-	Tubular Exchanger Manufacturer‘s Association
ISO R281	-	Rolling Bearings – Dynamic Load Ratings and Rating Life

Chiller Design Duty

a) Water Chilling Unit shall be of Screw type & shall produce actual refrigeration capacity of 225 / 400 TR, cooling 450 / 800 US GPM of chilled water from 56.0 to 44.0 °F when supplied with 675 / 1200 US GPM of condenser water at 80°F. The bidder shall submit performance characteristics of chillers for both specified conditions as above and at ARI conditions.

b) The bidder shall submit printout of computerized selection of chillers duly stamped and signed by authorized representative of the chiller manufacturer along with the tender.

c) The cooler shall be selected for 0.00050 (fps units) / 0.0001 (mks unit) fouling factor and a maximum liquid pressure drop of 6.0 meters. Water side shall be designed for minimum 150 psig working pressure. The condenser shall be selected for 0.00100 (fps units) / 0.0002 (mks unit) fouling factor and maximum liquid pressure drop of 6.5 meters. Water side shall be designed for minimum 150 psig working pressure.

d) Power shall be supplied to the chiller at 415 volts – 3 phase - 50 Hertz. The chiller shall use R-134a refrigerant.

Screw Compressor

The Rotary Screw Water chilling machine shall consist of Single / Twin, Horizontal / Vertical, Hermetic / Semi -hermetic / Open, Direct driven low speed helical rotary compressors, refrigerant / air cooled motor, oil separator, evaporator, condenser, factory mounted microprocessor based panel, interconnecting refrigerant piping, electronic expansion valve, controls and accessories to make it compact & efficient unit. The capacity control shall be achieved by use of slide valve to provide fully modulating control from 100 % to 20 % of the full load. The cost of starter is to be included in the cost of unit.

Hermetically Sealed Compressor

The Vertical type helical rotary compressor shall be direct drive at low speed for higher reliability & efficiency. The compressors should have minimum rotating parts. The rotors shall be mounted on antifriction bearings designed to reduce friction and power input & suitable to handle radial & axial loads.

Compressor Motor

The driving motor shall be suitable hermetic type protected against damages by means of built in protection devices & suitable for 415 Volts ± 10%, 50Hz ± 5%, AC supply.

Semi hermetic Compressor

The horizontal helical rotary compressor shall be direct drive at low speed for higher reliability & efficiency. The compressor should have minimum rotating parts.

Compressor Motor

The compressor should be driven by refrigerant cooled, hermetically sealed, two pole squirrel cage induction motor & should be suitable for 415 Volts ±10%, 50Hz ± 5%, AC supply.

Open Type Compressor

Open type Rotary Screw Compressor shall be direct driven by a TEFC motor operating with three-phase 415 Volts ±10%, 50Hz ± 5%, AC supply.

Microprocessor Control Panel

The chiller shall be controlled by a stand-alone microprocessor based control center. The chiller controller shall be factory wired and unit mounted on the chiller machine. Separate mounting of chiller controller is not acceptable, so that any shifting of the chiller will not necessitate sensor field wiring.

The chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches. The control center shall provide reliable and safe operation, alarms and protection.

The control panel shall include a high-end touch screen VGA display for user interface. The screen shall detail all operations and parameters, using a graphical/alphanumeric representation of the chiller and its major components. Data shall be displayed in either English or Metric units. The sophisticated program and sensor shall monitor the chilled water temperature to prevent freeze up. The panel shall display countdown timer messages so the operator knows when functions are starting and stopping.

Every programmable point shall be displayed with the allowable ranges, so that the chiller cannot be programmed to operate outside of its design limits.

The chiller control panel shall also provide:

1. System operating information including:
    a. return and leaving chilled water temperature

    b. return and leaving condenser water temperature

    c. evaporator and condenser saturation temperature

    d. differential oil pressure

    e. percent motor current

    f. evaporator and condenser saturation temperature

    g. compressor discharge temperature

    h. oil reservoir temperature

    i. operating hours

    j. number of compressor starts

2. Digital programming of set points through the universal keypad including:
    a. leaving chilled water temperature

    b. percent current limit

    c. pull-down demand limiting

    d. remote reset temperature range

3. Status messages indicating:
    a. system ready to start

    b. system running

c. system coast down

d. system safety shutdown-manual restart

e. system cycling shutdown-auto restart

f. system prelube

g. start inhibit

4. The text displayed within the system status and system details field shall be displayed as a color coded message to indicate severity: red for safety fault, yellow for warnings, and blue for normal messages.

5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive shall include:

a. evaporator – low pressure

b. evaporator – transducer or leaving liquid probe

c. evaporator – transducer or temperature sensor

d. condenser – high pressure contacts open

e. condenser – high pressure

f. auxiliary safety – contacts closed

g. discharge – high temperature

h. oil – high temperature

i. oil – low differential pressure

j. oil – differential pressure calibration

k. oil – pressure set point not achieved

l. control panel – power failure

m. motor or starter – current imbalance

5.1 Safety shutdowns with a VSD Shall include:

a. VSD shutdown – requesting fault data

b. VSD – stop contacts open

c. VSD – 105% motor current overload

d. VSD – high phase A, B,C inverter heat sink temp.
e. VSD – high converter heat sink temperature

f. harmonic filter – high heat sink temperature

6. Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required. Alarms / shutdowns with a fixed speed drive shall include:

a. multiunit cycling – contacts open

b. system cycling - contacts open

c. oil – low temperature differential

d. oil – low temperature

e. control panel - power failure

f. leaving chilled liquid - low temperature

g. leaving chilled liquid - flow switch open

h. motor controller – contacts open

i. power fault

j. control panel - schedule

k. starter – low supply line voltage

l. starter – high supply line voltage

m. proximity probe – low supply voltage

n. oil pump - drive contacts open

6.1 Alarms / shutdowns with a VSD shall include:

a. VSD shutdown – requesting fault data

b. VSD – stop contacts open

c. VSD initialization failed

d. VSD - high phase A,B,C instantaneous current

e. VSD – single phase input power

f. VSD – high DC bus voltage

g. VSD – high internal ambient temperature

h. VSD – invalid current scale selection

i. VSD – low phase A, B, C inverter heat sink temp.
j. VSD – low DC bus voltage

k. VSD – logic board processor

l. VSD – run signal

m. VSD – serial communications

n. harmonic filter – logic board or communications

o. harmonic filter – high DC bus voltage

p. harmonic filter – high phase A, B, C current

q. harmonic filter – phase locked loop

r. harmonic filter – low DC bus voltage

s. harmonic filter – DC bus voltage imbalance

t. harmonic filter – Input current overload

u. harmonic filter – logic board power supply

v. harmonic filter – run signal

w. harmonic filter – DC current transformer

Security access to prevent unauthorized change of set points, to allow local or remote control of the chiller ; Access shall be through ID and password recognition.

The Control center shall be capable to interface with a building automation system to provide for operation through BMS system.

The necessary gateway card /Chiller system manager for transmitting the Chiller Control center data to the BMS including any software development/ configurations shall be provided along with the chillers to get all operation data, alarms, alarm history, temperatures, pressures, amps, run hrs, remote chiller start/stop, reset of chilled water temperature, reset of current limit and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down on a recycling safety etc.

The protocol for the gateways shall be Modbus-RTU / Modbus-TCP or BacNet IP / (MS/TP) as per the requirement. Cost of necessary hardware / software to integrate the chiller panel to BMS system shall be included by the chiller manufacturer / supplier. And the Subcontractor shall provide all data & access on to BMS for control and monitoring of entire HVAC system.

Motor

The compressor motor shall have IP54 protection and shall be either open or Semi hermetic (refrigerant cooled), squirrel cage, induction type. Hermetic motors shall be liquid refrigerant cooled and Open motors shall be Air-cooled or water-cooled TEFC type. Motor drive shaft will be directly connected to the compressor shaft with a flexible disc coupling to provide for factory alignment of motor and compressor shafts. For units utilizing remote electro-mechanical starters, a large steel terminal box with gasketed front access cover will be provided for field-connected conduit. Overload/ over current transformers will be furnished with all units. The motor shall be supplied with winding temperature sensors or thermistors for over temperature protection. The motor shall be suitable for load characteristics and the operational duty of the driven equipment with a mandatory margin of at least 20% over the absorbed input Kw power of the chiller and comply with these specifications and latest IEC codes. The total efficiency shall include losses of the auxiliaries such as independent excitation, motor driven fans, lube-oil pumps etc. Lube oil pump supply voltage shall be derived from the 415V supply being given to the drive motor , so that any failure of lube oil supply is linked to the drive motor. Over voltage surge protection shall be provided to protect motor. The motor shall be designed and rated for 4 hot starts per hour with a maximum cool down period of 15 minutes.

a. The motor shall be capable of successful operation when running at rated load with variations in voltage and frequency as follows:

   i. Within ± 10% of rated voltage with rated frequency.
   ii. Within ± 5% of rated frequency with rated voltage.
   iii. Combination variation in voltage and frequency of 10% (sum of absolute values) of the rated values, the frequency variation not exceeding ± 5% of rated frequency.

   Terminal box of sturdy construction shall provide enough space for terminating, connecting and earthing of XLPE - insulated copper / aluminium conductor cable. All terminal boxes shall be located at the same side of the motor and have terminal and cable glands suitable for cables specified. The terminal box shall be tested to high voltage fault withstanding test and lightening resistance test. A rupture disc to ensure pressure release mechanism to be provided in terminal box with pressure release set point at 0.5 kg/cm2 in order to facilitate safety pressure release in case of accidental flashing inside terminal box at any point of time.

b. Motor shall include following accessories and features :

   i. Thermistors or Temperature detectors in stator windings.

Evaporator

Evaporator will be of the shell-and-tube, flooded type designed for 180 psig working pressure on the refrigerant side and 150 psig on waterside. The heat exchanger shall be hydrostatically tested at 1.5 times the design pressure. Shell will be fabricated from minimum 10 mm thick rolled carbon steel plates with fusion welded seams; have carbon steel tube sheets, drilled and reamed to accommodate the tubes; and intermediate tube supports spaced no more than four feet apart. The evaporator heat exchanger will be designed, tested and mandatorily provided with U-stamp name plate in accordance with ASME Section VIII, Div 1 Pressure Vessel Code.

Tubes shall be copper of 19 mm dia O.D. and minimum 0.635 mm wall thickness high efficiency, internally and externally enhanced type having plain copper lands at all intermediate tube supports to provide maximum tube wall thickness at the support area. Each tube will be roller expanded into the tube sheets providing a leak-proof seal, and be individually replaceable. Water velocity through the tubes will not exceed 12 fps. Two liquid level sight glasses will be located on the side of the shell to aid in determining proper refrigerant charge. Mist eliminators or baffles will be located above the tube bundle to prevent liquid refrigerant carryover to the compressor. The evaporator will have a refrigerant relief device sized to meet the requirements of ASHRAE 15 Safety Code for Mechanical Refrigeration.

The Evaporator shall be horizontal, shell and tube type, provided with the following connections and accessories.

i. Refrigerant inlet and outlet pressure gauges.
ii. Water inlet and outlet connections.
iii. Drain and vent connections with stop valves.
iv. Pressure gauges & transducers / Temperature gauges & thermistors on water inlet and outlet connections.
v. Descaling valves.

Evaporator shall be factory insulated with multi-layer 75 mm thick/or equivalent thermal insulation as per manufacturers standard with vapour barrier, thermal insulation material. The insulation shall be set in hot asphalt or any other compound applied to 100% of insulation contact surface recommended by the insulation manufacturer and shall be applied in layers staggering and sealing the joints.

Condenser

The condenser shells shall be of rolled carbon steel plate with fusion welded seams. Removable compact water boxes of cast iron or welded steel with stub-out water connections shall be provided to permit access for tube cleaning and replacement. The tubes shall be finned from outside having spiral

ridges from inside, roller expanded into the tube sheets providing a leak proof seal. The tube material will be copper. Intermediate steel tube supports should be provided at intervals not exceeding 1200 mm. The condenser heat exchanger will be designed, tested and mandatorily provided with U-stamp name plate in accordance with ASME Section VIII, Div 1 Pressure Vessel Code.

The condenser shall be horizontal, shell and tube type. The condenser shall be complete with the following accessories:

i. Refrigerant inlet and outlet pressure gauges.
ii. Water inlet and outlet connections.
iii. Drain and vent connections with stop valves.
iv. Pressure gauges & pressure transducers, and temperature gauges & Thermistors on water inlet and outlet connections.
v. Descaling valves.

Compressor Motor Starter

A variable speed drive will be factory installed on the chiller. It will vary the compressor motor speed by controlling the frequency and voltage of the electrical power to the motor. The adaptive capacity control logic shall automatically adjust motor speed and compressor pre-rotation vane position independently for maximum part-load efficiency by analysing information fed to it by sensors located throughout the chiller.

Drive will be PWM type utilizing IGBT‘s with a power factor of 0.95 or better at all loads and speeds.

The variable speed drive will be free standing or unit mounted in a IP54 / NEMA 12 enclosure. Field power wiring shall be a single point connection and electrical lugs for incoming power wiring will be provided. The VSD drive will be UL listed.

The following features will be provided:

1. Door interlocked circuit breaker with 50KA rating capable of being padlocked.
2. Drive to be rated for 45 deg C ambient without any deration at full continuous frequency converter output current; Manufacturer catalogue should be submitted tp prove same
3. UL listed protection.
4. Over voltage and under voltage protection.
5. 3-phase sensing motor over current protection.
6. Single phase protection.
7. Insensitive to phase rotation.
8. Over temperature protection.

Digital readout at the VSD panel of output frequency, output voltage, 3-phase output current, Kilowatt-hours, self-diagnostic service parameters. .

Kilowatts - The KW accuracy is typically +/- 3% of reading. KW meter scale is as required. This is displayed on the VSD panel.

KWh Meter – The unit‘s cumulative input power consumption is measured and displayed digitally via the VSD panel. KWh scale shall be as per OEM standard.

Ammeter – Simultaneous three-phase true RMS digital readout via the VSD panel. The ammeter accuracy is typically +/- 3% of reading.

Voltmeter – Simultaneous three-phase true RMS digital readout via the unit control panel. The voltmeter accuracy is typically +/- 3% of reading.

Multifunction digital meter mounted on the VSD panel is acceptable for above parameters.

VSD starter should be air cooled IP 54(NEMA 12) enclosure type with active harmonic filter to reduce harmonic distortions. The chiller should have THDi (current) less than 5% at equipment level. The VSD panel should display the current distortion so that low THDv (voltage) is achieved at PCC(Point of common coupling) at grid level. Manufacturer to provide PC based software for communication with the VSD, fault logging and analysis

The active filter will be provided separately with same IP 54(NEMA-12) enclosure and will be UL listed. The following digital readouts shall be provided at the VSD display panel as part of the filter package; input KVA, total power factor, 3 phase input voltage, 3 phase input current, 3 phase current total current distortion (THD), self-diagnostic service parameters.

Installation

The chilling machine shall be installed over a cement concrete platform and shall be adequately isolated as per manufacturer‘s recommendations against transmission of vibrations to the building structure by use of spring packages. For open type, special attention shall be paid to the alignment of the drive and driven shafts; final alignment shall be checked at site in presence of the Contractor or his authorised representatives, using a dial indicator. Compressor and motor sole plates, anchor bolts and sleeves and necessary vibration isolation pads shall be included.

Painting

Water chilling machine shall be finished with durable epoxy / enamel paint. Shop coats of paint that have become marred during dispatch or erection, shall be cleaned off with mineral spirits, wire brushed and spot primed over the affected areas, then coated with enamel paint to match the finish over the adjoining shop-painted surface.

Performance Rating

The unit shall be selected for the lowest operating noise level. Capacity ratings, and power consumption with operating points clearly indicated, shall be submitted and verified at the time of

testing and commissioning of the installation. Capacity shall be ascertained by measurements of chilled water flow rate and temperature of chilled water in and out of the chilling unit.

Power consumption shall be computed from measurements of incoming voltage & input current to the chilling machine. Power consumption of chillers shall be as per DBR at full load at specified fouling factors and design parameters as per basis of design section of tender.

Performance Testing

Prior to dispatch, chilling machines shall be subjected to inspection and witness of performance tests by Department or his authorized representative to verify various performance parameters as confirmed by contractor earlier at the time of award of contract. The contractor shall quote separately including the charges for all performance testing(s).

One chiller of each type /capacity shall be factory Performance tested in the presence of Department or his representative:

a) Under simulated conditions of design parameters at full load (100%) & at 3 part load points (75%, 50%, 25%) at constant condenser water entering temperature of 88 deg F in an Euro vent / ARI-accredited test facility.

The manufacturer shall supply certified test reports to confirm performance as specified. The manufacturer shall provide proper ARI / Eurovent certification documents for the test bed with submittals for inspection. The performance test shall be conducted in accordance with ARI Standard 550/590-98 / Eurovent procedures and tolerances.

The equipment will be accepted if the test procedures and result are in conformance with Eurovent / ARI standard 550/590-98. If the equipment fails to perform within the allowable tolerances, the manufacturer will be allowed to make one revision to his equipments and retest as required. The contractor shall pay all associated expenses resulting from retesting. In the event that this revision does not achieve submitted performance, Employer reserves the right to reject the equipment or accept with a penalty.

The contractor shall pay a penalty to Department of Rs. 1,00,000/- per chiller for excess of each input KW at full load as compared to his tender submission and input KW measured during testing carried out at manufacturer‘s work as per ARI condition or / and tender design condition. The Department reserve the right to accept Chillers after recovery of penalty for all chillers whether tested at works or not.

Cooling Tower

Scope of Work

This specification covers the design requirement, materials, constructional feature, manufacture & supply, installation, testing, commissioning of FRP CTI approved Cooling Towers.

Codes & Standards

The design, materials, manufacture, testing & performance of CTI approved cooling tower shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed. The cooling tower shall also conform to the latest application of International Standards.

Types & Capacity of Cooling Tower

The cooling tower shall be induced draft counter flow type conforming to their respective specification & of rectangular / square profile. Each cooling tower actual capacity.

Constructional Feature of Cooling Tower

The induced draft counter flow FRP cooling tower shall be complete with FRP casing, fill, internal supporting structure, drift eliminators, fan, fan motor, hot water distribution system & cold water basin. All steel components including assembly hardware shall be hot dip galvanized. Suitable access shall be provided for the inspection & maintenance of fan. The design of louvers, fill & drift eliminators shall ensure minimum resistance to flow of air. The induced draft propeller fan of the cooling tower shall be direct driven by TEFC squirrel cage motor located outside the moist air stream. The fill sheet includes both louvers and drift eliminators & the louvers should prevent water from escaping the fill sheets to assure proper & efficient heat transfer throughout wide variations in the airflow. Drift losses for the cooling tower should not be more than 0.02% of the circulated water. Suitable screens between the side of the cold-water basin & the base of the fill should be provided to prevent foreign materials in the circulating water flow & should be easily removable. The fan motor shall be suitable for 415 volts ±10%, 3 phases, 50 Hz ± 5%, AC supply conforming to IP 55 with IE-3 grade motor.

Cold Water Basin

The cold-water basin shall be a deep fibre glass reinforced sump on which cooling tower structure shallbe supported Basin fittings shall have the following.

i) Bottom Outlet.
ii) Screened suction assembly fixed to the basin.
iii) Drain at underside of suction, suction side sheet.
iv) Overflow fixed to inside of casing side sheet.
v) Ball type automatic make-up water valve.
vi) Equalizing connection & balancing valves for multiple CTs as required.
vii) Quick Fill arrangements

Mechanical Equipment

The cooling tower shall be provided with low speed, low noise, acoustically treated fans running at lower RPM. Fan speed shall not be more than 750 RPM. Fan shall be of the propeller type lightweight

rotor fitted with multiple aerofoil blades. The entire fan assembly shall be statically and dynamically balanced. Fan shall be driven by TEFC motor suitable for 415 volts ±10%, 3 phases, 50 Hz ± 5%, AC supply conforming to IP 55 and IE-3 grade. Fan motor shall be energy efficient motor weather proof construction, designed and selected to operate in humid air stream. Fan guard shall be provided to prevent birds from nesting during idling periods. G.S.S canopy shall be provided over the fan motor for protection against rainwater. Care shall be taken that fan air is not restricted. Motor terminal box shall be made watertight.

VFD shall be provided for each motor and Operation of VFD system shall be based approach of cooling tower.

Fillings

The Fillings shall be made of corrosion proof and rigid film in cross fluted design and arranged in square / rectangular form and shall be elevated from the floor of the cold water basin to facilitate cleaning and easy replacement. They shall be arranged in such a manner to ensure negligible resistance to airflow and to eliminate backwater spots and prevent fouling trough scales that may form. In order to reduce carry-over losses through entrapment of water droplets in air stream, PVC drift eliminators shall be installed.

Distribution Header

Hot water distribution system shall comprise of header and branch arms system.

Accessories

The cooling tower basin shall be provided with automatic float valve with a stop valve for continuous make up water flow, quick fill arrangement with stop valve, over-flow and drain connections with stop valves. A hot water bleed connection to the drain line through a stop valve shall be provided. It shall be connected to the drain line below the drain stop valve. Stainless Steel ladders shall be provided in such a manner and location as necessary to give safe and complete access to all parts of tower requiring inspection. Each ladder shall be made of iron sides and 16 mm straps and shall be bolted to the tower on the top and grouted in masonry at the bottom end. All Hardware used shall be of stainless steel. All pipe connections shall be hot dip galvanized and double flanged.

Painting

All exposed steel surfaces shall be given two coats of epoxy paint & the colour finish of cooling tower shall as per Architect‘s decision.

Performance Data

The complete performance ratings and power consumption at varying outdoor wet bulb temperatures shall be submitted and verified at the time of testing and commissioning of the installation. The Capacity of the cooling tower shall be computed.

Testing

Cooling tower being critical equipment for proper functioning of processing equipment, strict quality control is required. Capacity of the cooling tower shall be computed from the measurements of water flow, incoming / outgoing water temperatures and ambient air wet bulb temperature using accurately calibrated thermometers. Computed ratings shall conform to the specified capacities and quoted ratings. Power consumption for cooling towers shall be computed from measurements of incoming voltage and input current.

Pumps

Scope of Work

This section deals with supply, erection, testing and commissioning of water pumps sets conforming to general specification and suitable for the duty selected as indicated in Technical Requirement of Equipment. The type, capacity and size of pumps shall suit the parameters given under. The Pumps selected should have high efficiency, which should be supported by selection charts and curves.

Vertical Inline Pumps Sets

Vertical Inline long coupled Centrifugal Pump shall be selected for water re-circulation duty. The pump casing shall have heavily ribbed construction, suction and discharge connection shall be flanged of the same size and shall be drilled and tapped for seal flush and gauge. The impeller made of bronze shall be double shrouded, single entry, radial flow type. It shall be hydraulically balanced to minimize axial thrust. The stuffing box shall be factory fitted with mechanical seal.

The pump is to be fitted with a factory installed flush line. Supply in the flush line to the mechanical seal, a 50 micron cartridge filter (alternatively, a cyclone separator when pump differential pressure exceeds 30 PSIG) and floating ball type sight flow indicator suitable for the working pressure encountered. The mechanical contractor shall change the filters after the system has been flushed and on a regular basis until the pumps are turned over to the owner.

The axially split, spacer type rigid coupling shall be used to allow seal maintenance without disturbing the pump or motor connections. The mechanical seal shall be accessible and easily replaced.

On the discharge side of each pump factory supplied- combination Valve shall be provided to incorporate the following three functions in one body:

- Tight shut-off,
- spring-closure type silent non-slam check and
- effective throttling.

The body shall have (2) 1/4‖ NPT connections on each side of the valve seat. Two connections to have brass pressure and temperature metering ports, with EPDM check valves and gasketed caps. Two other

connections to be supplied with drain plugs. Metering ports are to be interchangeable with drain ports to allow for measurement flexibility when installed in tight locations. The valve disc shall be bronze plug & disc type with EPDM seat to ensure tight shut-off and silent check operation. The valve stem shall be stainless steel with flat surfaces provided for adjustment with open-end wrench.

For Grooved Piping: Valve body shall be ductile iron with grooved ends and anti-rotation lugs on the inlet and outlet of the body.

Flange adapters, where necessary are to be ductile iron flanges with anti-rotation lugs and EPT gaskets. Valve body shall be Cast Iron with PN16 flanged ports.

The valve shall be selected and installed in accordance with the manufacturer‘s instructions and be suitable for the pressure and temperature specified.

On the suction of each pump factory supplied suction guide, with Outlet Flow Stabilizing Guide Vanes, removable Stainless Steel Strainer and Fine Mesh Start-up Strainer shall be provided. Supply suction guide with carbon steel body, carbon steel guide vanes and PN16 flanged ports.

Strainer element shall be stainless steel construction with 0.125"(3 mm) perforations. Fine mesh start-up strainer shall be 20 mesh galvanized steel. The mechanical contractor shall inspect the strainer prior to activating the pump and, further, shall remove the Fine Mesh Start-up Strainer after a short running period. (24 hours maximum). Space shall be provided for removal of the strainer and connection of a Blow-down Valve.

The construction of Vertical Inline Pumps shall be as follows and as per IS 1520

Duty	Chilled / Condenser / Hot Water
Casing	Cast Iron
Impeller	Bronze
Pump Shaft	Stainless Steel Grade 416
Bearings	Ball / Journal Bearing
Speed (Synchronous)	1500 RPM
Motor	TEFC, IE-3
Mechanical seal	Factory fitted

The impellers of pumps shall be statically and dynamically balanced.

Motor Capacity

The capacity of motor shall be at least 15% in excess of BHP requirement of pump & shall be as per Standard Specifications. The tenderer shall provide detailed calculation for selection of pumps.

The contractor as per manufacturer recommendations shall carry out the installation of pumps. The pump shall be installed on a concrete foundation with vibration isolators as per Approved layout plan from Engineer-in- Charge.

After installation of the complete system and before testing, the pump shall be lubricated in strict accordance with the manufacturer‘s instructions.

The pumps shall be installed in a manner that would allow maintenance without causing damage to the insulation.

After completion of installation and testing, the pumps shall be painted as specified in tender document.

Variable Speed Pumping System

Scope of Work

This section deals with supply, erection, testing and commissioning of variable speed pumping system for chilled water conforming to general specification and suitable for the duty selected as indicated in Technical Requirement of Equipment. The type, capacity and size of pumps shall suit the parameters given under. The Pumps selected should have high efficiency, which should be supported by selection charts and curves. This package shall consist of the following:

1. Pump, Motor, Base Frame, Coupling
2. Pump Control Panel
3. Adjustable Frequency Drive
4. Sensor Transmitters
5. Sequence of Operation
6. Connection drawings and wiring diagrams to be supplied with the pumping package.

References

ANSI	- American National Standards Institute
NEMA	- National Electrical Manufacturers Association
UL	- Underwriters Laboratories Inc.
ETL	- Electrical Testing Laboratories
CSA	- Canadian Standards Association
NEC	- National Electrical Code
ISO	- International Standards Organization
IEC	- International Electro technical Commission

Submittals

Submittals shall include the following related to this project only & not general:

1. System summary sheet
2. Sequence of operation
3. Shop drawing indicating dimensions, required clearances and location and size of each field connection
4. Power and control wiring diagrams
5. System profile analysis including variable speed pump curves and system curve. The analysis shall also include pump, motor and AFD efficiencies, job specific load profile, staging points, horsepower and kilowatt/hour consumption.
6. Pump data sheets

Quality Assurance

1. The pump manufacturer shall assemble the pumping package. An assembler of pumping systems not actively engaged in the design and construction of centrifugal pumps shall not be considered a pump manufacturer. The manufacturer shall assume "Unit Responsibility" for the complete pumping package. Unit responsibility shall be defined as responsibility for interface and successful operation of all system components supplied by the pumping system manufacturer.

2. The manufacturer shall have a minimum of 20 years‘ experience in the design and construction of variable speed pumping systems.

3. The local supplier of Chilled Water Variable Speed Pumping System (VSPS) Must have relevant expertise in all aspects of design, application engineering, Installation, programming, interfacing, commissioning and after sales service.

4. The manufacturer shall be fully certified by the International Standards Organization per ISO 9001. Proof of this certification shall be furnished at time of submittal.

5. Manufacturer shall be listed by Underwriter's Laboratories as a manufacturer of packaged pumping systems.

6. Bidders shall comply with all sections of this specification relating to packaged pumping systems. Any deviations from this specification shall be bid as a voluntary alternate clearly defined in writing. If no exceptions are noted, the supplier or contractor shall be bound by these specifications.

Manufactured Units

1. Furnish and install as shown on the plans a Variable Speed Pumping System as manufactured by approved make.

2. The control system shall include as, a minimum, the programmable logic pump controller, adjustable frequency drive(s) and remote sensor/transmitters as indicated on the plans. Additional items as specified or as required to properly execute the sequence of operation shall be supplied & installed.

3. The variable speed pump logic controller, adjustable frequency drive(s) and remote sensor/transmitter(s) shall ship as individual components to the jobsite.

4. Pump logic controller, adjustable frequency drives, sensor/transmitters and related equipment shall be installed by the AC contractor as shown on the plans.

5. Line voltage power wiring shall be installed by the electrical expert hired by the AC contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package.

6. Low voltage (24 VDC and 115 VAC) wiring shall be installed by the controls expert hired by the AC contractor as shown on the field connection drawings and wiring diagrams supplied with the pumping package

Components

A) Pump Logic Controller

1. The pump logic controller assembly shall be listed by and bear the label of Underwriter's Laboratory, Inc. (UL). The controller shall be specifically designed for variable speed pumping applications. Pump Logic Controller shall be suitably interfaced with one Adjustable Frequency Drive housed within same enclosure.

2. The controller shall function to a proven program that safeguard against damaging hydraulic conditions including:

   a) Pump flow surges

   b) Hunting

   c) End of curve

   d) Motor overload

3. The pump logic controller shall be capable of receiving up to two discrete analogue inputs from zone sensor/transmitter as indicated on the plans. It will then select the analogue signal that has deviated the greatest amount from its set point. This selected signal will be used as the command feedback input for a hydraulic stabilization function to minimize hunting. Each input signal shall be capable of maintaining a

different set point value. Controller shall be capable of controlling up to three pumps in parallel.

4. The pump logic controller shall be capable of accepting an additional analogue input for a flow sensor. This input shall serve as the criteria for the end of curve protection algorithm.

5. The hydraulic stabilization program shall utilize a proportional-integral-derivative control function. The proportional, integral and derivative values shall be user adjustable over an infinite range.

6. The pump logic controller shall be self-prompting. All messages shall be displayed in plain English. The operator interface shall have the following features:

   a. Multi-fault memory and recall last 10 faults and related operational data.
   b. Red fault light, yellow warning light, and Green power on light
   c. Soft-touch membrane keypad switches.

7. The display shall have four lines, with 20 characters on three lines and eight large characters on one line. Actual pump information shall be displayed indicating pump status.

8. The following communication features shall be provided to the BAS:

   a. Remote system starts / stops non-powered digital input.

   b. Failure of any system component. Output closes to indicate alarm condition.

   c. One 4-20 mA output with selectable output of:

      1. Frequency.

      2. Process variable

      3. Output current

      4. Output Power

B) Variable Frequency Drive

1. The variable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design.

2. The VFD, including all factory-installed options, be tested to UL Standard 508. The VFD shall also meet C-UL and be CE marked and built to ISO 9001 standards.

3. The VFD shall be housed in a IP 55 enclosure.

4. The VFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no de-rating. This

voltage vector control shall minimize harmonics to the motor to increase motor efficiency and life. Power factor shall be near unity regardless of speed or load.

5. The VFD shall have balanced DC link reactors to minimize power line harmonics. VFD‘s without a DC link reactor shall provide a 3% impedance line reactor.

6. Automatic motor adaptation (AMA) algorithm shall be utilized. This feature shall allow for automatically optimized drive performance and efficiency leading to additional energy savings.

7. Input and output power circuit switching can be done without interlocks or damage to the VFD.

8. The following customer modifiable adjustments shall be provided:

   a. Acceleration time.

   b. Deceleration time.

   c. Minimum frequency.

   d. Maximum frequency.

9. RS-485 communication for Johnson Controls N2 and Landis and Staefa FLN.

10. An automatic energy optimization selection feature shall be provided. This feature shall reduce voltages when lightly loaded and provide a 3% to 10% additional energy savings.

11. The VFD shall be suitable for elevations to 3300 feet above sea level without de-rating. Maximum operating ambient temperature shall not be less than 110 degrees F. VFD shall be suitable for operation in environments up to 95% non-condensing humidity.

12. The VFD shall be capable of displaying the following information in plain English via a 40 character alphanumeric display:

    a. Frequency

    b. Voltage

    c. Current

    d. Kilowatts per hour

    e. Fault identification

    f. Percent torque

g. Percent power

h. RPM

C) Sensor / Transmitters

Provide field mounted differential pressure sensor transmitter(s) as indicated on the plans. Unit shall transmit an isolated 4-20mA dc signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts with two 0.25" male NPT process connections. It shall be protected against radio frequency interference and shall have a watertight, NEMA 4 electrical enclosure capable of withstanding 2000 PSI static pressure with a 0.5" NPT conduit connection. Accuracy shall be within 0.25% of full span.

Minimum two numbers of differential pressure sensors located at strategic location with substantial flow demand or remoteness at each zone served by secondary pumping shall be provided.

D) Sequence of Operation

1. The system shall consist of a pump logic controller, multiple pump/VFD sets, with manual and automatic alternation and pump staging.

2. The pumping system shall start upon the closure of customer's contact when the pump logic controller Mode of Operation selector switch is in the REMOTE position.

3. When the pump logic controller selector switch is in the LOCAL position, and start command on controller is given via operator interface, the pumping system shall operate automatically.

4. Sensor/transmitters shall be provided as indicated on the plans.

5. Each sensor/transmitter shall send a 4-20mA signal to the pump logic controller, indicative of process variable condition.

6. The pump logic controller shall compare each signal to the independent, engineer/user determined set points.

7. When all set points are satisfied by the process variable, the pump speed shall remain constant at the optimum energy consumption level.

8. The pump logic controller shall continuously scan and compare each process variable to its individual set point and control to the least satisfied zone.

9. If the set point cannot be satisfied by the designated lead pump, the pump logic controller shall initiate a timed sequence of operation to stage a lag pump.

10. The lag pump shall accelerate resulting in the lead pump(s) decelerating until they equalize in speed.

11. Further change in process variable shall cause the pumps to change speed together.

12. When the set point criteria can be safely satisfied with fewer pumps, the Technologic pump logic controller shall initiate a timed de-stage sequence and continues variable speed operation [wherever applicable].

13. As the worst case zone deviates from set point, the pump logic controller shall send the appropriate analogue signal to the AFD to speed up or slow down the pump/motor.

14. In the event of an VFD fault, the pump logic controller automatically initiates a times sequence of events to start the redundant pump/AFD set in the variable speed mode. The redundant variable speed system shall be started through the pump logic controller.

15. Upon VFD fault(s), the pump controller shall display an alarm condition through a plain English message.

16. VFD fault indication shall be continuously displayed on the operator interface of the pump until the fault has been corrected and the controller has been manually reset.

17. In the event of the failure of a zone sensor/transmitter, its process variable signal shall be removed from the scan/compare program. Alternative zone sensor/transmitters, if available, shall remain in the scan/compare program or control.

18. Upon sensor failure a plain English warning message shall be displayed on the operator interface of the pump logic controller.

19. In the event of failure to receive all zone process variable signals, a user selectable number of VFDs shall maintain a user adjustable speed; reset shall be automatic upon correction of the zone failure.

Double Skinned Air Handling Unit

Scope of Work

The specification for Double Skin Air Handling Units covers the design requirement, constructional feature, supply, installation, testing & commissioning. The floor mounted horizontal / vertical type air handlers shall be of double skin construction, draw through type comprising of various sections such as pre filter section, cooling coil section, fan section etc.

Double Skinned Air Handling Units

a) Double Skinned Casing

The casing shall be self-supporting type, factory fabricated & assembled made of extruded anodised aluminum hollow sections to make a rigid frame structure. The frame shall be assembled using pressure die cast aluminum joints. The self-supporting unit shall consist of sandwiched panel made out of 0.6mm thick pre-plasticide / pre-coated GI sheet outside &

0.6mm GI sheet inside (0.6 mm polished stainless steel in case of AHU for Operation Theatre) duly factory fabricated insulated with 23 mm thick for indoor application / 48 mm thick for outdoor application PU foam insulation in between. The insulated panels shall be bolted to mainframe with neoprene rubber gaskets held captive in the framed extrusion to make it leak proof. Suitable airtight access doors / panels with pressure die cast aluminum hinges & nylon handles and locks shall be provided for access to various sections for maintenance. The Entire housing shall be mounted on Extruded Aluminum channel framework having pressure die cast aluminum jointers or the framework shall be joined together with corner plates Condensate. Drain Pan shall be constructed of 22 gauge Stainless steel sheet with all corners welded with uniform slope from all sides leading to drain pan ensuring no stagnation of condensate water.

b) Motor & Drive

The fan motors shall be suitable for 415 ± 10% volts, 50 ± 5 % HZ, 3 phases TEFC SQ. Cage induction motor of IE-3 grade. The motor shall be specially designed for quiet operation & motor speed shall not exceed 1440 RPM. Drive to fan shall be provided through belt drive arrangement. Belts shall be of oil resistant type only.

c) Fan of Double Skinned Air Handling Units

The casing shall have heavy gauge GI construction forward curved / backward curve DIDW imported fan statically & dynamically balanced mounted on EN8 solid shaft or C 40 carbon steel. The supply air DIDW fan shall be forward / backward curved. The fan impeller shall be supported to housing with angle iron frame & pillow block heavy duty ball bearing. The fan shall be selected for a fan outlet velocity below 10 meter / sec. The fan housing with TEFC Sq. Cage motor shall be mounted on a common adjustable base frame on vibration isolators in case the impeller diameter is exceeding 450 mm & rubber turret mounts vibration isolators for fan diameter up to 450mm diameter. The fan motor shall be installed inside the housing of air handling unit to keep low noise level. The fan & motor assembly shall be of aluminum extruded section only.

d) AHRI Certified Cooling / Heating Coils

The cooling & heating coil shall be made of aluminum fins and copper tubes of dia.12.5mm or 16mm OD. The minimum no. of fins / cm for cooling coils shall be 4.7 & for heating coil it shall be 2.4. The bonding of aluminum fins with copper should be done hydraulically. The tube thickness shall be 26 G & fin thickness shall be 37 G. The cooling / heating coil should be tested for leaks at a hydraulic pressure of at least 10 Kg / sq.cm. for a minimum period of 3 hours at works. The velocity across face should be limited to 152 metre / minute. In case of chilled / hot water coils the design should be such to limit water velocity to maximum of 2.5 m / sec. The cooling coil shall have copper header and MS adaptor.

e) Filters

Each unit shall be provided with a factory assembled pre-filter section containing washable synthetic tube air filters having extruded aluminum frame. The filtration efficiency shall be as per MERV 8 rating. Filters shall fit so as to prevent by pass. Holding frames shall be provided for installing a number of filters cells in banks. These cells shall be held within the frames by sliding the cells between guiding channels. Face velocity across filters shall not exceed 152 MPM.

Accessories

Each air handling unit shall be provided with manual air vent at highest point in the cooling /heating coil. In addition, the following accessories may be required at air handling units.

(a) Thermometer at each AHU coil inlet and outlet with tubing and gauge cocks.

(b) Pressure gauge with isolation valves at inlet and outlet of each AHU coil.

(c) Butterfly valves at inlet and outlet of the each coil.

(d) Y strainer at inlet of each coil.

(e) Union and condensate drain piping from the unit up to the drain trap.

(f) PIB Control Valve located in chilled water lines connected to the coil. This valve shall be operated by the cooling thermostat and shall control the flow of chilled water

(g) Cooling / heating thermostat.

(h) Automatic Controls and Instruments shall be located in return air stream.

(i) Flexible connection between the fan outlet and duct.

(j) Vibration isolators of at least 90% efficiency.

Safety Features

Each handling unit must have safety features as under:-

a) The fan access door must have micro switch interlocked with fan motor to enable switching off the fan motor automatically in the event of door opening.

b) The access door shall further have wire mesh screen as an added feature, bolted on to the unit frame.

c) Fan and motor base shall be properly earthed from the factory.

d) All screws used for panel fixing and projecting inside the unit shall be covered with PVC caps to avoid human injury.

Note: Fan Section Unit shall have same specification as that of AHU but it shall be without cooling / heating coil. Fan Section Unit shall be with MERV 8 & MERV 13 filters.

Fan Coil Units

Scope of Work
The specification for Fan Coil Units covers the design requirement, constructional feature, supply, installation, testing & commissioning.

The horizontal Type of Fan Coil
The horizontal type of fan coil units shall be complete with centrifugal blowers of aluminum construction, 3 speed permanent split-capacitor type fan motor, cooling coil, sandwiched type insulated drain pan extended type to accommodate all the valves as required for chilled water pipe connection.

The interior chassis shall be constructed of 16 gauge cold rolled galvanized sheet steel and painted with approved shade of powder coating finish. All ceiling suspended vertical fan coil units shall be securely mounted from the building structure. All FCUs shall be internally lined with 15 mm thick fire retardant open cell nitrile rubber insulation & finished with 0.5 mm thick perforated aluminium sheet.

Drain pan shall be fabricated from 18 gauge cold rolled stainless steel with all corners welded, and an additional inner bottom panel of 18 gauge stainless steel shall be provided to prevent damage to, and floatation of the bottom panel insulation. The pan shall be insulated with not less than 15 mm thick expanded polystyrene or 8 mm thick expanded polyethylene insulation sandwitched between top and bottom panels to effectively prevent condensation. The pan shall be of sufficient size to catch all drippage of condensation from any part of the unit. In all cases pan shall be large enough to cover cooling coil supply and return water headers, bends control valves, strainers and entire copper piping.

The cooling coil shall be 4 row deep having minimum 4.7 fins / cm. The fins configuration of Sigma flow or plain fin shall be acceptable. The OD of copper tube shall be 9.5 mm minimum & wall thickness of 0.5 mm.

The fan shall be centrifugal, forward curved driven by 3 speed permanent split capacitor type fan motor. The Fan Coil Units shall be provided with the following accessories given below.

a) Double fire retardant Canvass Connection.

b) Pre filters of MERV 8 rating.

c) Strainer with ball valve at inlet & ball valve at outlet.

d) Copper connections between chilled water lines, controls etc.

e) Electrical wiring between motors & speed regulator.

f) Copper / Brass Connection Set with valves, insulated (factory supplied insulation kit / box) copper / brass connection set for chilled line consisting of 2-Way motorised modulating diaphragm type pressure independent cum balancing control valve, ball valve with strainer at inlet, ball valve at outlet, copper connection set with braided pipe flexible connector at in and

out at one end etc. Valves and associated item sizes shall be 25 mm up to 2 TR & 32 mm for 2.5 TR & above for chilled water application.

It may be noted that all accessories specified above shall be provided along with the Fan Coil Unit and shall be included in the price of Fan Coil Unit.

Each Fan Coil Unit shall be tested at factory & complete in all respects. The sound level of the unit should not exceed 40 dB. The test certificate shall be furnished with each Coil Unit. It is necessary to design the fan coil unit in a way to have silent operation.

The Fan Coil Unit shall be powder coated both internally & externally.

Hot Water Generator

Scope of Work

This specification covers the design requirement, materials, constructional feature, manufacture & supply, installation, testing, commissioning of Electric Fired Hot Water Generator.

Codes & Standards

The design, materials, manufacture, testing & performance of Hot Water Generator & Humidifier shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed. The Hot Water Generator shall also conform to the latest application of Indian Standards.

Constructional Feature of Hot Water Generator

The hot water generator shall be Vertical / horizontal shell type. The shell shall be constructed out of 8mm thick Ms sheet and dish end shall be 10mm thick MS sheet with electric fusion welded seams & in accordance with ASME Boiler & Pressure Vessel Code, Section IV.

The shell shall be duly insulated & shall be mounted in a cabinet of suitable angle iron frame from 16 SWG mild steel sheet steel covers complete with hinges, locks etc. to make a sturdy compact assembly. The cabinet shall be provided with sufficient ventilation of heaters terminals of the boiler. The angle iron frames shall be provided with lifting lugs & pedestals.

The heaters shall be provided in such a way as to provide balanced distribution of the load. The electrical heater which shall be mounted within seamless copper sheathed electrically resistant U-Tubes, flange mounted with stainless steel studs. The heaters will be easily removable without opening of terminal plates. The heaters shall be suitable for 240±10%, 50±5% Hz, Single Phase AC supply and will be in direct contact with water contained in the shell.

Microprocessor based step controller with thermistor sensor to control the HWG in stages. Features of this control should include dip switch programming, status LED's.. Step controller shall have built-in test mode to verify Load wiring, contactors and stage operations with 1 Sec time delay. A separate power controller shall be provided for proportional control (0-100% load), in between the switching on and off of step

control stages for precise temp. control up to 250KW and above 250KW a microprocessor based step controller with thermistor sensor to control the HWG in stages.

The HWG shall be BMS compatible and RS-485 Communication port shall be provided for remote programming and control.

Controls & Accessories

The hot water generator will be provided and not limited to following controls & accessories.

a) 100 mm dia dial type thermometer mercury in bulb at inlet & outlet (Range 0 -100 °C)

b) 100 mm dia pressure gauge with ball valve at inlet & outlet (Range 0 to 20 Kg/cm ^{2}.)

c) Flow switch, float switch, automatic alarm for low water level and high temperature with independent indication lights.

d) Pressure relief valves.

e) Inlet & outlet pipes with flanges.

f) Drain points with valves.

g) Descaling valves.

h) Automatic air vent.

i) Thermostat for individual heater banks or step controller.

j) Safety thermostat.

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Pressure Testing

The hot water generator shall be tested in the factory at 250 PSI

Insulation

The hot water generator shall be insulated with 50mm thick fiber glass of density 32 Kg / m^3& cladded with 0.63 mm aluminum sheet on ms frame welded on generator body.

Electrical Control Panel

The electrical control panel shall be mounted directly on the main frame conforming to standard specification of Indian Electrically rules. All controls shall be factory wired & tested.

a) Incoming MCCB with Copper busbar.

b) On-off Toggle switch for operating individual banks.

c) Contactor for individual banks with HRC fuses.

d) Indicating on/off lights status for individual banks.

e) Fault indicating lights.

f) Alarm with manual reset.

g) Copper connections with cable & control cabling.

h) Three phase ammeters & voltmeter with selector switch.

i) Microprocessor based step controller

j) Hot Water Generators shall be completely BMS compatible having Potential free Dry contacts for :
   a. System On/Off status indication

   b. Low Water Level Trip

   c. Hi. Temp. Trip

   d. Auto/Manual Selector Mode

   e. Start/Stop Command

   f. RS-485 Communication port for remote programming and control

The electrical panel doors should be openable only after total incoming power supply is cut off.

Painting

The external surface of the shell shall be de-rusted, cleaned & applied with three coats of primer & finally have powder coating of approved shade.

Technical Requirements of Hot Water Generator

a) Capacity	As per Basis of Design
b) No. of HWG	As per Basis of Design
c) No. of Banks	
UP TO 75KW	3 Banks
UP TO 200KW	4 BANKS
ABOVE 200KW	5 BANKS OR more
d) Controls, protections &	YES

Electrical panel duly factory wired.

Air Washer

Scope of Work

The specification for package type double skin air-washer for mechanical ventilation covers the design requirement, constructional feature, supply, installation, testing & commissioning.

Type

The Air-washer system shall be Draw through type having 90% saturation efficiency with imported cellulose paper pads. The air washer shall be designed for maintaining inside temperature 5 - 7 °C higher than the outside wet bulb temperature.

Housing

Double skinned panels shall be 25 mm thick made of galvanized steel, pressure injected with foam insulation (density 40 Kg / m3) shall be fixed to 1.5 mm thick aluminium alloy twin box section structural framework with stainless steel screws. Outer sheet of panels shall be made of galvanized pre-plasticized sheet of 24 gauge thick and inner sheet of 24 gauge plain GI sheet. The entire framework shall be mounted on an aluminium alloy or galvanized steel (depending on size) channel base as per manufacturer‘s recommendation. The panels shall be sealed to the framework by heavy duty _O‘ rings gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots, handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on site assembly with continuous foam gasket. All fixing and gaskets shall be concealed. Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type. Recirculation tank shall be fabricated from 18-gauge stainless steel sheet duly reinforced with all corners welded. The tank shall be complete with double brass strainers, make-up connection with float, drain and overflow connections.

Fan

The blower shall be Centrifugal Forward / Backward Curved DIDW fan wheel of totally GI Construction with Inlet Cones and shall be complete with individual motor and drive and shall be mounted on C Channel frame and Cushy Foot or Spring Mounts. Each Air-washer system shall comprise of one / two no. fans to handle air quantities. Each fan shall be driven by suitable HP TEFC motor. The fan wheel will be of the multiblade type and mounted on two self-aligning pillow block bearings of the requisite size. The fan shall be run with the help of ―V‖ Groove drives as per the recommendation of the drive supplier.

Motor

The TEFC IE-3 grade motor shall be suitable for 415 ± 10% volts, 3 phase, 50 Hz ± 5%, A.C supply. The motor shall be with class F/H insulation confirming to IS 325. The motor speed shall be 1440 RPM maximum designed and guaranteed for continuous operation at the nameplate rating. It should confirm to IP 55.

Pre Filter Section

The filter section shall incorporate cleanable aluminum filters of size 610 x 610 x 50 mm thick made out of 18 G with aluminum fill only. The velocity across the filters should be limited to 152 MPM. The filter bank should be mounted in 16 G aluminum frame with provisions of removal of filter for cleaning. The filtration capacity of the filter shall be down to 10 micron particle size with the minimum efficiency of 90%.

Air Washer Section

The air-washer section shall consist of imported cellulose paper pads of intersecting angle of 45/15 OR 60/30 Deg. The fill shall be cross fluted configuration assembled in self supporting pads in light weight construction. The pads shall be able to redistribute the water & shall be impregnated with insoluble antiriot salts rigidifying saturates & wetting agents with built in eliminators.

The velocity across the fill shall not exceed 152 MPM & shall not allow carryover water. A FRP distributor should evenly distribute water on the fill. Eliminator plates shall be four bend made from 24 gauge galvanized sheet steel or PVC.

The efficiency of fill should be able to perform with an efficiency of 90% minimum & thickness of fill should be 200 mm minimum.

Tank & Wet Section

The tank & wet section shall be made out of 18G stainless steel only.

Pump, Piping & Valves

The air-washer shall be provided with monoblock pump set as specified in Bill of Quantities. It will be complete with inter connecting GI medium class piping, GM gate valves, check valves, Y-Strainers, suction screen etc. The accessories shall include make up, drain, over flow, quick fill & brass float valve, canvass connections at each blower outlet.

Efficiency

The overall efficiency of air washer system shall be at least 90% and factory test certificate shall be submitted along with the equipment.

Installation

The fans, pumps, air-washer / scrubber etc. shall be provided with necessary vibration isolation cushy foot mounts. The contractor shall arrange all necessary accessories such as nut bolts etc.. The contractor shall arrange his own labour with material for completion of assembly.

The contractor, shall cast the RCC foundations for equipments. Anti-vibration pads of adequate efficiency shall be provided.

Transit Damage

The contractor at his own cost shall restore the unit to original conditions in case of any damages.

Testing

The AC contractor shall compute the unit air quantity with the help of velocity meter. The computed results shall be tallied with specified capacities and power consumption shall be tallied with the indicated figures in the technical data furnished with the bid by the contractor.

All necessary instruments of proper accuracy and services needed for the tests required for the computation of capacities and power consumption as required by the Engineer-in- Charge shall be provided by the contractor at his own cost.

It shall also be the responsibility of the Contractor to supply the motors and starters to satisfy the local regulations pertaining to the limitation of starting current and indemnify the owner from all liabilities arising out of any objections raised by the local authorities in this regard.

Scrubber

Scope of Work

The specification for package type double skin scrubber for mechanical ventilation covers the design requirement, constructional feature, supply, installation, testing & commissioning.

Type

The scrubber shall be double skin spray type system & shall be draw through type.

Housing

Double skinned panels shall be 25 mm thick made of galvanized steel, pressure injected with foam insulation (density 40 Kg / m3) shall be fixed to 1.5 mm thick aluminium alloy twin box section structural framework with stainless steel screws. Outer sheet of panels shall be made of galvanized pre-plasticized sheet of 24 gauge thick and inner sheet of 22 gauge plain GI sheet. The entire framework shall be mounted on an aluminium alloy or galvanized steel (depending on size) channel base as per manufacturer‘s recommendation. The panels shall be sealed to the frame work by heavy duty ‗O‘ rings gaskets held captive in the framed extrusion. All panels shall be detachable or hinged. Hinges shall be made of die cast aluminium with stainless steel pivots, handles shall be made of hard nylon and be operational from both inside and outside of the unit. Units supplied with various sections shall be suitable for on site assembly with continuous foam gasket. All fixing and gaskets shall be concealed. Units shall have hinged, quick opening access door in the fan section and also in filter section where filters are not accessible from outside. Access doors shall be double skin type. Recirculation tank shall be fabricated from 18 gauge stainless steel sheet duly reinforced with all corners welded. The tank shall be complete with double brass strainers, make-up connection with float, drain and overflow connections.

Fan

The blower shall be Centrifugal Backward Curved DIDW fan wheel of totally GI Construction with Inlet Cones and shall be complete with individual motor and drive and shall be mounted on C Channel frame and Cushy Foot or Spring Mounts. Each Scrubber shall comprise of one / two no. fans to handle air quantities. Each fan shall be driven by suitable HP TEFC motor. The fan wheel will be of the multiblade type and mounted on two self-aligning pillow block bearings of the requisite size. The fan shall be run with the help of –V‖ Groove drives as per the recommendation of the drive supplier.

Motor

The TEFC IE-3 grade motor shall be suitable for 415 ± 10% volts, 3 phase, 50 Hz ± 5%, A.C supply. The motor shall be with class F/H insulation confirming to IS 325. The motor speed shall be 1440 RPM maximum designed and guaranteed for continuous operation at the nameplate rating. It should confirm to IP 55.

Pre Filter Section

Filters section shall incorporate metallic viscous filter (for removal of oil and grease) of thickness 50 mm in suitable aluminium frame. Velocity of air across the filters shall not exceed 2.5 m/s.

Spray Arrangement

The wet section will have 18 G SS Tank and body with folded construction with the bolted openable sides also in 18 G GI sheet. Spray arrangement shall be 2 bank air washer with 1/8‖ (3 mm) bore bronze nozzles with brass plug complete with GI pipes and spray headers. Minimum number of nozzles shall be 1 / sqft of face area. Face velocity not to exceed 500 FPM (2.5 m/s). PVC drain/overflow and bleed off outlet are to be provided on all wet sections.

Pump

The unit will have a single phase 220 volts + 10% 50 c/s power supply monoblock self priming pump assembly to provide recirculated tank water and a pressurized flow via a piping system for proper water distribution. The pump capacity will be such that it can take care of the bank of Nozzles provided and the rigid media

Installation

The fans, pumps, scrubber etc. shall be provided with necessary vibration isolation cushy foot mounts. All necessary accessories such as nut bolts etc. shall be arranged by the contractor. The contractor shall arrange his own labour with material for completion of assembly.

The contractor, shall cast the RCC foundations for equipments. Anti-vibration pads of adequate efficiency shall be provided.

Transit Damage

The contractor at his own cost shall restore the unit to original conditions in case of any damages.

Testing

The EPC contractor shall compute the unit air quantity with the help of velocity meter. The computed results shall be tallied with specified capacities and power consumption shall be tallied with the indicated figures in the technical data furnished with the bid by the contractor.

All necessary instruments of proper accuracy and services needed for the tests required for the computation of capacities and power consumption as required by the Engineer-in- Charge shall be provided by the contractor at his own cost.

It shall also be the responsibility of the Contractor to supply the motors and starters to satisfy the local regulations pertaining to the limitation of starting current and indemnify the Department from all liabilities arising out of any objections raised by the local authorities in this regard.

Ventilation Fans

Scope of Work

The specification for supplies & exhaust air blowers for mechanical ventilation covers the design requirement, constructional feature, supply, installation, testing & commissioning.

Type

The blower shall be of Tube Axial Flow fans / Inline fans / Propeller Fans / with or without ducting system & shall be of floor mounted / ceiling hung type.

Capacity

The capacity of Tube Axial Flow fans / Inline fans / Propeller Fans, diameter, maximum motor H.P & static pressure etc.

Axial Flow Fans

The exhaust air blower shall be Tube Axial Flow fans connected to the duct & shall be of floor / ceiling / wall mounted type as per Shop Drawings. The capacity of tube axial flow fans, diameter, maximum motor H.P & static pressure etc. shall be according to schedule of equipment. The noise level of axial fan shall be less than 80 dba at a distance of 2.5 mt from the fan.

Axial Flow Fan shall be **AMCA certified** for Air and Sound performance in accordance to **AMCA 210 and AMCA 300**.

The cylindrical casing should be made from welded carbon steel sheet. The inlet & outlet of the casing shall be fitted with flanges for ductwork connection & other accessories as required. The casing shall be coated with minimum 2 coats of rust proof primer and enamel paint thereafter or to be Powder Coated after phosphating process. The blade of axial flow fan shall be made of die cast aluminium alloy. The blade angle shall be set at manufacturing place & shall also have facility to modify latter. The hub shall consist of two half-hubs pressed in carbon steel & the centre boss shall be made of die-cast aluminium alloy. The blade feet shall be locked in two half - hubs. The impeller assembly shall be fixed on the shaft by means of a double cone type expansion bush. The design shall facilitate the alteration of blade angle without disconnecting the hub from the motor shaft. The fan shall be directly driven by TEFC sq. cage induction motor IE-3 grade. The fan motors shall be 415±10% volts 50HZ ± 5%, 3 phase TEFC SQ. Cage induction motor. The motor shall be specially designed for quiet operation. After assembling the impeller shall be statically & dynamically balanced. Fan RPM shall be 1000.

The mounting ring shall be of CRCA / sheet steel with brackets to connect the frame, with the Fan / Motor assembly. Rubber mounts shall be provided between the mounting frame and the mounting brackets.

All the fans selected for smoke extraction shall withstand 250 °C temperature for 2 hours & shall work satisfactorily at this temperature. Motors selected for this application shall be certified according to standard BS EN 12101-3:2002 / UL 705 for 250 °C for 2 hours.

Complete Fan assembly for smoke extraction application (Fan Impeller, Fan Casing, Motor base frame along with Motor) shall be tested and approved by Exova Warrington fire in accordance with BS EN 12101-3:2002 / UL 705 standard for "Powered Smoke and Heat Exhaust Ventilators for Smoke Control Systems" for (250 degree C) temperature for a 2 hours of operation.

All fan shall have Class-H motor.

Propeller Fans

The Propeller Fan blades shall be pressed steel of aerofoil design for high fan efficiency and static pressure. The blades shall be riveted to a central steel hub. The motor and blades assembly shall be mounted in a cast iron / sheet steel frame with steel brackets. Rubber mounts shall be provided between the mounting frames and brackets. The fan motor shall be totally enclosed type.

Propeller fan shall be in Plastic and GI construction as per requirement and suitable for single phase operation with speed regulator, gravity louvers etc.

In-Line Fans

Inline fans shall be complete with centrifugal impeller, casing, direct driven motor, vibration isolators, direction of discharge and rotation position shall be as per the job requirement and shall be marked on the fan assembly. Housing shall be constructed of hot rolled GSS sheet metal construction. Housing metal parts shall be either spot-welded or screwed or mounted together with rivets. Indication showing rotation arrow and make, model number and duty conditions of the fan shall be available on the housing. Fan wheel shall be forward curved type, statically and dynamically balanced. The fan shall be provided with ball bearings can be used in any mounting position at maximum indicated temperature.

Inline fan shall be box type with acoustically insulated and suitable for single phase operation with speed regulator, low nose application etc.

Bleed Fans with Pre & Fine Filters

single skin GI heavy gauge construction Fresh Air Bleed Fan with Pre Filters of MERV 8 rating and Fine Filters of MERV 13 rating consisting of GI Propeller Fan / Centrifugal Fan / Mixed Flow Fan suitable for static pressure of 40 MM minimum of various capacities suitable for single phase operation complete with gravity louvers, dampers, speed regulator etc. The face velocity across filters shall be limited to 152 MPM maxm. It shall be installed in each AHU Room at fresh air opening with louvers made on AHU Room external wall and shall be interlocked with AHU to run / off simultaneously.

Accessories

All necessary accessories shall be provided for proper operation and shall also include as part of Unit Price.

- Dunlop cushy foot vibration isolators for the blowers
- Double canvas connections at the outlets of each fan
- Nuts, Bolts, Shims etc. as required for the grouting of the equipment
- Slide rails for mounting the motor and belt adjust
- Bird Screens in the Inlet
- Detachable and washable fresh air filters at the inlets

Performance Data

All fans shall be selected for the lower operating noise level. Capacity ratings, power consumption, with operating points clearly indicated shall be submitted and verified at the time of testing and commissioning of the installation. All the fans should be AMCA certified for sound and performance.

Testing

Capacity of all fans shall be measured by an anemometer. Measured airflow capacities shall conform to the specified capacities and quoted ratings. Power consumption shall be computed from measurements of incoming voltage and input current. Contractor has to carry out the field balancing, if required.

Automatic Control & Instruments

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of automatic controls and instruments conforming to these specifications.

Type

All automatic controls shall be electrical / electronic controls as described in the tender specification.

Automatic controls required for various types of machines have been described in the various sections of these specifications. The manufacturers before dispatch may install the individual safety controls and selected automatic controls within the machines. However, the EPC Contractor, if not already installed on the machines, may install the following automatic controls, at site.

Controls for Air-handler

The Valve should be self-balancing dynamic flow control valves that are pressure independent, two-way, Modulating to accept digital or analogue input signals and provide flow feedback signal to the control system.

Two way modulating valve complete with pressure independent dynamic balancing capability for each air handling units shall be provided in chilled / hot water line at each air handling unit / FCU. A space temperature sensor shall actuate each valve. Constant space condition shall be maintained by continuous proportional modulation of the chilled / hot water through the coil. The valve shall be provided with spring return function so that it reverts to fully close position (two way valve) when fan is shut off. Motor shall be proportional modulating motor. Motor shall be suitable for 24 volts supply and shall have an integrated mounted 220/24 volts transformer factory-installed.

Flow Switch

Flow Switch shall be provided in condensing water outlet and chilled water outlet at each water-chilling machine. Flow switch shall prevent the compressor from starting unless the water flow is established in condensing & chilled water lines. Time delay shall be incorporated for flow switch to avoid false alarms.

Thermostat

The thermostat shall be electric, fixed differential cooling / heating type as specified with sensing element located in return air stream. All thermostats shall be supplied with the standard mounting boxes as recommended by the manufacturer.

If the Basis of Design asked for digital thermostat then it has to be installed which will have provision of setting of room temperature, setting of fan speed (High, Medium, Low) & for Humidistat, it shall be also of digital display type, which shall have provision of setting the RH and display space RH also.

Indoor Air Quality Monitoring Unit

Latest generation digital display type BMS compatible Indoor Air Quality (IAQ) Monitoring Unit to monitor and display PM 2.5, PM 10, CO2, RH etc for various air handling Units for return air. It shall include all necessary item and accessories as required such as sensors, control / communication / power cabling, transformer and adaptor etc. Display unit shall be mounted outside the AHU room. Unit shall display data in various colour for easy identification of Excellent / Good / Slight / Moderate / Heavy / Serious range limit.

Instruments

a) Thermometer: The alcohol filled V-form thermometer shall have range of 50 °C. for air-conditioning application. These shall be provided at inlet / outlet of chillers & air-handlers.

b) Pressure gauges: The pressure gauges shall be dial type of 150 mm dia to be installed at inlet / outlet of chillers, condensers, suction and discharge ends of pump-sets. The air-handlers shall have common pressure gauge for inlet & outlet. The pressure gauges shall be connected to the pipes by common dia copper pipe with shut off cocks required for gauges protection during testing.

Calibration & Testing

All automatic controls & instruments shall be factory calibrated & provided with necessary instructions for site calibration & testing. Various items of the same type shall be completely interchangeable and the manufacturer shall guarantee their accuracy. All automatic controls & instruments shall be tested at site for accuracy & reliability before commissioning the installation.

Variable Frequency Drives

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of variable frequency drives conforming to these specifications. The VFD should be specially designed & applicable for HVAC field & general-purpose product shall not be acceptable. AHU VFD shall be with IP-55 enclosure, mains disconnect & 4 PID controllers.

Certification UL, CE

VFD Design Requirements

1	Voltage Variations	380-480V
2	Nominal supply frequency	50 Hz ± 5%
3	True Power Factor (λ)	> 0.9 at nominal rated load
4	Displacement P.F. ($\cos \varphi$)	> 0.98
5	Short circuit current rating	100 kA RMS
6	Harmonic current control	5% non-saturating dual reactors on both rails of DC bus. Swinging chokes which do not provide full harmonic filtering throughout the entire load range are not acceptable. VFDs with saturating (nonlinear) DC reactors to provide additional 3%

		AC chokes.
7	EMC Compliance (for emission and immunity)	a) For powers ≤90 kW : Shall comply with requirements of IEC 61800-3 : 2004, Category C1 with 50m motor cable. b) For powers >90 kW : Shall comply with requirements of IEC 61800-3 :2004, Category C2 with 50m motor cable.
8	VFD rated continuous output current	Meet or exceed the normal rated currents of standard IEC induction motors
9	Torque mode	Variable torque. Not programmable in constant torque mode for variable torque fan and pump applications
10	Torque ratings	a) Starting torque : 135% for 0.5 seconds b) Overload torque : 110% for 1 minute
11	Cable lengths	a) Upto 150 m for screened / armoured cable b) Upto 300 m for unscreened / armoured cable
12	Cable type	To allow for SWA (Single Wire Armour) cable & MICS (Mineral Insulated Copper Sheath) cable in the motor circuit.
13	V/f ratio	Dynamically varying; fixed V/f curves not acceptable
14	Energy optimization function	Automatic energy optimization algorithm, which continuously adjusts the applied voltage based on load and speed.
15	Output power switching	Without any interlocks and damage to VFD
16	Motor tuning function	Automatic, without having to decouple the load and motor.
17	Signal Isolation	Galvanic Isolation between power and control circuitry
18	System response time	< 2 ms
18	Motor noise reduction	Adjustable carrier frequency modulation. VFDs with fixed switching frequency not acceptable
20	Ramp time	Programmable from 1 to 3,600 seconds

VFD Service Conditions

1	Ambient Temperature with full VFD rated output current:	a) For powers ≤90 kW : 45 P^{0P}C without derating b) For powers >90 kW : 40 P^{0P}C without derating
2	Relative Humidity	0 to 95%. non condensing
3	Max. altitude above sea level	Upto 1000m without derating
4	AC line voltage variation	U±U 10% of nominal with full output
5	VFD enclosure protection	IP 55 integral with no additional cabinets
6	Aggressive environment	Class 3C2
7	Vibration	1.0 g

VFD Protective Features

1	Motor overload protection	Class 20 $IP^{2P}t$ electronic motor overload protection with automatic compensation for changes in motor speed.
2	Protective functions	Against input transients, loss of AC line phase, output short circuit, output ground fault, over voltage, under voltage, VFD over temperature and motor over temperature.
3	Function at input phase loss	Auto derate and warning. Should cause no damage to VFD
4	Function at over temperature	Automatically reduce carrier frequency or auto derate.
5	Function at over load	Automatically reduce output current to a pre-programmed value
6	Alarm log	Record last 10 alarms with description of alarm, date & time.

7	Dry pump detection	Automatically detect and trip during a dry running situation or no flow condition, when used in pumping application
8	End of curve protection	Detect and display a warning or trip when encountering an end of curve situation, when used in pumping application

VFD Interface Features

1	Customer interface	Identical interface for full range of VFDs in a project
2	Display type	Graphical, alphanumeric, 6 line, back lit
3	Auto – Manual operation	Control panel to have inbuilt Hand – Off – Auto Keys
4	Programming assistance key	Key for displaying on-line context sensitive assistance for programming and troubleshooting.
5	Protection against unauthorized access	2 level password protection for read & write to prevent unauthorized access.
6	Parameter up load / down load	Control panel with program up load / down load function and also size / rating independent parameters.
9	Languages	English
10	Indicating lamps	Red FAULT light, yellow WARNING light and a green POWER-ON light.

VFD HVAC Features

1.	Quick set up menu	Menu with factory preset typical HVAC parameters
2	HVAC application menus	Fan, Pump, and Compressor menus specifically designed to facilitate start-up of these applications.
3	Speed control using 3 feedback signals	A three-feedback PID controller to control the speed of the VFD
4	3 – zone control	Sum, difference, average, compare to common set point or compare to individual set point and select

		min. or max. deviating signal
5	Square root function of feedback signal	Calculate the square root of any / all individual feedback signals so that a pressure sensor can be used to measure air flow
6	PI programming	Auto tuning PI controller to facilitate faster commissioning
7	Installation of pressure sensor near to output of pump.	Actively adjust its set point based on flow, to facilitate such installation
8	Independent PID controllers	Three Nos.,. additional PID controllers to control damper and valve positioners in the system and to provide set point reset
9	Floating point control interface	To increase/decrease speed in response to contact closures.
10	Meter displays	5 simultaneous meter displays on LCP
11	Display of feedback signals and set points	Display all connected feedback signals and its set points, in their own engg. units (e.g. : bar / $P^{0P}C$ etc.)
12	Sleep mode	Programmable and be able to stop the VFD in the following situations: a) Output frequency drops below set –sleep‖ level for a specified time, b) External contact commands that the VFD go into Sleep Mode, or c) Detects a no-flow situation.
13	Run permissive circuit	Receive a –system ready‖ signal before starting and also be capable of initiating an output ―run request‖ signal to the external equipment.
14	Loss of load detection	Monitor a broken belt / loose coupling and indicate via keypad warning, relay output or serial communication. This function shall be based on torque and shall have a proof timer.
15	Real time clock	Integral feature and shall be capable of: a) Display current date & time on control panel b) Start / stop, change speed depending on time c) Time stamp all faults d) Program maintenance reminders based on time
16	Energy log	Function to monitor energy consumption pattern over

		programmable hours, days & weeks
17	Load profile	Store a load profile to assist in analysing system demand and energy consumption
18	Sequential logic controller	To perform logic functions which has logic operators, comparators and timer functions.
19	Cascade controller for multiple motors	To control one variable speed motor and 2 fixed speed motors. Software to have full functionality and not just on / off
20	Automatic restart	To automatically restart on receiving power after a power failure
21	Adjustable ramp time	To avoid nuisance tripping, automatically adjust the ramp times.
22	Catching a spinning fan	To have a flying start function to effectively control an already spinning fan – in both forward and reverse direction
23	Programmable current limit	Programmable for site / application requirement. Shall be able to program for trip after an adjustable time
24	Start Delay	A programmable start delay shall be provided.
25	Critical frequency lock out	a) Semi automatic setting of lock out range. b) 4 such lock out ranges to be provided

VFD Input & Output

1	Digital inputs	At least 4 programmable digital inputs
2	Digital outputs	At least 2 programmable digital outputs
3	Relay outputs	At least 2 programmable relay outputs (Form C 240 V AC, 2 A) with adjustable on/off delays.
4	Analogue inputs	At least 2 programmable analogue inputs, independently selectable for Voltage (0-10V DC) or Current (4-20mA) inputs

5	Display of analogue signal	The Local Control Panel to display each analogue signal in its engg. units for troubleshooting & setup.
7	Optional I/O modules	Ppossible to order additional I/Os including DIs, DOs, ROs, AI, AOs and Ni 1000 / Pt 1000 inputs.
8	Serial com interface for AI/DI	Capable of reading the status of all analogue and digital inputs of the VFD through serial bus communications
9	Serial com interface for AO/DO	Capable to command all digital and analogue outputs (including options) through the serial communication bus
10	Fire over ride mode	On receipt of a digital fire input, override all other local or remote commands, ignore most normal safety circuits including motor overload, display FIREMODE, select forward or reverse operation and speed source or preset speed.

VFD Serial Communications

1 The VFD shall include a standard EIA-485 communications port and capabilities to be connected to the following serial communication protocols at no additional cost and without a need to install any additional hardware or software in the VFD:

a) Metasys N2

b) Modbus RTU

2 VFD shall have standard USB port for direct connection of Personal Computer (PC) to the VFD. The manufacturer shall provide no-charge PC software to allow complete setup and access of the VFD and logs of VFD operation through the USB port. It shall be possible to communicate to the VFD through this USB port without interrupting VFD communications to the building management system.

3 The VFD shall have provisions for an optional 24 V DC back-up power interface to power the VFD‘s control card. This is to allow the VFD to continue to communicate to the building automation system even if power to the VFD is lost.

CoiloTron / UVC Emitters – AHU Mounted

Scope of Work

This section deals with supply, installation testing & commissioning of CoiloTron / UVC Emitters System inside the AHU with accessories to reduce mold and fungus growth on the coil / drain pan and keep the coil surface clean as required conforming to these specifications and shall be in accordance with Bill of Quantities. The EPC Contractor shall depute CoiloTron representative for co-ordination during manufacturing of AHU & also for start up, testing, commissioning & performance test at site. Emitters shall be Double Ended Type and each fixture shall have 2 lamps. The lamps shall be high output type 425 mA each. Energy output of the lamp measured 3'3" (1M) from the Lamp shall not be less than 144 µwpercm². The lamps shall be rated for useful lamp life not less than 11,000 hours.

Design Requirements

Irradiation

1. Emitters and fixtures are to be installed in sufficient quantity and in such an arrangement so as to provide an equal distribution of UVC energy on the coil and in the drain pan.

2. The system shall comprise one or more number of individual units or fixtures, all mounted on factory provided metallic frame. All necessary materials to form the frame including mounting supports, screws, and hardware shall be factory provided.

3. To maintain energy efficiency, the UVC energy produced shall be of the lowest possible reflected and shadowed losses. The reflector shall be mirror surface with specular property not less than 86 % reflectivity to ensure maximum reflection of produced UVC rays on to the Cooling Coil and drain pan.

Intensity

1. The lamps shall operate at wave length of 254 nM and not at 180 nM or lower, to ensure no uncontrolled ozone is put out by the lamps.

Installation

1. Emitters and fixtures shall be installed downstream of the cooling coil at right angles to the coil fins, such that UVC energy bathes all surfaces of the coil and drain pan. The wiring kit for emitters shall be supplied by manufacturer. Installation of UV fixtures on vertical support structures shall allow easy movement of lamp fixtures as needed to cover the entire surface area of Cooling Coil and drain pan with UV radiation

Equipments

1. Units shall be high output, HVAC type, germicidal UVC light sources, factory assembled and tested. Components shall include a housing, reflector, high efficiency electronic power source, Emitter sockets and Emitter tube, all constructed to withstand HVAC environments. All electrical connections within the fixture or frame shall be factory ready, ending on terminals. All fixtures within an AHU shall be daisy looped. All electrical cables shall be UL Listed. It shall be possible to connect all the UV frames or fixtures within an AHU easily and quickly with minimum labor time, opening the terminal box alone, and without opening the fixtures.

2. Each lamp shall be housed individually in a quartz sleeve equivalent to GE 214 to ensure high rate of transmission of UV intensity. The quartz sleeve shall cover the entire length of the lamp and lamp holders. The quartz sleeve is essential to ensure multiple beneficial features;

    - Prevent carry over moisture from Cooling Coil from contacting lamp surface.
    - Prevent dust particles settling on lamp surface
    - Ensure lamp surface is maintained at constant temperature and to prevent cooling of lamp surface due to passage of air over it.
    - Contain and hold mercury from spilling into the AHU section , in the event of breakage of lamp. This is required to ensure compliance to environmental codes.
    - Facilitate environmentally safe disposal of broken lamp

3. Final finished UV Fixture shall be Listed to UL 1995

4. Final finished UV Fixture shall be tested and certified to comply to Fire and Smoke Safety to UL 2043

Pressurized Expansion Tank & Air Separator

Scope of Work

This section deals with supply, erection, testing and commissioning of pressurized expansion tank & air separator for chilled / hot water conforming to general specification and suitable for the duty selected.

Pressurized Expansion Tank

Expansion tanks shall be ASME rated pre-charged bladder type pressure vessels. Expansion tanks shall be designed to absorb the expansion forces of heating/cooling system water while maintaining proper system pressurization under varying operating conditions. The heavy duty bladder shall contain system water thereby eliminating tank corrosion and water logging problems. Tanks shall be factory pre charged at 12 psi. Sight glass and seismic restraints shall be available on request. Bladder material shall be Heavy Duty Butyl Rubber. System connections shall be of Forged Steel. Tank‘s shell shall be of Carbon Steel. Tank‘s maximum operating design pressure shall be 125 psi. Tank‘s maximum operating design temperature shall be 240ºF. The tank shall be fitted with lifting rings and a floor mounting skirt for vertical installation. The tanks can be installed in the horizontal position with the system connection located below the horizontal centreline of the tank.

Air Separator

Furnish and install, as shown on plans, a centrifugal type air separator. The unit shall be (NPT/flanged/grooved) inlet and outlet connections tangential to the vessel shell. The unit shall have an internal stainless steel air collector tube with 5/22‖ (4mm) diameter perforations and 63% open area designed to direct accumulated air to the compression tank on an air control system or an air vent on an air elimination system via an NPT vent connection at top of unit.

Vessel Shell diameter is to be three times the nominal inlet/outlet pipe diameter, with a minimum vessel volume for sufficient velocity reduction. The air separator must be designed, constructed and stamped for 125 psig @ 3500 F (862 kPa @ 1770 C) in accordance with Section VIII, Decision I of the ASME Boiler and Pressure Vessel Code, and registered with the National Board of Boiler and Pressure Vessel Inspectors. The air separator(s) shall be painted with one shop coat of light grey air dry enamel.

A manufacturer‘s Data Report for pressure Vessels, form U-1 as required by the provisions of the ASME Boiler and pressure Vessel Code, shall be furnished for each air separator upon request.

Electrochemical Water Treatment & Disinfection System

Scope of Work

This specification covers the design requirement, materials, constructional feature, manufacture & supply, installation, testing, commissioning of Electrochemical Water Treatment & Disinfection System for condenser / cooling tower water circulating system.

The cooling tower treatment system offered must be based on electrochemical technology wherein equipment attains the chemical decomposition by electrical current. The treatment system to provide controlled electrolysis, in a reaction chamber, to prevent scaling and control formation of bacteria, algae and slime that arise in cooling water systems.

The treatment system offered must eliminate the need of any dosing chemicals to treat cooling water, and substantially reduce the Bleed Off (Blow Down) requirement by increasing the Cycle of Concentration, thereby saving large quantity of make-up water. Supplier to substantiate such water savings by Mass Balance calculations using chemical analysis reports of Make-Up and Circulating Water.

Codes & Standards
The treatment system for Scale Precipitation and removal shall conform to the following International Standards:-

- ISO 9001:2000: Quality Management Standard
- EN 61010-1: Safety requirements for electrical equipment for measurement, control and laboratory use.
- CE/UL Standards: PN 32, PN 75, PN 8016 and AST 64

Operating Principle

The treatment system must operate using the electrolysis principle and include a reaction tank which is used as a cathode; inside the tank electrodes (anodes) are installed.

Water to flow through the tank continuously for electrical current to flow between the cathode (the tank) and the anode (electrodes inserted in the tank) and cause the dissociation of the salts in the water into ions. The cations are attracted to the tank wall, while the anions are attracted to the anodes. The anodes in the tank must be made of titanium with nickel oxide coating (Ti.Ni.O). The anodes must be resistant to high electrical current and do not dissolve in the water.

The cations include, among others, the calcium, which is the scale builder in the water. This calcium combines with carbonates present in the water and –controlled scale‖ is produced on the wall of the

tank. The qualities of this controlled scale prevent it from adhering firmly to the tank wall, thus allowing for its scraping and flushing.

The following chemical reactions take place when an electrical current is applied to the electrodes:

An alkaline environment (pH > 9.5) is created next to the Cooling Tower Treatment System reaction tank's inner walls, which act as a cathode. As a result of this calcium and scale deposits crystallize & precipitate on the tank walls. Also this highly alkaline environment does not permit any microorganism to survive.

The pH level in the water system does NOT change. The pH levels of the water in the reaction tank's water inlet and water outlet are the same.

Next to the anodic electrodes up to 30% of the chlorides that are naturally present in the water, are transformed to free chlorine or hypochlorite (OCl-). In the electrolysis process radical oxygen, ozone and hydrogen peroxide are also being produced. Chlorine combined with the ozone and oxygen provides sufficient reduction of microbes to maintain & control of bacteria and algae in the cooling tower and further contribute to the disinfection of the water inside the reaction tank.

The piston, plunger and drain valve in the Electrochemical Treatment System reaction tank remove the precipitated scale and other sediments and pollutants from the walls and volume of the tank, which prevents a breeding ground for the development or proliferation of microorganisms. This removal is fully automatic and can take place several times a day.

Since the Legionella bacteria is being created under conditions of stagnant water, Sediment, scale deposits, and corrosive areas, it was found that in most cases it is being prevented while using the Electrochemical Treatment System, as the system treat the surroundings that causes the Legionella growth.

The Electrochemical Treatment System to be capable to work in a maximum temperature of ~48ºC.

Technical Specification

Tank

Operating Pressure	**:**	Maximumof6 bar(88 psi)
Material	**:**	Carbon steel, epoxy painted on external Side

Tank Internals & Accessories

Electrodes	**:**	Proprietary and patented metallurgy.
Scraper	**:**	Patented Polypropylene shaft and scraperare operated by motor

Valves **:** 2" manual butterfly Inlet valve

2"manual butterfly outlet valve

2"electricaldrainageball valve

1" hydro cyclone electrical drainage ball valve

Air release/intake valve, ARI ¾‖, Model AV-10 rated for 140psi, PN-10.

PH Meter **:** Thermo Alpha PH-500 or equivalent.

Electrical & Control System

Operation Control : 220V;50Hz. Lambda, 24VDC.3.1A.

Electrolysis Power Supply : Lambda or equivalent

Interactive Display : Delta or Equivalent

Electrical connection required : 3ph,480V,25Amp

Type Of Electrochemical Water Treatment & Disinfection System

The Electrochemical Water Treatment & Disinfection System shall be either Unitary (Single) Treatment System or Mega Treatment System (Plug & Play Format) as specified in the BOQ & suitable for the site requirement.

Components of Unitary (Single) Treatment System

- Reaction tank(serves as cathode).
- 3 Electrodes(anodes)
- Scraper motor for scraper operation.
- Scraper made of polypropylene, mounted inside the reaction tank.
- 2"manualbutterflyInletvalve
- 2"manualbutterflyoutletvalve
- 2"electricaldrainageballvalve
- 1"hydrocycloneelectricaldrainageballvalve
- Automaticcontrolelectricalpanel:380V,25Amp.
- Air release/intakevalve,ARI¾‖forprotectionofthetank.

Components of Mega Treatment System (Plug & Play format)

- Multiple Treatment Systems

- A container
- Pipes connections
- 2Circulation pumps
- Main panel control
- Main electrical box
- Main pH meter
- Main conductivity meter

The container to arrive in a" plug & play" format.

Monitoring & Control Facilities

- The treatment system shall have the provision of automatic control by a PLC with an interactive display/HMI for monitoring of machine operation. Alternately the HMI system shall have the option to be operated locally also.
- HMI system shall have the provision of set up of all basic parameters for better and efficient operation of the system.
- The treatment system display unit should be able to measure the amount of calcium and make up water of cooling tower, Circulation pump flow, next flushing time, pH and conductivity as measured by electrodes and power supply data as measured by the system in volts and ampere respectively.
- Provision for alarm acknowledge and active alarm list.
- Provision for manual flushing should also be available in the system.

The HMI system to be operated by a password and a personal IP number.

System Input Parameters

The following input data shall be considered for selection of treatment system by the manufacturer.

a. Cooling Tower Capacity - As per DBR
b. Circulation Flow Rate - 3 US GPM / TR
c. Make up water Consumption - 0.85% of Flow
d. Delta ‘T‘ of cooling tower - 10.0 ºF
e. Cooling tower Operational Time - 24 Hrs
f. Water sample test reports of Make-up and Cooling Tower circulation water to be provided by EPC Contractor as per the below mentioned parameters-
   - PH
   - CONDUCTIVITY
   - TDS
   - TOTAL ALKALINITY (CaCO3)
   - TOTAL HARDNESS (CaCO3)

- CALCIUM AS CaCO3
- TEMPERATURE
- SiO2

Output Water Quality

The makeup water quality generated by the system shall prevent the following:-

- Scale Precipitation
- Corrosion
- Bio growth and Algae
- Wastage of Blow down water

Other Benefits

- Savings in Water consumption
- Savings in Maintenance Costs
- Chemical-free: no health risks and environmental friendly.
- Improvement in chiller/condenser efficiency and IKW/TR
- Exterior to the cooling tower-no changes/installations in CT
- Green sustainable and Patented Technology

Chilled Water / Hydronic Cassette & Hi Wall Units

Scope of Work

This section deals with supply, erection, testing and commissioning of chilled water / hydronic cassette / hi wall units confirming to general specification and suitable for the duty selected. The type, capacity and size of indoor units shall be as per approved shop drawings.

General

Indoor units shall be ceiling mounted cassette type / hi wall type as specified in approved shop drawings. Each unit shall have electronic control valve to control chilled water flow rate respond to load variations of the area.

The fan shall be dual suction, aerodynamically designed turbo, multi blade type, statically & dynamically balanced to ensure low noise and vibration free operation of the system. The fan shall be direct driven type, mounted directly on motor shaft having supported from housing.

The cooling coil shall be made out of seamless copper tubes and have continuous aluminum fins. The fins shall be spaced by collars forming an integral part. The tubes shall be staggered in the direction of airflow. The tubes shall be hydraulically/ mechanically expanded for minimum thermal contact resistance with fins. Each coils shall be factory tested at 21 kg/sqm air pressure under water.

Unit shall have cleanable type filter fixed to an integrally moulded plastic frame. The filter shall be slide away type and neatly inserted.

Each indoor unit shall have electronic control valve for maintaining design room temperature. Each unit shall be provided with digital thermostat for cooling or cooling and heating option.

Each unit shall be with wired LCD type remote controller. The remote controller shall memorize the latest malfunction code for easy maintenance. The controller shall be able to change fan speed and angle of swing flap individually as per requirement.

Ceiling Mounted Cassette Type Unit (Multi Flow Type)

The unit shall be ceiling mounted type. The unit shall include pre-filter, fan section and chilled water coil section. The housing of the unit shall be powder coated galvanized steel. The body shall be light in weight and shall be able to suspend from four corners. The fan shall be aerodynamically designed diffuser turbo fan type. Also Units shall have an external attractive panel for supply and return air. Unit shall have four way supply air grilles on sides and return air grille in center.

Each unit shall have high lift drain pump, fresh air intake provision (if specified) and very low operating sound.

All the indoor units regardless of their difference in capacity should have same decorative panel size for harmonious aesthetic point of view. It should have provision of connecting branch ducts.

Hi Wall Mounted Unit

The units shall be wall-mounted type. The unit includes pre filter, fan section & chilled water coil section. The housing of unit shall be light weight powder coated galvanized steel.

Unit shall have an attractive external casing for supply and return air.

Colour

The colour of indoor units should be white or to suit interiors as designed by the architects and approved by engineer in charge.

Copper / Brass Connection Set with valves

insulated (factory supplied insulation kit / box) copper / brass connection set for chilled line consisting of 2-Way motorised modulating diaphragm type pressure independent cum balancing control valve, ball valve with strainer at inlet, ball valve at outlet, copper connection set with braided pipe flexible connector at in and out at one end etc. Valves and associated item sizes shall be 25 mm up to 2 TR & 32 mm for 2.5 TR & above for chilled water application.

Electrical Motors

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of all types of motors used for HVAC Units conforming to these specifications. The motor installation, wiring & its control shall be carried out in accordance with the specifications as detailed below.

Motors

The motor shall be of the following design and should run at all loads without any appreciable noise or hum.

Totally enclosed fan cooled Sq. Cage.

Enclosure and type of motor shall depend upon duty and usage unless otherwise specified.

a) The winding of motors shall be class _F/H‘ insulation and suitable for local conditions. The insulation of motors shall confirm to IS:325/1978.

b) All motors shall comply with IS:325, IEC-34.1 or BS – 2313, IEC-72.1 for foot mounted motors.

c) The rating of the motor shall be as per actual requirement. The motors shall be selected on the basis of ambient temperatures and allowable maximum temperature rise.

d) Motor above 1HP shall be three phase unless otherwise specified.

e) All motors shall be rated for continuous duty as per IS:325. Motor shall be suitable for operation on 415 volts ± 10% volts, 50 ± 5% Hz three phase AC supply (or 230 ± 10% volts, 50 ± 5% Hz for single phase AC supply). Motor shall have IE-3 grading.

f) Motors shall be provided with cable box to receive Aluminum / Copper conductors, PVC / XLPE insulated, PVC sheathed and armored cables.

g) All motors shall be provided with combination of _Ball and Roller Bearing‘. Suitable grease nipples for regreasing the bearing shall be provided.

h) Motors above 0.25 HP shall be provided with overload protection. Motors above 100 HP shall be provided with thermal protection and thermistor detector in the stator winding.

i) The starter current and the type of starter to be used shall be as follows (unless otherwise specified)

	Type of motor	**Starting Current**	**Starting method**
a)	Sq. Cage motor up to 7.5 HP	600% of full load current	D.O.L
b)	Above 7.5 HP up to 60 hp	250% of full load current	Star / Delta
c)	75 HP & above	200% of full load current	Closed transition Star / Delta or Double Star

Motor Starters

a) All starter shall confirm to IS: 13947. The starter shall be enclosed in sheet metal enclosure, which would be dust vermin proof.

b) All starter should have suitable range of voltage and frequency.

c) All starter shall have integral stop/start push button of international colour code.

d) Contactor shall have number of poles as required for appropriate duty. Contacts should be made of solid silver faced & shall be suitable for at least 40 contacts per hours.

e) In event of power failure, the starter should automatically disconnect.

f) All starters shall be provided with thermal over load relay.

g) All star delta starters shall have adjustable timers.

h) Terminal blocks with integral insulating barrier shall be provided for each starter.

i) All starters shall be provided as specified in Schedule of Quantities. All starter shall be compatible to the drive and driven equipment.

j) Extra contact for interlocking purpose shall be provided in the starter.

k) All starter shall be compatible for Auto / Manual operation (BMS Compatible)

l) All starter shall have separate single phasing preventer.

Installation of Motors

a) The motor and drive machine shall be fixed on slide rails to facilitate belt and other adjustments.

b) Vibration isolation arrangement shall be provided.

c) The installation of motor shall be carried out as per IS:900.

d) The motor with driving equipment shall be mounted on foundation and connected to each other with flexible coupling with guard in condenser & chilled water pumps.

e) All motor shall be wired as per specifications. Earthing of motor frame shall be done with GI strips / GI Wire as per IS standard.

f) All motors shall be tested at manufacturer‘s works as per I.S. standard and test certificates shall be furnished.

g) All motors shall be tested at site for vibrations, heating and electrical insulation resistance.

Motor Control Centre, Ventilation Sub Panel, Power & Control Cabling, Earthing etc.

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of Motor Control Centre, Ventilation Panels, AHU Sub Panel, power / control cabling & earthing work shall be carried out as per the specification given below. All work shall confirm to Indian Electricity Act (amended up to date), I.S. code of practices, local rules and regulations etc. The codes & standard to be followed shall be as given below:-

- BIS 13947 (Part 4) - AC contactors up to 1000V

- BIS 13947 - AC Circuit Breakers
- BIS 2705 - Current Transformers
- BIS 3156 & 4146 - Potential Transformers
- BIS 4064 - Air break switches for voltage not exceeding 1000V
- BIS 13947 - Control switches
- BIS 1822 - Motor duty Switches
- BIS 12021 - Specification for control transformer
- BIS 8623 - Factory built assembly of switchgear & control gear
- BIS 13947 (Part I) - Degree of protection for enclosure
- BIS 3842 - Specification for electrical relays for AC system
- BIS 13707 - Specification for HRC fuses
- BIS 5082 - Wrought Al. and Aluminium alloys, bars, rods, tube and sections for electrical purposes
- BIS 13947 (Part 1) - General requirement for switchgear & control gear for voltage not exceeding 1000V
- BIS 3231 - Electrical relays for power system protection

Motor Control Centre / Ventilation Sub-Panel

Motor control centre shall be floor mounted extendable type bolted construction & Ventilation sub-panel shall be wall mounted type. The sheet steel (CRCA) used for fabrication shall be of 2.0mm for load bearing members and 1.6mm for non-load bearing members. The panels shall be supplied with required base channels. These panels shall be cubical sectionalized type, totally enclosed dust & vermin proof. Gaskets shall be provided in all joints to prevent dust to reach the internals of the panels to make it completely dust proof. The degree of protections for panels shall be IP 52 for indoor applications and IP 65 for outdoor applications as per IS:2147.

These panel (MV) shall be suitable for voltages up to 500 volts, three phase 50 Hz, 4 wire supply capable of functioning satisfactorily in temperature ranging up to 45 to 50 degree centigrade and rupturing capacity suitable for connected load & design should be type tested for 42 KA fault level. All joints of panels shall be welded and braced as necessary to provide a rigid support for all components. The base channel provided in the floor mounted MV panel shall be 100mm x 50mm x 6mm & a clear space of 200mm between the floor and the bottom most part of the unit shall be provided. The panel shall be correctly positioned. Self- threading screws shall not be used in the construction of control panels. Appropriate knock-out holes of proper sizes shall be provided for

incoming and outgoing cables. The facility for bottom or top entry of cables in the panels shall be provided. Necessary cables clamps shall provided for holding the cables in position.

All power/control wiring inside the panel shall be colour coded and control wiring ferruled for identification purpose. All labeling shall be provided in engraved anodized aluminum strips on the front face of the panel.

Each circuit breaker shall be housed in separate compartments. It shall have steel sheets on top and bottom of compartment. The steel sheet hinged door shall be interlocked with the circuit breaker on the ―ON‖ position. When the breaker is on the ―ON‖ position, suitable preventive measures shall be provided, such as interlocks, to prevent the breaker from being drawn out. When the breaker is in ―ON‖ position steel sheet shall be provided between the tiers in the vertical section. The door of this compartment shall not form part of the draw out arrangements.

Bus-Bars

The bus-bar and its connections shall be aluminum Electrolytic grade E-91 as per IS: 5082 and shall be of rectangular section. These should be suitable for full load current for phase bus-bar and neutral bus-bar shall be of half rated current capacity. The bus-bar should have provision on either side for extension. The bus-bar should be sleeved with colour coded heat shrinkable PVC sleeve. Bus-bar supports shall be of fibre glass reinforced thermosetting polyester having in built and tracking barriers to break the path of conducting dust through moulded ribs.

In panels bus-bar connections shall be done by drilling holes with cadmium coated bolts and nuts. Extra cross section shall be provided to compensate drilling of the holes. Insulated aluminum strips of suitable size of full rated current capacity shall be used for interconnecting bus-bar and breaker.

A horizontal / vertical wire way shall be provided for interconnecting control wiring between different vertical sections.

The terminal blocks shall be used for outgoing terminals and neutral link at a suitable located place in the control panel. Separate compartments for outgoing and incoming cable shall be provided. The current transformers of all instruments shall be mounted with terminal blocks.

All live parts including incoming and outgoing link / terminals should be totally shrouded by means of non hygroscopic and fire retardant material.

Air Circuit Breakers

The circuit breaker shall be capable of making and breaking the specified fault currents without straining or damaging any part of the switchgear. The breakers shall be air break, motorized / manually operated and draw out type. All feeders of rating 800A and above shall be ACB and of fully draw out type. The circuit breaker shall be stored energy closing type, manual/electrically operated with tripping mechanism. The circuit breaker shall be provided with 4 NO + 4 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. Circuit breakers with stored energy closing mechanism shall be capable of making the rated short-circuit current, when the stored energy is suitably charged by a spring. It shall also be capable of closing on no-load without suffering undue mechanical deterioration. The maximum make-time shall also not be exceeded.

The direction of motion of the handle, for manual spring charging shall be marked. A device indicating when the spring is charged fully shall also be provided. Motors and their electrically operated auxiliary equipment for charging a spring shall operate satisfactorily between 85% and 110% of the rated supply voltage. The breaker operating mechanism should store energy for O-C-O operation and shall not, in any case, get stuck in closed position during this cycle. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible. The breaker operating mechanism shall be electrically and mechanically trip-free in all positions.

All ACBs shall be provided with microprocessor based trip unit for protection against overload, short circuit and earth faults. The releases shall be communicable to other systems on an open communication protocol. The Communication Port shall be provided in front/back. The circuit breakers shall be suitable for locking in fully isolated condition.

Following interlocks and features shall be provided so that

a) Truck can be moved within panel only when CB is off.

b) CB can be closed only when the test (or) service limit switches permits.

c) Breaker compartment door cannot be opened when the CB is in Service/test position.

d) Breaker cannot be put in to service position with compartment door open.

e) Earth slide beyond the test position till trolley is drawn out.

Closing and tripping coil shall operate satisfactorily under the following conditions of supply voltage variation:

a) Closing coils – 85% to 110% of rated voltage..

b) Trip coils – 70% to 110% of rated voltage.

Moulded Case Circuit Breakers

The MCCBs shall confirm to the latest applicable standards. MCCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator. Operating handle for operating MCCBs from door of board shall be provided. MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings. MCCBs shall incorporate time delay devices to ensure that it will tolerate harmless transient overload unless this is well in excess of 25% of its rated value for a sustained period. The circuit breaker shall be provided with 2 NO + 2 NC of auxiliary potential free contacts required for indication, control, interlocking and other purposes. All contacts shall be wired to a terminal block. The breaking capacity of MCCB‘s shall be as per the design requirements.

Miniature Circuit Breakers

Miniature Circuit Breaker shall comply with IS-8828-1996/IEC898-1995. Miniature circuit breakers shall be quick make and break type for 230/415 VAC 50 Hz applications with magnetic thermal release for over current and short circuit protection. The breaking capacity shall not be less than 10 KA at 415 VAC. MCBs shall be DIN mounted. The MCB shall be Current Limiting be type (Class-3). MCBs shall be classified (B,C,D ref IS standard) as per their Tripping Characteristic curves defined by the manufacturer. The MCB shall have the minimum power loss (Watts) per pole defined as per the IS/IEC and the manufacturer shall publish the values. The housing shall be heat resistant and having a high impact strength. The terminals shall be protected against finger contact to IP20 Degree of protection. All DP, TP and TPN miniature circuit breakers shall have a common trip bar.

Rotary Switch / Selector Switch / Switches / HRC Fuses / Starters / Single Phase Preventers / Toggle Switch

These shall be of approved make and conforming to relevant ISI standard. The rupturing capacity of HRC fuses should not less than 80 KA and in case of switches it should be 60 Amps maximum.

Current Transformer

The current transformers shall have accuracy of class I and 5P10 / 10P10 and suitable VA burden for operation of the connected meters and relays.

Overload Relays

All the motors shall have overload relay protections conforming to relevant IS.

Time Delay Relays

These shall be adjustable type with time delay adjustments of 0-180 or as per manufacturers standards.

Indicating Lamps And Metering

These shall confirm to BS37 & BS39. All meters shall be flush mounted and draw-out type. The indicating lamp shall be filament type and with very low burden & economy resistor.

Voltmeter And Ammeters

Motor Control Centre (MV Panel) shall have flush type voltmeter & ammeter of size 96 x 96 mm.

Push Button Stations

These shall be suitable for panel mounting and accessible from front without opening. These shall be provided for manual starting and stopping of motors/equipments as per normal practices. The contacts shall be suitable for 6AMP current capacity.

Name Plate

Suitable anodized Aluminium name plate of 1.2 mm thick shall be provided on all the Switchboards and individual compartments.

Conduits

These shall be preferable made of mild steel, stove enameled from inside and outside with minimum wall thickness of 1.6 mm for conduits up to dia of 25mm and 2 mm for conduits above 25 mm diameter.

Cables

Cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

The cables shall comply with the latest edition of the following standards

- BIS: 7098 (PART-I) - XLPE Cables - LT
- BIS: 8130 - Conductors for insulated electric cables & flexible cords.
- BIS: 3975 - Mild steel wires, strips & tapes for armouring of cables.
- BIS: 10418 - Wooden drums for electric cables.
- BIS: 10810 (PART 58) - Oxygen Index test

The material of cable shall be as follows:-

a) The MV power cable of 660/1100 V. grade shall be XLPE insulated Aluminium conductor armoured cable.

b) The MV control cables shall be PVC insulated copper conductor armoured stranded cable.

) The HT power cable of 415 V grade shall be XLPE insulated Aluminium conductor armoured cable.

Laying of Cables

These shall be laid as Indian Standard code of practice. All cables shall be laid on 16G GI Perforated U shaped Channel 40mm x 20mm cable trays. In case more than one cable is running, then proper space in between the two cables shall be provided to avoid loss of current carrying capacity. While cables are running on walls, proper saddles must be provided.

Wire Sizes

Single stand PVC-copper conductor wires shall be used inside the control panel for interconnecting different components. All wires shall be neatly dressed and coloured beads shall be provided for easy identification in control wiring. The minimum size of control wiring shall be 1.5sq.mm. Testing of panels as per code of practice shall be done at works by Employer / Architect before inspection & dispatch to site.

Drawings

Necessary drawings of all control panels and wiring of equipment etc., shall be submitted by the contractor for approval of the Engineer in Charge. On final completion of job and before handing over of AC System As Built Drawings shall be submitted to the Department.

Testing

All equipment and components supplied may be subjected to inspection and tests by the Engineer-in-Charge or his authorized representatives during manufacture, erection / installation and after completion. No tolerances shall be allowed other than the tolerances specified or permitted in the relevant approved Standards, unless otherwise stated. If the guaranteed performance of any item of equipment is not met and / or if any item fails to comply with the specification requirement in any respect whatsoever at any stage of manufacture, test or erection, the Engineer-in- Charge may reject the item, or defective component thereof, whichever he considers necessary.

The complete electrical installation shall be tested in accordance with relevant IS codes in presence of Electrical Supervisor of the client before commissioning of plant.

Painting of Panels

All sheet metal enclosures shall be powder coated only after de-rusting & hot-dip phosphating degreasing etc. at works only.

NOTE: Rubber mats of 1100 volts shall be laid in front of all switch boards.

Sizes Of Power Cabling

The following size of power cabling shall be used only :

	HP of Motors	**Cable size**
a)	Up to 5 HP	3c x 4sq.mm aluminium conductor armoured cable.
b)	5 to 7.5 HP	3c x 6sq.mm aluminium conductor armoured cable.
c)	10 to 15 HP	2no. 3c x 6sq.mm aluminum conductor armoured cable.
d)	20 to 25 HP	2 Nos.,. 3 x 16sq.mm aluminum conductor armoured cable.
e)	30 to 35 HP	2 Nos.,. 3c x 25sq.mm aluminum conductor armoured cable.
f)	40 to 50 HP	2 Nos.,. 3c x 35sq.mm aluminum conductor armoured cable.
g)	60 HP	2 Nos.,. 3c x 50sq.mm aluminum conductor armoured cable.
h)	75 HP	2 Nos.,. 3cx 70sq.mm aluminum conductor armoured cable.
i)	100 HP	2 Nos.,. 3cx 95sq.mm aluminum conductor armoured cable.
j)	125 HP	2 Nos.,. 3cx 120sq.mm aluminum conductor armoured cable.

Capacity of Relays and Contacts

The following capacity relays and contacts shall be used for various rating of motors:

Type of Starter Contactor Overload Relay

			Contactor	**Phase Relay Range**
a)	50/60 HP Motor	Star Delta Starter	70 Amp.	30 - 50 Amp.
b)	40 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
c)	30 HP Motor	Star Delta Starter	45 Amp.	20-33 Amp.
d)	25 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
e)	20 HP Motor	Star Delta Starter	32 Amp.	14-23 Amp.
f)	15 HP Motor	Star Delta Starter	25 Amp.	9-15 Amp.

g)	10 HP Motor	Star Delta Starter	16 Amp.	6-10 Amp.
h)	7.5 HP Motor	D.O.L. Starter	16 Amp.	9-15 Amp.
i)	5 HP Motor	D.O.L. Starter	16 Amp	6-10 Amp.

Earthing

The earthing of all equipments shall be carried out by Copper strips / wires as mentioned below. All panels / three phase motors shall be earthed with two number distinct and independent Copper strips / wires of the following sizes:

1.	Motor upto 5.5 KW	10 SWG Copper Wire	8 SWG GI Wire
2.	Motor 7.5 to 18.75 KW	8 SWG Copper Wire	6 SWG GI Wire
3.	Motor 18.75 to 50 KW	25x3 mm Copper Strip	25x6 mm GI Strip
4.	Motor 51 to 89 KW	25x6 mm Copper Strip	32x6 mm GI Strip

The earthing connections shall be connected to main earth station or main earth grid. The earth connections shall be connected to equipments after removal of paint, grease etc.

Air Distribution

Scope of Works

The scope of this section comprises supply, fabrication, installation & testing of all sheet metal GI ducts as well as supply, installation, testing & balancing of all grills, diffusers & other accessories in accordance with these specification.

GI Duct (Site Fabricated)

The duct shall be fabricated out of galvanized sheet, class VIII (Zinc coating 120 gm/m²□as per the parameters given below which are conforming to IS 655-1963.

Maximum Side	**Thickness of GI / AL Sheet**	**Type of Transverse Joint Connections**	**Bracing**
(1)	(2)	(3)	(4)
Mm	Mm		

Up to 300	0.63 / 0.80	S-drive, pocket or bar slips, on 2.5m centers	None
301 to 600	0.63 / 0.80	S-drive, pocket or bar slips, on 2.5m centres	None
601 to 750			25 x 25 x 3 mm
		S-drive, 25mm pocket or 25 mm bar slips on 2.5m centers.	angles, 1.2m from joint
751 to 1000	0.80 / 1.00	Drive, 25-mm pocket or 25mm bar slips, on 2.5 m centres 40 x 40 mm angle connections,	25 x 25 x 3 mm angles, 1.2 m from joint
1001 to 1500		or 40-mm bar slips, with 35 x 3 mm bar reinforcing on 2.5 m centres.	40 x 40 x 3 mm angles, 1.2 m from joints
1501 to 2250	1.00 / 1.25	40 x 40 mm angle conn sections, or 40-mm bar slips, 1 m maximum centres with 35 x 3 mm bar reinforcing.	40 x 40 x 3 mm diagonal angles, or 40 x 40 x 3 mm angle 60 cm from joint.
2250 to above*	1.25 / 1.50	50 x 50 mm angle connections, or 40 mm pocket or 40 mm bar slips, 1 m max. centres with 35 x 3 mm bar reinforcing.	40 x 40 x 4 mm diagonal angles, or 40 x 40 x 3 mm angles, 60 cm From joint.

* Ducts 2250 mm and larger require special field study for hanging and supporting methods.

In addition to above the following points should be also taken into account while fabrication of ducts.

a) All ducts of size larger than 450mm shall be cross broken.

b) All ducts shall be supported from the ceiling / slab by means of MS rods of dia 9mm with MS angle of size 40 x 40 x 5 mm at the bottom with neoprene pad in between the duct & MS angle. The ducts shall be suspended from the ceiling with the help of dash fasteners. The contractor shall arrange provision for necessary ancillary materials required for hanging the ducts.

c) The vanes shall be provided wherever required and shall be securely fastened to prevent noise & vibration.

d) The rubber gasket shall be installed between duct flanges in all connections and joints.

e) All flanges and supports should be primer coated.

f) The flexible joints shall be fitted to the delivery side of AHU fans with Fire Retardant Double canvass. The length of flexible joints should not be less than 150 mm and not more than 300 mm between faces.

g) The ducting work can be modified if deemed necessary in consultation with the Engineer in Charge to suit actual site conditions in the building.

Box Type Dampers & Splitters

These dampers shall be provided in the ducting work for proper control and balancing of air distribution. All dampers shall be louver type robust construction. These dampers shall be fitted with easily accessible operating mechanism, complete with links, levers, quadrant for proper control and setting in a desired position. The position of the handle of the damper operating mechanism shall be clearly visible and shall indicate the position of the damper in the duct. All dampers, splitters shall be fabricated out of G.S. sheet of two gauges higher than the duct piece having these fittings. Dampers shall be installed in duct at all required locations. No extra payment shall be made separately since these form part of Air Circulation System.

NOTE : In case angle iron supports are not feasible to be installed for supporting the ducts due to height constraint then the contractor shall support the ducts with M.S flats of at least double the thickness of the angle iron supports.

Supply And Return Air Grills And Ceiling Diffusers

The supply and return air grills and ceiling diffusers shall be made of powder coated extruded aluminum sections. The supply air grills / diffusers shall be provided with screw operated opposed blade volume control device made of MS duly black painted.

All grills / diffusers shall have soft continuous rubber / foam gasket between the periphery of the grills / diffusers and surface on which it has to be mounted. The colour of grills / diffuser shall be as per the approval of the Engineer in Charge.

Linear Supply And Return Grills

The linear continuous supply / return air grills shall be made of powder coated extruded aluminum construction with fixed horizontal bars. The thickness of fixed bar louvers shall be 5mm in front and the flange shall be 20mm wide with round edges. The register shall be suitable for concealed fixing and horizontal bars of the grills shall mechanically crimped from the back to hold them.

The colour of grills shall be as per the approval of the Engineer in Charge.

Front Fixed Bar Rear Adjustable Louvered Grills

The grills shall be made of powder coated extruded aluminum construction with front fixed horizontal bar at 0 degree inclination with one way or two way deflection with rear vertical individually

adjustable louvers in black shade mounted on Nylon bushes to hold deflection setting under all conditions of velocity and pressure.

The colour of grills shall be as per the approval of the Engineer in Charge.

Square / Rectangular Ceiling Diffusers

The square / rectangular ceiling diffusers shall be made of powder coated extruded aluminum construction with flush fixed pattern. The diffusers shall have Anti-Smudge ring and spring loaded removable central core in various pattern for air flow direction. The diffusers shall be mounted by concealed screw fixing arrangement. The colour of diffuser shall be as per the approval of the Engineer in Charge.

Volume Control Device

The opposed blade volume control device shall be made of MS duly black painted. Specially designed blade shall have an overlapping lip, which shall ensure a tight closure.

Fresh Air Intake Louvers With Bird Screen

The fresh air intake louvers at least 50mm deep will be made of powder coated extruded aluminum construction. Bird / insect screen will be provided with the intake louvers. The blades shall be inclined at 45 degree on a 40mm blade pitch to minimize water ingress. The lowest blade of the assembly shall be extended out slightly to facilitate disposal of rain water without falling on door / wall on which it is mounted.

The intake louvers shall be provided with factory fitted volume control dampers in black finish.

Painting

All ducts collar / shoot behind the grills / diffuser shall be given at least two coats oil black enamel paints.

Testing

The complete duct system shall be tested for air leakage & complete air distribution system shall be balanced in accordance with air quantities indicated on the approved drawing.

Factory Fabricated Ducting

General

Ducting work shall mean all ducts, casing, dampers, access doors, joints, stiffeners and hangers.

Governing Standards

Unless otherwise specified here, the construction, erection, testing and performance of the ducting system shall conform to the SMACNA – 1995 standards (―HVAC Duct Construction Standards – Metal and Flexible – Second Edition – 1995‖ – SMACNA).

Duct Materials

The duct shall be fabricated from Lock Forming Quality (LFO) grade galvanized steel sheets with 120 gms / sq.m galvanizing (total coating on both sides) on the sheets.

All ducts wherever specified, shall be factory fabricated in box sections from G.I. continuous coils with all suitable joints, supports, sealing arrangements etc.

The thickness of galvanized sheet and type of flange class at 1200 mm spacing shall be as follows :-

Size of Duct	**Sheet Thickness**	**Type of Flange**
Up to 450 mm	0.63 mm	C&S cleats
450 mm to 750 mm	0.63 mm	Type E
751 mm to 1000 mm	0.80 mm	Type E
1001 mm to 1500 mm	0.80 mm	Type H
1501 mm to 1800 mm	1.00 mm	Type H
1801 mm to 2100 mm	1.00 mm	Type J
2101 mm and above	1.25 mm	Type J

The gauges, joints and bracings for sheet metal ducting work shall further conform to the provision as shown on the drawings.

Ducts larger than 600 mm shall be cross broken or straight beaded. Duct sections upto 1200 mm length may be used with bracing angles omitted.

Changes in section of duct work shall be affected by tappering the ducts with as long a taper as possible. All branches shall be taken off at not more than 45 DEG. Angle from the axis of the main duct unless otherwise approved by the engineer – In – Charge.

All ducts shall be supported from the ceiling / slab by means of fully threaded GI rods of 9 mm – 12 mm dia, with M.S. slotted double – C channel of 3.0 mm thickness / MS angle of size 40 x 40 x 5 mm at the bottom. The rods shall be anchored to R.C. slab using metallic expansion fasteners.

Installation

During the construction, the contractor shall temporarily close duct openings with sheet metal covers to prevent debris entering ducts and to maintain opening straight and square, as per direction of engineer – In – Charge.

Great care should be taken to ensure that the ducting work does not extend outside and beyond height limits as noted on the drawings.

All duct work shall be of high quality approved galvanized sheet steel guaranteed not to crack or peel on bending or fabrication of ducts. All joints shall be air tight and shall be made in the direction of air flow.

The ducts shall be reinforced with structured members where necessary, and must be secured in place so as to avoid vibration of the duct on its support.

All air turns of 45 degrees or more shall include curved metal blades or vanes arranged so as to permit the air to make the abrupt turns without an appreciable turbulence. Turning vanes shall be securely fastened to prevent noise of vibration.

The ducting work shall be varied in shape and position to fit actual conditions at building site. All changes shall be subjected to the approval of the engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the engineer – In – Charge. The contractor shall verify all measurements at site and shall notify the engineer – In – Charge of any difficulty in carrying out his work before fabrication.

Self adhesive sponge rubber / PVC gaskets of 6 mm maximum thickness shall be installed between duct flanges as well as between all connection of sheet metal ducts to walls, floor column, heater casing and filter casings. Sheet metal connections shall be made to walls and floor by means of wooden member anchored to the building structure with anchor bolts and with the sheet screwed to them.

Flanges, bracing and supports shall be galvanized steel. The connection shall be 4 bolts slip on type flange system with sealant injected within the flanges. Accessories such as damper blades and access panels are to be of materials of appropriate thickness and the finish similar to the adjacent ducting, as specified.

Joints, seams, sleeves, splitter, branches, take-offs and supports are to be as per duct details as specified, or as decided by Engineers –in –Charge.

Hexagon nuts and bolts, stove bolts or buck bolts, rivets, or closed center top rivets, or spot welding may fix joints requiring bolting or riveting. Self tapping screws must not be used .All jointing materials must have a finish such as cadmium plating or galvanized as appropriate.

Fire retarding non- porous, vermin proof flexible joints are to be fitted to the suction and delivery of fans. The material is to be normally double heavy canvas or as directed by Engineer-in-Charge .On all circular spigots the flexible materials are to be screws or clip band with adjacent screws or toggle

fitting. For rectangular ducts the material is to flanged and bolted with a backing flat or bolted to mating flange with backing flat.

The flexible joints are to not less than 75 MM and not more than 250 MM between faces.

The duct work should be carried out in a manner and at such times as not to hinder or delay the work of the other agencies especially the boxing or false ceiling contractors.

Duct passing through brick or masonry, wooden frames work shall be provided within the opening. Crossing duct shall have heavy flanges, collars on each side of wooden frame to make the duct leak proof.

Dampers

Splitter Dampers

At the junction of each branch duct with main duct and split of main duct, volume dampers must be provided. Dampers shall be two gauges heavier than the gauge of the large duct and shall be rigid in construction.

The dampers shall be of an approved type, lever operated and complete with locking devices, which will permit the dampers to be adjusted and locked in any positions, and clearly indicating the damper position.

The dampers shall be of splitter, butterfly or louver type. The damper blade shall not be less than 1.25 mm (18) Gauge, reinforced with 25 mm angles 3 mm thick along any unsupported side longer than 250 mm. Angle shall not interfere with the operation of dampers, nor cause any turbulence.

Opposed Blade Dampers

Automatic and manual volume opposed blade dampers shall be complete with frames and nylon bush as per drawings. Dampers and frames shall be constructed of 1.6 mm steel sheets and blades shall be of extruded aluminium of aerofoil design. The dampers for fresh air inlet shall additionally be provided with fly mesh screen, on the outside, of 0.8 mm thickness with the mesh.

Wherever required for system balancing, a balancing opposed blade damper with quadrant and thumb screw lock shall be provided.

After completion of the duct work, dampers are to be adjusted and set to deliver air flow as specified on the drawings.

Access panel

A hinged and gasketed double skin, factory fabricated access panel measuring at least 450 mm x 450 mm shall be provided on duct work before each fire damper and at each control device that may be located inside the duct work.

Miscellaneous

All duct work joints are to be true right angle and with all sharp edges removed.

Sponge rubber gaskets also to be provided behind the flange of all grilles.

Each chute from the duct, leading to a grille, shall be provided with an air deflector to divert the air into the grille through the shoot.

Diverting vanes must be provided at the bends exceeding 600 mm and at branches connected into the main duct without a neck.

Proper hangers and supports should be provided to hold the duct rigidly, to keep them straight and to avoid vibrations. Additional supports are to be provided where required for rigidity or as directed by engineer – In – Charge.

The ducts should be routed directly with a minimum of directional change.

All edges shall be machine treated using lock formers, flanges and rollers.

All the flanges shall be connected to the GSS ducts by rivers at 100 mm centres.

The ducts should be supported by approved type supports at a distance not exceeding 2.0 meters

Pre-insulated Double Walled Oval Spiral Ducting (Factory Fabricated)

Factory fabricated GSS sheet metal pre-insulated double walled oval spiral ducting with sand witched 12.5 mm thick PUF / Fibreglass / Mineral Wool insulation complete with neoprene rubber gaskets, elbows, splitter dampers, vanes, hangers, supports etc. as per approved drawings and specifications of following sheet thickness complete as required as per SMACNA / IS standard. Tee, bend, reducer, elbow, taper etc shall be of same specification as of ducts and shall be based on approved drawings. Selected insulation material shall be CFC free. Ductwork insulation shall have (R value in m2 . K/W) for outside application, supply ducts R -1.4 & return ducts R -0.6 and for inside application, supply ducts R -0.6. Green building compliance adhesive shall be used.

All closed room with no false ceiling shall have non reducing oval ducting. Corridor / Passage shall be with rectangular ducting. All visible ducts in Corridor / Passage shall be painted in black colour or with colour as opted by engineer in charge.

Insulated Flexible ductwork

Insulated Flexible ductwork shall be as described in the SMACNA Low Pressure Duct Standards (5th Edition).

a. Where flexible connections are indicated or required between rigid ductwork and particular components or items of equipment, the internal diameter of the flexible duct shall be equal to

the external diameter of the rigid ductwork and of the spigot served. The use of flexible duct between rigid sections of sheet metal ductwork to change direction or planes will not be permitted except where indicated or expressly authorised by the Owner.

b. The flexible duct shall have a liner and a cover of tough tear-resistant fabric equal in durability and flexibility to glass fibre and shall be impregnated and coated with plastics. It shall be reinforced with a bonded galvanised spring steel wire helix between the liner and the cover and an outer helix of glass fibre cord or equal shall be bonded to the cover to ensure regular convolutions.

c. Alternatively the flexible duct shall consist of flexible corrugated metal tubing of stainless steel, aluminium, tinplated steel or aluminium coated steel. The metal may be lined on the inside or the outside or both with plastics material.

d. The joints of rigid spigots shall be sealed with a brush coat of pipe jointing paste or mastic compound. Ducts up to 150mm diameter shall be secured with a worm drive type hose slip. Ducts over 150mm diameter shall be secured with a band clip.

e. The frictional resistance to air flow per unit length of the flexible duct shall not exceed 50% more than the frictional resistance per unit length of galvanised steel ducts of equivalent diameter. The radius ratio R/D for bends shall not be less than 2, where R is the centre line radius and D is the diameter of the flexible duct.

f. Flexible ductwork shall not pass through fire/smoke resistant building construction nor be used at extract points where deposits of flammable substances are likely to occur in high fire risk areas.

g. The leakage from any section of flexible duct shall not exceed 1% of the design air flow rate at the static operating pressure.

h. Flexible ducts shall be suitable for an operating temperature range of -18^{o}C to 120^{o}C and shall comply with BS 476 Part 1, Section 2, Clause 7 (Class 1: Surface of very low flame spread).

Fire Dampers

Scope of Work

The scope of this section comprises the supply, installation, testing & commissioning of fire dampers conforming to these specifications.

Motorized Combined Smoke & Fire Dampers - Spring Return Type

a) All supply air Ducts in AHU room crossing shall be provided with approved make fire and smoke dampers of at least 90 minutes fire rating certified by CBRI, Roorkee as per UL555:1973.

b) The fire damper blades & outer frame shall be formed of 1.6 mm galvanized steel sheet. The damper blade shall be pivoted on both ends using chrome-plated spindles in self-lubricating

bushes. Stop seals shall be provided on top & bottom of the damper housing made of 16G Galvanized steel sheet. For preventing smoke leakage side seals will be provided.

In normal operating conditions damper blade shall be held in open position with the help of a 24 V operated electric actuators thereby providing maximum air passage without creating any noise or chatter.

c) The damper shall be actuated through electric actuator. The actuator shall be energized with the help of a signal from smoke detector installed in AHU Room / R. A. Duct. The fire damper shall close due to temperature rise in S. A. Ducts through the electric temperature sensor, which is factory set at 165 °F.

d) Each motorized smoke cum fire damper shall have its own panel which will incorporate necessary circuit required to step down voltage available from UPS or emergency power supply to show status of the damper (open or close), to allow remote testing of damper, indication in event of damper closure due to signal from smoke sensor / temp. sensor & reset button. Additional terminal will be provided to have audio cum video signal in Central Control Room.

e) Damper actuator shall be such that it should close the damper in the event of power failure automatically and open in the same in case of Power being restored.

f) The fire Damper shall be mounted in fire rated wall with a duct sleeve 600 MM long. The sleeve shall be factory fitted on fire damper. The joints at sleeve end shall be slip on type. Minimum thickness of GI Sheet shall be 18G.

g) The damper shall be installed in accordance with the installation method recommended by the manufacturer.

h) Hinged access doors of suitable size complete with airtight gaskets shall be provided in all fire dampers & plenums.

Insulation / Lining Work

Scope of Works

The scope of this section comprises supply & fixing of thermal / acoustic insulation of ducts, pipes etc. as per the specification given below.

Material & Process of Acoustic Insulation of AC Plant Room / DG Room

a) Resin Bonded Fibre Glass Wool

The Thermal conductivity values in W/m.K of fibre glass shall confirm to following:

Mean Temperature P^{0P}C	**Density In Kg / Cmt.**	**Thermal Conductivity W/m.k**
25P^{0P}C	32/48	0.030

Acoustic Lining of DG Room / AC Plant Room

The four walls and ceiling of Rooms shall be provided with acoustic lining of thermal insulation (50 mm thick for AHU / Fan Room & 75 mm thick for DG Room, BOQ thickness shall be followed) as per following specifications.

a) Clean the surface.

b) A 610 x 610 mm frame work of 25 x 50 x 50 x 50 x 50 x 25 mm _U‘ shape channel made of 0.6 mm. thick G.S.S. shall be fixed on to walls by means of rawl plug in walls & dash fasteners in ceiling. Before fixing channel shall be filled with fibre glass.

c) Fix the resin bonded glass wool having density of 32 Kg/cmt.in the frame.

d) Finally, finish it by covering the surface with 0.5 mm thick perforated aluminium sheet with brass screws. Before fixing aluminium sheet, fibre glass tissue paper must be sandwitched.

e) All horizontal and vertical joints shall be covered with at least 25 mm. wide, 1mm aluminium strips held in position by steel or brass screws.

Material & Process of Acoustic Insulation of Duct / AHU Room

a) Open Cell Nitrile Rubber

Material shall be engineered Nitrile Rubber foam open cell type. The Random Incidence Sound Absorption Coefficient (RISAC); tested as per ISO 354, should be minimum as per enclosed chart. The material should be fibre free. The density of the same shall be within 140-180 Kg/m3. It should have antimicrobial product protection. It should pass Fungi Resistance as per ASTM G 21 and Bacterial Resistance as per ASTM E 2180. The material should have a thermal conductivity not exceeding 0.050 W/m.K. The material should withstand maximum surface temperature of +850 C and minimum surface temperature of -200 C. Thickness of the material shall be as specified for the individual application. The material should conform to Class 1 rating for surface spread of Flame as per BS 476 Part 7 & UL 94 (HBF, HF 1 & HF 2) in accordance to UL 94, 1996.

The insulation should be installed as per manufacturer‘s recommendation.

<u>Installation Process, Option-1</u>

The surface shall be cleaned and adhesive recommended by the manufacturer should be applied on the walls. The Foam sheets shall be cut to required size and a layer of adhesive should also be applied to both the surfaces wall and armasound. When it is tack dry, it is should stuck with pressure to the walls / ceiling. Have 5 fastener with washer (of G.I Sheet 2.5 inch x 2.5 inch) / sqm, 4 at corners & 1 at centre. The length of the fastener should be min. 50 mm.

Installation Process, Option 2 (If mechanical protection is required), This option shall be opted for this project.

A G.I. 25 X 25 X 0.8 pressed steel frame grid of 1 m X 1m shall be made. Arma Sound Sheets of 1 m X 1m shall be fixed in this grid, as per above given procedure. The entire insulation should be covered with, s. steel wire mesh of 5 mm X 5 mm grid & 32 G.

Acoustic lining of walls shall be terminated approximately 15 cm above the finished floor to prevent damage to insulation due to accidental water-logging in plant / AHU rooms.

Technical Data:

Property	**Values**	**Remarks**
Max. Surface Temperature	+ 105 Deg. C	For temperatures below – 20 Deg. C and above + 105 Deg. C consult our Technical Department
Max. Surface Temperature for Flat Surfaces	+ 85 Deg. C	above + 85 Deg. C consult our Technical Department
Min. Surface Temperature	- 20 Deg. C	
Thermal Conductivity	0.047 W/m.K	Testing according to DIN EN 12667
Fungi Resistance	Pass	ASTM G21
Bacterial Resistance	Pass, >99.9% reduction in bacterial growth	ASTM E-2180
Fire Performance	Class 1 UL 94 (HBF, HF 1 & HF 2)	Surface Spread of flame according to BS 476 Part 7: 1997 In accordance to UL 94, 1996
Density	140 – 180 Kg/m3	
Tensile Strength	100 – 125 kPa	
Elongation	34 - 41 %	
Resistance to chemicals	Organic Solvents Very Good Dilute inorganic acids & bases Very Good Mineral oils	

Property	Values	Remarks
	Very Good	
Health Aspects	Dust & Fibre Free	
UV Resistance	Material must be protected in case of heavy UV-irradiation	

Material & Process of Thermal Insulation of Duct / CHW Pipes / AC Equipments Refrigerant Pipes

Material

- Insulation material shall be Closed Cell Elastomeric Nitrile Rubber.
- Density of Material shall be between 60+/-10% Kg/mP^{3P}.
- Thermal conductivity of elastomeric nitrile rubber shall not exceed 0.035 W/mP^{0P}K at an average temperature of 0P^{0P}C.
- The insulation shall have fire performance such that it passes Class 1 as per BS476 Part 7 for surface spread of flame as per BS 476 and also pass Fire Propagation requirement as per BS476 Part 6 to meet the Class ‗O' Fire category as per 1991 Building Regulations (England & Wales) and the Building Standards (Scotland) Regulations 1990.
- Water vapour permeability shall not exceed 0.017 Per inch (2.48 x 10-14 Kg/m.s.Pa), i.e. Moisture Diffusion Resistance Factor or ‗μ' value should be minimum 7000.

Thickness of the insulation shall be as specified for the individual application.

Pipe Insulation

All chilled water, refrigerant and condensate drain pipe shall be insulated in the manner specified herein. An air gap of 25 mm shall be present between adjacent insulation surfaces carrying chilled water or refrigerant. Before applying insulation, all pipes shall be brushed and cleaned. All Pipe surfaces shall be free from dirt, dust, mortar, grease, oil, etc. Nitrile Rubber insulation shall be applied as follows:

- Insulating material in tube form shall be sleeved on the pipes.
- On existing piping, slit opened tube of the insulating material (slit with a very sharp knife in a straight line) shall be placed over the pipe and adhesive shall be applied as suggested by the manufacturer.
- Adhesive must be allowed to tack dry and then press surface firmly together starting from butt ends and working towards centre.

- Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations.
- The insulation shall be continuous over the entire run of piping, fittings and valves.
- All valves, fittings, joints, strainers, etc. in chilled water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

The detailed application specifications are as mentioned separately. The manufacturer‘s trained installer should only be used for installation.

Recommended Adhesive

In all cases, the manufacturer‘s recommended Adhesive should be used for the specified purpose.

Pump Insulation

Chilled water pump shall be insulated to the same thickness as the pipe to which they are connected and application shall be same as above. Care shall be taken to apply insulation in a manner as to allow the dismantling of pumps without damaging the insulation.

Shell Insulation

The chiller shells shall be factory insulated in accordance with the manufacturer‘s standards.

Cold Water & Expansion Tank Insulation

Cold water tank, and chilled water expansion tank shall be insulated as per manufacturer‘s standard.

Installation Exposed Directly to Sunlight

For installations exposed to sunlight, after giving 36 hours curing time for the adhesive apply manufacturer‘s recommended UV/Mechanical Protection. Please refer the separate detailed guidelines on UV/Mechanical Protection. FRP coating should be provided for protection from sun light.

Parameters for Selection of Thickness

a) Design Basis: Condensation Control

b) Region: Non Costal Area

c) Application: Outdoor & Indoor

d) Design Conditions: 30 Deg. C & 82 % RH

Thickness of Insulation

a) Chilled Water Pipe Line Temperature 7.0 Deg. C

Up To 32 mm Pipe Size	- 25 mm Thick Insulation
Above 32 mm & Up To 600 mm Pipe Size	- 32 mm Thick Insulation
Above 600 mm & Up To 800 mm Pipe Size	- 38 mm Thick Insulation
Chilled Water Tank	- 32 mm Thick Insulation

Note:- All buried pipes / pipes in trench irrespective of sizes shall be insulated with 38 mm thick insulation.

b) Drain Water Pipe Line Temperature 15.0 Deg. C

Up To 50 mm Pipe Size	- 19 mm Thick Insulation

c) Refrigerant Pipe Line Temperature 3.0 Deg. C

Up To 50 mm Pipe Size	- 32 mm Thick Insulation
Above 50 mm & Up To 100 mm Pipe Size	- 38 mm Thick Insulation

d) Duct Insulation

Supply Air Duct	- 13 mm Thick Insulation

(Line Temperature 14 Deg. C)

Return Air Duct	- 09 mm Thick Insulation

(Line Temperature 22 Deg. C)

Supply Air Duct in Return Air Path	- 09 mm Thick Insulation

(Line Temp. 14 Deg.C)

For all above, BOQ thickness shall be followed.

All length of piping shall have Mechanical Protection with 26 G aluminum cladding.

Note:

a) All length of exposed piping shall have UV protection also. Apply two coats of special UV resistant paint after the above process.

b) For Mechanical protection, 26 G aluminum cladding shall be used.

c) Duct Insulation - Selected insulation material shall be CFC free. Ductwork insulation shall have (R value in m2 . K/W) for outside application, supply ducts R -1.4 & return ducts R -0.6 and for inside application, supply ducts R -0.6. Green building compliance adhesive shall be used.

e) Pipes & Valves Insulation - Insulation shall be CFC free and insulation R value (m2.K/W) shall be 0.5 for pipe < 40 mm dia & 0.9 for >=40 mm dia. Green building compliance adhesive shall be used.

Under deck Insulation with Extruded Polystyrene with Overlap Edge

Ceiling of exposed roof shall be provided with under deck insulation as per following specifications. Under deck insulation to be done only if over deck insulation is missed during construction of building.

a) Clean the surface & apply the adhesive on it.

b) Fix minimum 75 mm Extruded Polystyrene with Overlap Edge of mean density 35 Kg/CMT with the help of adhesive.

c) Apply adhesive between all longitudinal and transverse joints of Extruded Polystyrene.

d) Fix the Extruded Polystyrene finally with the help of rawl plug & dash fasteners in ceiling.

e) Insulation thickness shall be of required thickness so that U factor of roof with insulation shall be 0.2 W/m2K or 0.04 in British Thermal Unit.

f) Insulation material shall be CFC free. Green building compliance adhesive shall be used.

Piping Work

Scope of Works

The scope of this section comprises supply, installation, testing & commissioning of chilled water / condenser water / drain water / Hot Water pipes, pipe fittings and valves etc. as detailed below in specifications. All pipes, fittings and valves etc. shall conform to relevant Indian standards.

Water Piping

The pipes, fittings and valves shall be of approved make given in the tender & shall be designed for 16 Kg/cm ² test pressures.

Chilled / Condenser / Hot water pipes shall be "Heavy" Class ―C‖ M.S. Black pipes up to 150 mm and MS ERW Black Pipes above 150 mm and it shall conform to IS:1239 (Part 1) -1991 & IS:3589 – 1991 Grade 330 with latest amendments. The wall thickness of "Heavy" Class M.S. Black pipes & MS ERW Black Pipes shall be as follows:-

	Nominal Pipe Dia in mm	**Wall Thickness of Pipe in mm**
a)	25	4.00
b)	32	4.00
c)	40	4.00
d)	50	4.50
e)	65	4.50
f)	80	4.80
g)	100	5.40
h)	125	5.40
i)	150	5.40
j)	200	6.00
k)	250	6.00
l)	300	6.00
m)	350	6.00
n)	400	6.00

o)	450	6.00
p)	500	6.00
q)	600	8.00
r)	700	8.00
s)	900	8.00

For Chilled Water AHU & FCU

Drain water / make up water pipes shall be "B" Class GI Pipe & shall Conform to IS: 4736. ‗U' trap shall be provided in the drain piping.

For Chilled Water Cassette & Hi Wall Unit, DX Unit

a. The piping system shall consist of Non-pressure pipe up to 4 kg/ sq.mm UPVC piping from 15 mm to 50 mm .

b. For any internal works, the UPVC pipes and fittings shall be embedded in the wall chase or run on the floor/ceiling unless otherwise specified. No unsightly exposed runs shall be permitted.

c. For proper drainage of Condensate, ‗U' trap shall be provided in the drain piping.

d. All condensate drain piping shall be insulated and painted as per the guidelines.

The pipes shall be sized for individual liquid flow & shall ensure smooth noiseless balanced circulation of fluid.

All piping and their steel supports shall be thoroughly cleaned and primer coated before installation.

Pipe Fittings

The pipe fittings for screwed piping shall be malleable iron and for piping with welded joints shall of weldable quality. Also the fittings shall be suitable for same pressure ratings as for the piping system.

All bends up to sizes 150 mm dia shall be ready made of heavy duty wrought steel of appropriate class.

All bends in sizes 200 mm and above shall be fabricated from the same dia and thickness of pipe in at least four sections and having a center in radius of at least 1.5 times diameter of pipes. Fittings such as tees, reducers etc. shall be fabricated from the same pipe and its length shall be at least twice the diameter of the pipe.

The dead ends shall be formed with flanged joints & shall have 6mm thick blank between flange pair for 150 mm and over.

Flanges

All flanges shall be of mild steel as per IS : 6392 / 71 (with latest amendments) & shall be slip on type welded to the pipes. Flanged thickness shall be to suit Class II pressure. 3 mm thick gasket shall be used in between the flanges.

Flanged pair shall be used on all such equipments which are required to be isolated or removed for service for example condenser / chilled water pumps, chilling m/c, AHU etc.

Piping Installation

The drawings attached with this tender indicate schematically the sizes, location of pipes & vertical shafts. The contractor, on award of the work, shall prepare detailed shop drawings based on tender drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports.

Piping shall be properly supported on, or suspended from, stands, clamps, springs, hangers as specified and as required at site. The contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers and shall be responsible for their structural sufficiency. A set of piping support calculations shall be submitted for structural engineer review and approval before site installation wherever critical & required.

All pipes in HVAC plant room shall be supported with engineered supports structures made of pipes and channels from floor only with necessary high density PUF pipe supports and engineered vibration / noise isolators.

Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamps are of dissimilar materials, a gasket shall be provided in between. Spacing of pipe supports shall not exceed the following:

Pipe Sizes	**Spacing Between Supports**	**Rod Size**
Up to 12 mm	1.2 Meter	8 mm
15 to 25 mm	1.8 Meter	8 mm
32 to 150 mm	2.4 Meter	10 mm
Above 150 mm	---------As Per Approved Shop Drawing------	

Vertical pipes passing through floors shall be plumb and parallel to wall. Pipes shall be supported on all floors. MS cleats shall be welded on pipes and rest on MS channel placed on the floor with 15 mm

thick resistoflex pads between the cleat and channel. U clamps with resistoflex sheet shall be provided to keep the pipe in position.

T heading in water piping shall be avoided.

Pipe sleeves at least 3 mm thick, 50 mm / 100 mm larger in diameter than condenser / chilled water pipes respectively shall be provided wherever pipes pass through retaining wall and slab. Annular space shall be filled with fibre glass and finished with retainer rings welded on the ends of the sleeve. All pipes passing through the retaining wall shall be provided with suitable water proofing compound.

Wherever pipes pass through the brick or masonry / slab openings, the gaps shall be sealed with fire sealant.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 20 gauge metal sheets shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm on both sides of the clamp, saddles or roller.

All piping work shall be carried out in a workmen like manner & shall be coordinated with other services running in the building, The entire piping work shall be organized, so that laying of pipes, supports, and pressure testing for each area shall be carried out in one stretch.

The EPC Contractor shall make sure that the clamps, brackets, clamp saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required size in accordance with relevant BIS Codes, edges bevelled and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reducers shall be used for the piping to drain freely. In other locations, concentric reducers may be used.

All buried pipes shall be cleaned and coated with zinc chromate primer and bitumen paint, and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters and wrapped with three layers of fibre glass tissue, each layer laid in bitumen.

Auto purge valves shall be provided at all highest points in the piping system for venting air. Air valves shall be 15 mm pipe size with screwed joints. Discharge from the air valves shall be piped through an equal sized mild steel or galvanized steel pipe to the nearest drain or sump. These pipes shall be pitched towards drain points.

Butterfly Valves

Butterfly valves shall be of PN 1.6 rating as per IS 13095 preferably with fixed linear design to suit duty and flanges as per IS 6392 Table "E". Valves of sizes 32 mm and above diameter shall be made of cast iron close end body, cast iron epoxy coated disc, Nitrile Seat and SS 410 Stem with tefflon bush. Valves up to 150mm NB shall be with detachable hand lever operation whereas valves above 150 mm NB shall have warm gear operation.

These valves shall be installed in condenser / chilled water lines, make up / drain water piping lines. All valves shall be supplied with factory test reports and the manufacturer must have test facilities at their works.

Non-Return Valve (Duct Plate Check Valves)

The dual plate check valves shall be used for horizontal / vertical run of pipes & shall conform to PN 1.6 rating .The valve design shall confirm to API 594 and tested as per ANSI SERIES.

The valves shall have cast iron body, and SS 410 plates, SS 410 Shaft & Nitrile Seat. All valves shall be supplied with factory test reports and the manufacturer must have test facilities at their works.

Y-Strainer & Pot Strainer

The Y-strainer shall be fabricated out of MS `Heavy' class pipe two size higher than that of strainer pipe size. Flanges as per BS 10 shall be provided at inlet & outlet of connections. The body shall be pressure tested at 16 Kg/Sq. cm and shall be hot dip galvanized. Permanent magnet shall be provided in the body of the strainer to arrest MS particles. Filter element shall be of nonmagnetic 20 gauge SS sheet with 3 mm perforation. Strainer shall be provided at inlet of each AHU & chilled water pumps,

Pot Strainer body shall be fabricated out of MS plate IS 226. Thickness of sheet shall be as per size of the strainer chamfered pipes with flanges shall be provided at inlet / outlet connections of the strainer. The tangential entry of water shall create a centrifugal action and due to velocity shall separate sediments and deposit on the inner surface of filter element and at bottom of the Strainer. Butterfly valves shall be provided at inlet / outlet connections. The strainer body shall have two separate chambers properly sealed to avoid mixing of filtered and unfiltered water. A powerful magnet shall be provided in the body to arrest MS particles. Filter element of Pot Strainer shall be of nonmagnetic 18 gauge SS sheet properly reinforced to avoid damage of the element. A cone with sufficiently large drain pipe with butterfly valve shall be provided at the bottom chamber to flush-out foreign particles. This arrangement shall avoid frequent opening of Pot Strainer for cleaning of filter element. Gauge connection shall be provided at inlet and out let connection.

A set of MS flanges with tongue and groove arrangement and neoprene rubber gasket shall be provided on the top cover and Pot Strainer flange with sufficient bolts and nuts to make the joint water tight. Bearing loaded lope cover lifting and swinging arrangement shall be provided. The pot strainer body shall be properly de-rusted and epoxy coated from inside and outside. Manufacturers Test Certificate shall be provided with each Pot Strainer.

Size of various Pot Strainer, Filter Element and Thickness of MS sheet shall be as under.

Pipe Size Thickness	**Pot Dia**	**Pot HT**	**Element Dia.**	**Element HT**	**MS Plate**
(mm)	**(mm)**	**(mm)**	**(mm)**	**(mm)**	**(mm)**
50	300	400	200	240	6
80	350	450	250	250	6
100	450	500	300	280	6
125	500	600	330	340	8
150	540	700	360	390	8
200	610	815	400	470	8
250	800	955	550	510	8
300	1000	1105	750	580	8
350	1190	1300	895	678	12
400	1350	1500	1020	785	12
450	1518	1700	1060	890	12
500	1690	1800	1100	900	12
600	2000	2200	1500	1160	12
700	2200	2400	1600	1300	12

The Y-Strainer & Pot Strainer confirming to SSPL 107 & SSPL 106 shall have cast iron body and factory tested at works at 16 Kg/sq. cm pressure. The screen shall be made out of 3 mm perforated stainless steel sheet. It should be easily removable when required to be cleaned. Isolating butterfly valves at either end of the pot strainer shall be provided.

Balancing Valves

The balancing control and shut off valves with built in pressure drop measuring facility shall be provided in return water lines for air-handling units, chillers, condensers as given in the tender drawings.

The valves of sizes 32 mm to 65mm dia. shall be of gun metal / cast iron construction with screwed ends angular design digital hand wheel with locking facility. Whereas valves of sizes 75mm and above shall be of cast iron construction with internal parts of SS 410 and EPDM / nitrile seat with flanged ends. The test cocks should be long enough to protrude out of valve insulation.

The valves shall be designed for PN 1.6 and tested for the seat at 1.1 times the design pressure and 1.5 times the design pressure for the shell. All valves shall be supplied with test certificates and the manufacturer must have test facilities at their works.

Pressure Independent Dynamic Balancing Cum Control Valve

These Valves shall be electronic, dynamic, modulating, 2-way, control devices and provided for all AHU cooling coils. Dynamic control valve shall accurately control flow, independent of system pressure fluctuation. These combination valves shall be guaranteed with free replacement for 3 years for any manufacturing or operational defect/mal-operation. Maximum flow setting shall be adjustable to different settings within the range of the valve size. Supplier shall be ISO:9001 and having at least 5 years of successful job experience to supply pressure independent dynamic control valve for similar application of project.

Valve actuator housing shall be rated to IP 40. Actuator shall be driven by a 24V AC and shall accept 2-10 VDC, 0-10 VDC, 4-20 mA, 3-point floating or pulse width modulation electric signal and shall include resistor to facilitate any of these signals. Actuator shall be capable of providing 4-20 mA or 2-10V DC feedback signal to the control system for Valves installed across AHU. The same is not required for Valves installed across FCUs. External LED readout of current valve position and maximum valve position setting shall be available for the Valves installed across AHU. Manual override to either a fully closed or fully open valve position shall be possible. The valve provided shall have facility of providing flow measurement through the valves.

Housing for 15 – 40 mm size shall be constructed of forged ASTM brass rated at no less than 1600 kPa static pressure minimum and 110°C. Housing for 50 – 150 mm shall be constructed of Ductile Iron ASTM A536-65T, Class 60-45-18 rated at no less than 1600 kPa static pressure minimum and 120°C. Valve housing for 15 – 40 mm shall be double union construction with a range of pipe connections available for the appropriate pipe size. Identification tags shall be available for all valves.

Flow regulation unit shall consist of stainless steel and hydrogenated acrylonitrile butadiene rubber and shall be capable of controlling flow within +/- 5% of each rated flow or Flow regulation unit shall consist of glass reinforced poly-phenylene-sulfide with a hydrogenated acrylo-nitrile butadiene rubber diaphragm. Flow regulation unit shall be accessible, for maintenance. Dual pressure/temperature test plugs for verifying accuracy of flow performance shall be provided for valve sizes 25mm and above.

Air-Vents

Air vents for purging of air trapped in piping system shall be provided at the highest point. Globe valves of the size as indicated below shall be provided & no additional price shall be paid.

Pressure Gauges / Thermometers

Pressure Gauges

Burden type pressure gauges of 100mm dia of suitable range shall be provided at the following locations:

a) Chiller / Condenser / Coils of AHU - Inlets and outlets.

b) All pumps - Suction & discharge

The water pressure gauge shall be made of stainless steel grade SS304. The dial plate shall be powder coated with white colour base & the calibration shall be done in black colour. All the pressure gauges shall be complete with ball valves & SS Siphon and confirming to IS:3624.

Thermometer

Direct reading V form type thermometer alcohol filled of suitable range / length shall be provided at the following locations:

a) Condenser / Chiller / Cooling coil – Inlets and outlets in separate wells of Brass / Gun metal.

The V form thermometer shall be made of aluminium die casting with golden colour anodizing. The thermometer shall have a V groove in the body to protect the refill from the damages during the installation. The refill shall be filled with blue colour mercury. The thermometer shall be complete with brass well & the calibration of temperature shall be in Celsius & Fahrenheit

Testing of Pipe System

During construction the EPC Contractor shall properly cap all lines, so as to prevent the entrance of sand, dirt, etc. Each system of piping shall be flushed thoroughly after completion for the purpose of removing dirt, grit, sand etc. from the piping and fittings.

All piping shall be tested to hydrostatic test pressure of at least one and half times the maximum operating pressure, but not less than 16 kg per sq. cm gauge for a period of not less than 24 hours. All leaks and defects in joints found during the testing shall be rectified, retested and gotten approved.

Piping repaired subsequent to the above pressure test shall be re-tested in the same manner.

Piping may be tested in sections and such sections shall be securely capped, then retested for the entire system.

The EPC Contractor shall provide temporary pipe connections to initially by-pass condenser/chiller and circulate water through condenser/chilled water pipe lines for minimum 8 hours. Water should be drained out from the lowest point. The temporary lines shall be removed and blanked with dead flanges. Pot strainers and Y strainers shall be cleaned and fresh water filled in the circuits.

The EPC Contractor shall make sure that proper noiseless circulation of fluid is achieved through all coils. If proper circulation is not achieved due to air bound connection, the Contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications.

After the piping has been installed, tested and run for at least three days of eight hours each, all insulated exposed piping in plant room shall be given two finish coats, 3 mils each of approved colour, conforming to relevant BIS Codes. The direction of flow of fluid in the pipes shall be visibly marked with identifying arrows.

The EPC Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test.

Balancing

After completion of the installation, all water system shall be adjusted and balanced to deliver the water quantities as specified or required.

All balancing valves, Automatic control valves and two-way diverting valves shall be set for full flow condition during balancing procedure. Each water circuit shall be adjusted thru balancing valves provided for this purpose. These shall be permanently marked after balancing is completed, so that they can be restored to their correct positions, if disturbed.

Complete certified balancing report should be submitted for evaluation to the Engineer-in- Charge or his authorized representatives. Upon endorsement three copies of the balancing report shall be submitted with the as-built drawings and completion documents.

Refrigerant Piping

a. All refrigerant pipes and fittings shall be hard drawn copper tube sand wrought copper / brass fittings suitable for connection with silver solder / phos-copper.

b. All joints in copper piping shall be sweat joints using low temperature brazing and / or silver solder. Before joining any copper pipe or fittings, its interiors shall be thoroughly cleaned by passing a clean cloth via wire or cable through its entire length. The piping shall be continuously kept clean of dirt etc. while constructing the joints. Subsequently, it shall be thoroughly blown out using carbon dioxide / nitrogen.

c. Refrigerant lines shall be sized to limit pressure drop between the evaporator and condensing unit to less than 0.2 kg per sq.cm.

d. Sight glass with moisture indicator and removable type combination dryer cum filter with MS housing and brass wire mesh / punched brass sheet shall be installed in liquid line of the refrigeration system incorporating a three valve by pass. After ninety days of operation, liquid line drier cartridges shall be replaced.

e. Heat exchanger shall be MS heavy duty pipe in pipe type and without any joint in the inner pipe.

f. Horizontal suction line shall be pitched towards the compressor and no reducers shall be provided for proper oil return.

g. After the refrigerant piping installation has been completed, the refrigerant piping system shall be pressure tested using Freon mixed with nitrogen/ carbon-dioxide at a pressure of 20 kgpersq. cm (high side) and 10 kg per sq. cm (low side). Pressure shall be maintained in the system for a minimum of 12 hours. The system shall then be evacuated to a minimum vacuum of70 cm of mercury and held for 24 hours. Vacuum shall be checked with a vacuum gage. All refrigeration piping shall be installed strictly as per the instructions and recommendations of air-conditioning equipment manufacturer.

Sound & Noise Attenuators

Attenuators shall be installed in ducts in accordance with requirements of details drawings.

Noise levels within conditioned spaces shall be not greater than those set out in schedule below:

a. Noise Level Design Criteria

SPACE	**MAXIMUM CONTROL LEVEL**
Public Areas	NC 40 – NC 45
Offices / Administrative area, Public Toilets	NC 40
Restaurants / Dining	NC 35 - NC 45
Corridors/ Lobbies	NC 35 - NC 45

b. Attenuators shall be of steel construction with casings out of minimum 22 G

galvanized steel. Acoustic fill shall be inert, non-hygroscopic, vermin proof, fibre glass of required density adequately protected against corrosion and covered with 26 gage perforated aluminium sheet. Attenuators shall be supplied complete with flanges.

c. Acoustic performance of the attenuators (net insertion loss) shall meet or exceed the values listed below :

OCTAVE BAND CENTRE FREQUENCY HZ	**63**	**125**	**250**	**500**	**1K**	**2K**	**4K**	**8K**
Insertion loss dB 900 mm long attenuators	2	7	12	19	23	23	18	11
Insertion loss dB 1500 mm long attenuators	6	10	18	30	42	34	23	14

d. The pressure drop values of the silencers shall be indicated for each duty.

e. Manufacturers shall submit a test certificate for acoustic and aerodynamic performance of the attenuators. Attenuators shall be tested in accordance with ACMA test methods/BS 4718 and insertion loss and self-generated noise for each octave band and pressure drop shall be stated in the schedule.

Noise Attenuators

Attenuators if required shall be of steel construction with casings out of minimum 22G galvanised steel. Acoustic fill shall be inert, non-hygroscopic, vermin proof, fibre glass of required density adequately protected against corrosion and covered with 26 gauge perforated aluminium sheet. Calculation needs to be provided to justify the db level attained.

Testing, Adjusting & Balancing

The EPC Contractor shall have a dedicated experienced, specialized, approved, testing and commissioning (T&C) team /agency responsible for coordination with other trades, preparation of T&C plan method statement & T&C procedures, organizing & scheduling the T&C activities along with the progress of works, supervision any re-testing, coordination with third parties for commissioning & certification, organizing & performing testing for satisfaction of all Statutory Bodies, T&C record documentation & handover

General

a. Testing, adjusting and balancing of heating, ventilating and air-conditioning systems at site.

b. Testing, adjusting and balancing of HVAC Hydronic system at site.

c. Testing, adjusting and balancing of exhaust system at site.

Comply with current editions of all applicable practices, codes, methods of standards prepared by technical societies and Associations including:

ASHRAE : Latest HVAC Application.

SMACNA : Manual for the Balancing and Adjustment of air distribution system.

d. EPC Contractor shall submit a Test, adjust, balance procedure/method statements/charts for approval to engineer in charge.

Performance

a. Verify design conformity.

b. Establish fluid flow rates, volumes and operating pressures.

c. Take electrical power readings for each motor.

d. Establish operating sound and vibration levels.

e. Adjust and balance to design parameters.

f. Record and report results as per the formats specified.

Definitions

a. Test	:	To determine quantitative performance of equipment.
b. Adjust	:	To regulate for specified fluid flow rates and air patterns at terminal equipment (e.g. reduce fan speed, throttling etc.)
c. Balance	:	To proportion within distribution system (submains, Branches and terminals) in accordance with design quantities.

Testing, Adjusting and Balancing (TAB) Procedures

The following procedures shall be directly followed in TAB of the total system. Before commencement of each one of the TAB procedure explained hereunder, the EPC Contractor shall intimate the Engineer-in- Change about his readiness to conduct the TAB procedures in the format given in these specifications.

Description of System and Requirements

Adjust and balance the following system to provide most energy efficient operation compatible with selected operating conditions.

a. All supply, return and outside air systems.

b. All exhaust air systems.

c. All chilled water systems.

d. All cooling tower (condenser) water systems.

e. Emergency purge systems.

Air Systems

I. Air Handlers Performance

The TAB procedure shall establish the right selection and performance of the AHUs with the following results :

a. Air-IN DB and WB temperature.

b. Air-OUT DB and WB temperature.

c. Dew point air leaving.

d. Sensible heat flow.

e. Latent heat flow.

f. Sensible heat factor.

g. Fan air volume.

h. Fan air outlet velocity.

i. Fan static pressure.

j. Fan power consumption.

k. Fan speed.

II. Air distribution

Both supply and return air distribution for each AHU and for areas served by the AHU shall be determined and adjusted as necessary to provide design air quantities. It shall cover balancing of air through main and branch ducts.

III. The Preparatory Work

To conduct the above test, following preparatory works are required to be carried out including the availability of approved for construction shop drawings and submittals:

a. All outside air intake, return air and exhaust air dampers are in proper position.

b. All system volume dampers and fire dampers are in full open position.

c. All access doors are installed & are air tight.

d. Grilles are installed & dampers are fully open.

e. Provision and accessibility of usage of TAB instruments for traverse measurements are available.

f. All windows, doors are in position.

g. Duct system is of proper construction and is equipped with turning vanes and joints are sealed.

h. Test holes and plugs for ducting.

Hydronic System Balancing

I. The Hydronic system shall involve the checking and balancing of all water pumps, piping network (main & branches), the heat exchange equipment like cooling and heating coils, condensers and chillers and cooling towers in order to provide design water flows.

II. The essential preparation work, must be done by the EPC Contractor prior to actual testing, adjusting and balancing of HVAC system and ensure following :

- Availability of co-ordinated drawings and approved submittals and system sketch with design water flows specified thereon.
- Hydronic system is free of leaks, is hydrostatically tested and is thoroughly cleaned, flushed and refilled.
- Hydronic system is vented.

III. The EPC Contractor shall confirm completion of the basic procedures and prepare check lists for readiness of system balance.

a. Check pumps operation for proper rotation and motor current drawn etc.

b. Confirm that provisions for TAB measurements (Temperature, pressure and flow measurements) have been made.

c. Open all shut-off valves and automatic control valves to provide full flow through coils. Set all balancing valves in the preset position, if these values are known. If not, shut all riser balancing valves except the one intended to be balanced first.

Balancing work for both Chilled Water System and Condenser Water System shall be carried out in a professional manner and test reports in the specified format shall be prepared and presented to the Engineer-in- Charge for endorsement.

Readiness for Commencement of Tab

Before starting of any of the tests, the readiness to do so should be recorded as per the prescribed check list.

Tab Instruments

I. Air Measuring Instruments

a. For measuring DB and WB temperature, RH and dew point, microprocessor based TSI USA make VelociCalc Plus Meter, Model 8386, or equivalent shall be used. This instrument shall be capable of calculating the sensible, latent total heat flows, sensible heat factor and give printouts at site and have data logging/downloading facility.

b. For measuring Air velocity, DB temperature and Air volume, TSI USA make VelociCalc meter model 8386/ 8345 or equivalent shall be used. It shall be able to provide instant print out of recorded Air volume readings.

c. Pitot tube.

d. Electronic Rotary Vane Anemometer TSI make or equivalent.

e. Accubalance Flow Measuring Hood TSI make or equivalent.

[All above instruments shall have a valid certification from a reputed testing institution.]

II. Hydronic Measuring Instruments

a. For measurement of water flow across balancing valves, instruments as provided by the manufacturer of the valves specific to the type of valves shall be need. This shall include but not be limited to differential pressure manometers. Temperature shall be measured using electric thermometers from thermo wells provided at strategic location by the EPC Contractor. The water balancing shall be carried out being computer simulation program provided / certified by the balancing valve manufacturer.

III. Rotation Measuring Instrument

a. Electronic Digital Tachometer.

IV. Temperature & RH Measuring Instrument

a. TSI VelociCalc model 8386 / VelociCalc model 8345 or equivalent.

V. Electrical Measuring Devices

a. Clamp on Volt ammeter.

b. Continuity Meter.

VI. Vibration and Noise Levels

Vibration and alignment field measurements shall be taken for each circulating water pump, water chilling unit, air handling unit and fan driven by a motor over 10 HP. Readings shall include shaft alignment, equipment vibration, bearing housing vibration, and other test as directed by the PMC.

Sound level readings shall be taken at ten (10) locations in the building as selected by the engineer in charge. The readings shall be taken on an Octave Band analyzer in a manner acceptable to him. The EPC Contractor shall submit test equipment data and reporting forms for review. In order to reduce the ambient noise level the readings shall be taken at night. All tests shall be performed in the presence of Engineer-in- Charge or his authorized representative.

Air Cooled Packaged Unit

Scope of Work

The specification for Air-cooled Package Units With Scroll Compressor covers the design requirement, constructional feature, supply, installation, testing & commissioning.

Type

The Air-cooled Packaged units shall be factory fabricated and supplied with factory test certificates.

Cabinet Construction

The cabinet of packaged units shall be fabricated out of heavy gauge corrosion resistant sheet with powder coating / enamel. The cabinet shall have removable panels to allow easy servicing of unit, giving easy access into the unit. The fan section of the packaged unit shall be acoustically insulated at works.

Compressor

The air-cooled packaged units shall comprise of one / two number Scroll compressor. The compressor section shall have all four walls acoustically insulated with 50mm thick fiberglass insulation, tissue paper & perforated Aluminium sheet to keep the sound level within 50db. The compressor should be suitable to withstand voltages varying from 340 to 460 volts.

Air-cooled Condenser

The condenser frame shall be constructed from heavy duty aluminium and incorporate a copper tube and aluminium fins coil. The coil shall be minimum of 3 rows deep, with a minimum fin spacing of 2.0 mm. The copper tubes of the condenser should be integrally firmed of minimum OD of 19 mm.

All interconnecting piping within ODU, coils, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

Refrigeration Circuit

The refrigeration system shall be of direct expansion type and shall incorporate one/ two no. hermetic scroll compressors complete with crankcase heaters. Refrigerant used shall be eco-friendly refrigerant.

Cooling Coil

The cooling coil shall be constructed of rifled bore copper tubes and louvered aluminium fins, with the frame and drip trays fabricated from heavy gauge aluminium. The drip tray must be double angled for condensate flow and easily removable for cleaning. The cooling coil shall be a minimum of 4 rows deep. The distance between the fins should not be less than 1.8mm and the face velocity shall not be more than 2.5m/s.

Fans

The fans shall be of the forward curved centrifugal type, double width, double inlet and statically and dynamically balanced. Each fan shall be driven by a high efficiency motor, through a self-tensioning belt drive arrangement. Each fan shall be mounted on a vibration isolated deck.

The unit shall be factory aligned, tested and complete with starter mounted inside the cabinet, refrigerant piping, complete with charging valves, thermostatic expansion valve, distributor, liquid strainer, dehydrator, liquid line shut off valve and HP/LP cut out etc. The selector switch should be concealed behind the hinged door and be suitable for operating the fan only or along with the cooling unit. The selector switch should be able to turn the unit on cooling and air temperature should be regulated with the thermostat which automatically starts and stops the compressor as required. In case of multiple compressors installed in one cabinet each should have independent refrigerant circuit. The blower of the packaged unit should be statically and dynamically balanced and driven by three phase motor of repute make. The air quantity of packaged unit should have at least of 400 CFM / Ton capacity.

The fan & fan motor should be able to take static pressure drop in coil, ducts, grills / diffusers. The unit should be factory wired and tested.

The air filter should have large surface and duct holding capacity which must be easily removable type for cleaning purposes.

Energy efficiency of unit shall be in compliance with ECBC 2017 under Super EBC Building Category.

Note:-

<u>For Hi CFM Packaged Unit</u>

a) Evaporator, Condenser, Fan etc of the unit shall be designed to meet the high sensible load of the air-conditioned area.

b) Cooling coil shall have minimum four rows and fan shall be capable of delivering 500 CFM/TR.
c) Evaporator shall have large surface area as compared with normal unit.
d) Tonnage rating of unit shall be based on 44.0 deg. C ambient.

Air Cooled Hi Wall Split Unit

Scope of Work

The specification for hi wall split unit covers the general design, materials, constructional features, supply, installation, testing, commissioning & carrying out performance test at site.

Codes & Standards

The design, materials, manufacture, inspection, testing & performance of Hi Wall Split Unit shall comply with all currently applicable codes, regulation & standards in the locality where the equipment is to be installed.

Cabinet of Indoor Unit

The cabinet of Indoor units shall be fabricated as per the standard of manufacturer and finishes shall be attractive. The cabinet shall have removable panels to allow easy servicing of unit, giving easy access into the unit.

Compressor

The compressor shall be hermetically sealed rotary compressor. The compressor should be suitable to withstand voltages varying from 180 to 240 volts. Refrigerant used shall be eco-friendly refrigerant.

Air Cooled Condenser

The Air cooled condenser should have high efficiency condenser coils having copper tubes & collared aluminium fins with serrated edges & wavy airways to ensure sub cooling. The air cooled condenser should be housed in factory finished cabinet duly enamel painted. The air cooled condenser should have aluminium fins mechanically bonded with copper tubes.

The fan of the air-cooled condenser shall be statically / dynamically balanced and driven by single phase motor of suitable horse power.

All interconnecting piping within ODU, coils, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

Cooling Coil

The Cooling coil should be at least 2 Row deep and shall have at least 4.7 fins/cm. The Cooling coil should have aluminium fins and copper tubes mechanically bonded. The unit shall be factory aligned, tested and complete with refrigerant piping, complete with charging valves, thermostatic expansion valve, distributor, liquid strainer, dehydrator, liquid line shut off valve etc.

The fan & fan motor should be able to take static pressure drop in coil, filters etc.

The unit should be factory wired and tested.

The air filter should have large surface and dust holding capacity which must be easily removable type for cleaning purposes.

Energy efficiency of unit shall be in compliance with ECBC 2017 under Super EBC Building Category i.e five star rated unit shall be opted. The unit shall be inverter Heat Pump type.

Air Cooled Precision Packaged Unit

Scope

This section applies to Air Cooled Pr. Air Conditioning Units located in the server room.

Fabricate, assemble, test at works, deliver to site, install and commission to proper operating conditions all air conditioning units to the type, size and capacity as required, specifications, engineering data, instructions and manufacturers recommendations unless exceptions are noted by the Consultant.

Energy efficiency of unit shall be in compliance with ECBC 2017 under Super EBC Building Category.

General

The design, construction, materials and finishes of all units shall be suitable for the location climatic and operating conditions indicated on this specification, schedules and drawings.

Each item of equipment shall be, packed and fully factory assembled complete with operating and safety controls and all customary auxiliaries deemed necessary for the safe, controlled, automatic operation of the requirement using an approved refrigerant (R134a / R410 / R407C) available in India.

The units shall be designed specifically for close control operation and operate within the tolerances as specified on the schedules.

Units are to be suitable for 415V, 3 phase, 50 Hz operation.

Cabinet Construction

It shall be double skin sandwich panels with steel sheet facing and incombustible (Class 0, ISO 1182.2) insulating core material. The insulation shall be mineral fiber 30 kg/ m3 density, 25 mm thick. The internal facing shall be galvanized steel sheet; the external one shall be epoxy-polyester-powder coated, pearl white colour. The structure framework shall be of steel sheet. The access to the unit shall be made easy by removing the front panel. The panel to base frame sealing shall be made of adhesive rubber.

The condensate pan shall be of polished stainless steel sheet.

Filtration

The standard filters shall be pleated type with cardboard frame; the efficiency shall be G4 in accordance with the Standard CEN-EN 779 (or EU4 in accordance with the equivalent Eurovent Standard EU 4/5). The filters shall be housed horizontally on the top of Under units and housed in front of the coil, behind the return grille in the front panel of Over units; they shall be easily removable. Filtration shall be 95% down to 5 microns.

Fans

It shall be free-wheel type, single inlet, steel sheet backward curved blades, direct driven by a 3-phase, IP 44 electric motor; it shall be installed on a 3 mm thick support plate with ant vibrating rubber isolators. The wheel shall be statically and dynamically balanced; the bearings shall be self-lubricating type. The fan(s) shall provide an external static pressure available for the circuit up to 350 Pa. Fan speed and pressure shall be adjusted by means of an auto-transformer.

Humidifier

The unit shall be internally fitted with bottled type electrode type humidifier. Electric steam humidifier shall be equipped with replaceable plastic steam cylinder, immersed electrodes, water inlet and outlet valves and flood level sensor. The steam shall be diffused in the air stream by means of a suitable distributor. The humidity production shall be controlled by the microprocessor. The capacity of humidifier shall be modulating type. The rating of humidifier shall be 9.6 kg/hr or as per manufacturer.

Electrical Heating

Electric heating coil shall be made of aluminum fins for low surface temperature with Multiple Stage heating (2/3 steps); the coil shall include an On-Off electronic temperature control and a safety thermostat with manual reset.

Scroll Compressor & Refrigeration Circuit

The refrigeration compressor shall be inverter scroll compressor with variable refrigerant volume or flow technology, class IP54; the refrigerant shall be R-134a / R-410 / R-407C. The refrigerant circuit shall include the electronic expansion valve, the dryer filter, the sight glass, the liquid receiver and safety valve. The circuit shall be nitrogen pressurised and the connections to the external condensing unit tapped. The compressor shall be isolated from the air flow to avoid noise transmission and heat dissipation to the air stream. The compressor shall be located at the bottom of the unit to prevent vibration transmission to the unit casing.

Evaporator Coil

It shall be of large face area to provide a Sensible Heat Ratio (SHR) over 0, 95 at 24°C, 50% RH room conditions. The coils shall be made of copper tubes and 14 aluminium fins per inch:

a special treatment by resins makes fins resistant to corrosive environment. The coil removal shall be possible from the rear side of the unit. The coil shall be a unique part with a very high slope so as to provide a uniform air flow on the entire face area. The coils shall have 3 to 5 rows in accordance with the unit capacity.

Dehumidification

A specific dehumidification cycle (split-suction) shall operate by reducing the operating surface temperature in a section of the refrigerator coil by means of a solenoid valve on the suction header. Full airflow of the unit will be maintained at all times to ensure consistent air distribution to the conditioned space.

Remote Air Cooled Condenser

The air cooled condenser shall be the low profile, weather proof type incorporating high efficiency, direct drive, external rotor motors with axial blade fans. The condenser shall be constructed from heavy duty aluminium and corrosion resistant components. Heavy duty mounting legs and all assembly hardware shall be included. Condensers shall be suitable for 24-hour operation and be capable of providing vertical or horizontal discharge. The condenser shall be fully factory wired.

All interconnecting piping within ODU, coils, joints and U bends within the condensing unit shall be painted with two coats of clear transparent polymer coating for protection against corrosion from ambient air.

Fan Speed Control Condenser

The condenser fans shall be directly driven by 4 pole 1210 rpm 230 volt 50 hz electric motors with an IP54 enclosure rating and class F insulation. The motor shall be equipped with permanently sealed ball bearing and high temperature grease. The motors shall be speed controlled to ensure stable operating conditions from –5.0 Deg. C to 48.0 Deg. C ambient by a factory fitted, direct acting pressure actuated fan speed controller. The control system shall be complete with input isolation switch, transducers and pressure switches.

Unit Controller

The unit controller shall be microprocessor based and include a large. LCD backlit graphic display for clear visibility of text and graphics. The display and control buttons shall be accessible from the unit front without removing any external panels. The controller shall feature ISP (In-system-Programming) technology to support program upload via a PC.

Control strategies shall be P-I-D with dew point compensation for accurate temperature and humidity control. A selection of return or supply air control shall be provided to suit the application.

The controller shall have a user friendly menu driven interface with supporting help screens and shall use multi protocol data communications. Access to the controller settings to prevent against unauthorized access.

In normal operating mode screen shall display unit number, temperature and relative humidity set points and actuals, graphs, time, date and operating status. Dynamic icons identify the system-operating mode. A 48-hour real time log of temperature and humidity data shall be retained by the control system. All parameters and data shall be protected in memory by an on-board battery.

Control

The control system shall allow programming of the following conditions:

- Temperature set point
- Humidity Set point
- High Temperature Alarm
- Low temperature Alarm
- High Humidity Alarm
- Low Humidity Alarm

The control system shall include the following settable features:

- Unit identification number.
- Startup Delay, Cold start Delay and Fan Run on timers
- Sensor Calibration.
- Remote shutdown & general Alarm management
- Return temperature control.
- Choice of Modulating output types.

Alarms

The microprocessor shall activate an audible, visual and general alarm in the event of any of the following conditions:

- High Temperature
- Low Temperature
- High Humidity
- Low Humidity
- Loss of Air
- High Pressure
- Low Pressure
- Humidifier Low Water
- Water Under Floor
- Spare Alarm 1 and 2 (Customized text)

These alarms shall have selectable control action enabled, disabled or off.

The microprocessor shall activate a visual alarm only in the event of any of the following conditions:

- Service Intervals (cool, filter and humidifier)
- Compressor Short Cycle.
- Condenser Water Flow Fall

- Low Battery
- Loss of Power (history only)
- Unit Off (History only)

All alarm occurrences shall be time and date stamped.
The unit shall also incorporate the following protections:

- Single phasing preventers.
- Reverse phasing
- Phase unbalancing
- Phase failure
- Overload tripping (MPCB) of all components

Data Logging

The control system shall maintain cumulative operating hours of mode (cool, heat, humidity, dehumidity) and fans).The 100 most recent alarms shall be retained in memory.

Open Comms NIC Card

The Open Comms NIC (Network Interface card) shall transform the controls into manageable nodes within a Network, NMS and BMS system. This interface card shall communicate with external systems via the following industry standard open Protocols:

- Modbus RTU over EIA-485
- SNMP vI
- HTTP vI.L

The NIC card shall provide redundant paths for communications, making it possible to connect to existing BMS systems using Modbus while simultaneously communicating to the NMS through SNMP and HTTP.

Pre-installation Inspection

Examine the areas and conditions under which the units are to be installed and correct any unsatisfactory conditions detrimental to the proper and timely completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

Installation

a. Install units in positions shown on drawings.

b. Align and level all units on prepared bases / supports.

c. Fix all units to supports. Fix units to bases with anchor bolts.

d. Ensure adequate space is available around the units for airflow and to allow inspection and maintenance of all components in accordance with manufacturers recommendations.

Commissioning

a. Carry out static checks on fans, levels of oil, electrical wiring, settings of all control and safety devices to ensure conditions are safe prior to start up and running.

b. Operate equipment to ensure all control and safety device function as required and log settings of all control and safety devices for tabulation.

c. Provide a new set of filters following commissioning over and above the additional spare filters.

Cleaning

a. Prior to start-up of unit, vacuum cleans the interior of all cabinets including coils and filters.

Variable Air Volume Unit

Scope

A. This section covers the construction and installation of variable air volume boxes Associated with the air conditioning systems indicated on the drawings.

General

B. The design, construction, materials and finishes of all units shall be suitable for the locations, climatic and operating conditions indicated in this specification and drawings.

C. Boxes shall be single duct variable volume pressure independent type.

D. Each VAV unit shall consist of Thermostat, Control and Power Wiring, Insulated Casing etc

Construction

A. The VAV terminals shall be made of minimum 0.8 / 1.00 mm galvanized steel sheet internally lined with engineered polymer foam insulation which complies to UL 181 and NFPA 90A or lining as specified in BOQ. Closed cell foam insulation shall be of minimum 22-24 Kg/cumtr. Density.

B. The 24 V, 50 Hz power source shall energise and operate each VAV box.

C. Actuators, reset controllers, circuitry, and distribution boxes shall be provided and installed at the factory and must be integrated into the unit casing. The control equipment must be easily accessible through an access door provided with quick release frames.

E. The controller shall be preset at the factory for specified maximum and minimum air flow rates.

F. The volume control linkage shall be calibrated to identify air volume in increments of percent of air flow from minimum to maximum air flow.

G. The unit shall allow for adjustment to air flow limits on site for future change.
Provision shall be made for calibration and resetting on site by:
1. External gauge tappings
2. Dials on the controller
3. Thermostat adjustment

H. Each unit shall be supplied complete with a fully site resettable controls calibration chart for setting of air flow on site. This shall be attached to the unit.

I. The room thermostat shall be electronic digital type and mounted as defined in the Particular Specification.

J. Volume dampers or valve and controls shall be run test, sequence of operation checked and air volume limit preset, prior to dispatch.

K. Air distribution boxes shall be fitted to the units according to the layout indicated on the drawings and details.

L. All VAV units shall be constructed in accordance with the best current practice and free from sharp edges.

M. Air leakage through the unit shall not exceed 2% of nominal capacity at 375 Pa.

N. Unit shall have pressure independent control.

Installation

A. Install air terminal units in positions shown on drawings.

B. Align and level all units.

C. Fix all units to wall, floors or supports as shown on drawings.
D. Ensure adequate space is available around the units to allow inspection and maintenance of all components in accordance with manufactures recommendations.
E. Co-ordination of air terminal location shall be made with the ceiling pattern, to ensure easy access in the future.
F. Manufacturers recommendations on installation shall be followed.

Commissioning

A. Carry out static check on unit, settings of controls and electrical connections to ensure conditions are safe prior to start up.
B. Operate units to ensure all control components and switches function correctly.

SYSTEM READY TO BALANCE CHECK LIST (NOT LIMITED TO FOLLOWING)

Description	**Ready**		**Date**
	Yes	**No**	**Corrected**
1. HVAC Units (AHU)			
a) General			
Louvers installed			
Manual dampers open & locked			
Automatic dampers set properly			
Housing Construction leakage			
Access doors-leakage			
Condensate drain piping and pan			
Free from dirt and debris			
Nameplate data			
b) Filters			
Type and size			
Number			
Clean			
Frame-Leakage			
c) Coils (Hydronic)			
Size and rows			
Fin spacing and condition			
Obstructions and / or debris			
Airflow and direction			

Piping leakage

Correct piping Connections and flow

Valves open or set

Air vents or steam traps

Provision made of TAB Measurements

d) Fans

Rotation

Wheel clearance and balance

Bearing and motor lubrication

Drive alignment

Belt tension

Drive set screws tight

Belt guard in place

Flexible duct connector alignment

Starters and disconnect switches

Electrical service & connections.

Nameplate data

e) Vibration Isolation

Springs & Compression

Base Level & Free

2. Duct System

a) General

Manual dampers open & locked

Access doors closed and tight

Fire dampers open and accessible

Terminal units open and set

Registers and diffusers open and set

Turning vanes in square elbows

Provisions made for TAB measurements.

Systems installed as per plans.

Ductwork sealed as required

b) Architectural

Windows installed and closed.

Doors closed as required.

Ceiling plenums installed and sealed.

Access doors closed and tight

Air shafts and openings as required

3. Pumps

a) Motors.

Rotation

Lubrication

Alignment

Set screws tight

Guards in place

Tank level and controls.

Starters and disconnect switches

Electrical service & connections.

Nameplate data.

b) Piping

Correct flow

Correct connections

Leakage

Valves open or set

Strainer clean

Air vented

Flexible connectors

Provisions made for TAB measurements

c) Bases

Vibration isolation.

Grouting

Levelling

4. Hydronic Equipment

a) Heat Exchangers/HW coil

Correct flow and connections

Valves open or set

Air vents or steam traps

Leakage

Provisions made for TAB measurements

Nameplate data.

b) Cooling towers

Correct flow and connections.

Valves open or set

Leakage

Provisions made for TAB measurements

Sump water level.

Spray nozzles.

Fan/pump rotation.

Motor/fan lubrication.

Drives and alignment

Guards in place.

5. Refrigeration Equipment

Crankcase heaters energized

Operating controls and devices.

Safety controls and devices.

Valves open

Piping connections and flow

Flexible connectors

Oil level and lubrication

Alignment and drives.

Guards in place.

Vibration isolation.

Starters, contactors and disconnect switches.

Electrical connectors.

Nameplate data.

6. Hydronic Piping systems.

Leak tested.

Fluid levels and make-up

Relief or safety valves.

Compression tanks and air vents.

Steam traps and connections.

Strainers clean

valves open or set

Provisions made for TAB measurements.

Systems installed as per plans.

7. Controls System

Data centers.

Outdoor return air reset

Economizer

Static pressure

Room controls.

8. Other Checks.

a) Other trades or personnel notified of

TAB work requirements.

b) Preliminary data complete

c) Test report forms prepared.

INSTRUMENT CALIBRATION REPORT

PROJECT _____

S/N	INSTRUMENT/ SERIAL NO.	APPLICATION USE	DATES OF CALIBRATION TEST DATE
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			
16.			
17.			

REMARKS

TEST DATE_____READINGS BY _____

CHILLER TEST REPORT

PROJECT_____UNIT_____

LOCATION_____

MANUF._____MODEL_____SERIAL NO. _____

CAPACITY_____REFRIG_____STARTER_____HEATER SIZE _____

Description	**Design**	**Actual**
a) COMPRESSOR		
Make / Model		
Serial No.		
Type (Reciprocating, Centrifugal, Screw, Scroll)		
Piping Material		
Suction Pr / Tem.		
Discharge Pr/Temp		
Refrigerant		
Oil Pump Type		
Oil Pressure		
Oil Failure Switch Pressure		
Unload Arrangement		
Unload Set Points		
Drive		
Compressor Speed		
Oil Level		
Oil Temperature		
L P Setting		

H P Setting

Anti-Freeze Setting

Purge Unit Type

Purge Operation Checked

b) COMPRESSOR MOTOR

Make / Model

Type

Voltage

Motor Rated Current

Motor F L Current

c) MOTOR STARTER

Make / Model

Type

Voltage

Amps

O/L Release Range

d) EVAPORATOR

Make / Model

No. of Passes

Ref : Level

Ref : Pressure / Temperature

Ent. Water Temp/Pressure

Leaving Water Temp/Pressure

Temperature Difference

Pressure Difference

Water Quantity

Relief Valve Setting

IKW / Ton

e) CONDENSER

Make/Model

No. of Passes

Ref : Pressure / Temp

Ent. Water Temp / Pressure

Leaving Water Temp/Pressure

Temperature Difference

Pressure Difference

Water Quantity

Relief Valve Setting

REMARKS

TEST DATE_____READINGS BY _____

PUMP TEST REPORT

PROJECT_____

DATA	**PUMP NO.**	**PUMP NO.**	**PUMP NO.**	**PUMP NO.**	**PUMP NO.**
Location					
Service					
Manufacturer					
Model Number					
Serial Number					
GPM/Head					
Req. NPSH					
Pump RPM					
Impeller Dia.					
Motor Mfr. / Frame					
Motor HP/RPM					
Volts/Phase/Hertz					
F.L Amps					
Seal Type					
Pump Off-Press.					
Valve Shut Diff.					
Act. Impeller Dia.					
Valve Open diff.					
Valve Open GPM					
Final Dischg. Press.					
Final Suction Press.					
Final Ap					
Final GPM					
Voltage					

Amperage

REMARKS

TEST DATE_____READINGS BY _____

COOLING TOWER TEST REPORT

PROJECT_____SYSTEM_____

LOCATION_____

MANUF._____MODEL_____SERIAL NO._____

NOM. CAPACITY_____WATER TREAT._____

Description	**Design**	**Actual**
a) TOWER / MOTOR		
Make / Model		
Type		
Tons		
No. of Fan Motors		
Motor HP / RPM		
Motor / Drive		
Motor Speed		
Motor Rated Current		
Motor FL Current		
O/L Release Setting		
CT Range		
CT Approach		
b) TOWER / FAN		
No. of Fans		
Type/ Drive of Fan		
Fan Dia		
Fan Speed		
Air Inlet Temperature		
Air Outlet Temperature		

Fan Air Quantity

Water Bleed GPM

c) TOWER / AIR DATA

Fan CFM

Outlet S.P.

Avg. Ent. W.B.

Avg. Lvg. W.B.

Ambient W.B.

Fan RPM

Voltage

Amps

d) TOWER / WATER DATA

Ent//Lvg./Water Pressure

Ent//Lvg./Water Temperature

Water Temperature – T

GPM

Bleed GPM

Voltage

Amps

REMARKS

TEST DATE_____ READINGS BY_____

AIR HANDLING EQUIPMENT TEST REPORT

PROJECT_____

SYSTEM/UNIT_____ **LOCATION**_____

Description	**Data**
a) UNIT	
Make/Model No.	
Type/Size	
Serial Number	
Arr./Class	
Discharge	
Pully dia/Bore	
No. Belts/make/size	
No. Filters/ type. Size (Pre.)	
No. Filters/ type/ size (secondary)	
b) MOTOR	
Make / Frame	
H.P / RPM	
Volts/Phase/cycles	
F.L amps.	
Pully Dia/Bore	
Pully /Distance.	
Total Cfm	
Total S.P	
Fan RPM	
Motor Volts. T	
Outside air Cfm	

Return air Cfm

Discharge S.P

Cooling Coil S.P

Filters S.P

REMARKS

TEST DATE_____READINGS BY _____

COOLING / HEATING TEST REPORT (AHU)

PROJECT_____

COIL DATA	**COIL NO.**	**COIL NO.**	**COIL NO.**	**COIL NO.**
System Number				
Location				
Coil Type				
No. Rows Fins/In				
Manufacturer				
Model Number				
Face Area, Sq.Ft.				

TEST DATA	**DESIGN/ ACTUAL**	**DESIGN/ ACTUAL**	**DESIGN/ ACTUAL**	**DESIGN/ ACTUAL**
Air Qty. CFM				
Air Vel. FPM				
Press. Drop In.				
Out. Air DB/WB				
Ret. Air DB/WB				
ENT. Air DB/WB				
Lvg. Air DB/ WB				
Air AT				
Water flow. GPM				
Press. Drop. PSI				
Ent. Water Temp				
Lvg .Water Temp				
Water AT				
Exp. Valve/ Refrig				

Refrig. Suction Pr.

Refrig. Suct. Temp

Inlet Steam press.

REMARKS

TEST DATE_____READINGS BY _____

FAN COIL TEST REPORT

PROJECT_____

DATE_____**LOCATION**_____

MANUFACTURER_____

AREA SERVED	**FCU MAKE**	**CAPACITY TR**	**TEMPERATURE DEG. F**	
			GRILLE	**ROOM**
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				

REMARKS

TEST DATE_____**READINGS BY** _____

FAN TEST REPORT

PROJECT_____

FAN DATA	**FAN NO.**	**FAN NO.**	**FAN NO.**
Location			
Service			
Manufacturer			
Model No.			
Serial No.			
Type / Class			
Motor Make / Style			
Motor H.P/RPM/ Frame			
Volts/Phase/Cycles			
F.L Amps.			
Motor pulley Dia./ Bore			
Fan pulley Dia./Bore			
No. Belts/ Make/Size			
Pully Distance.			
CFM			
FAN RPM			
S.P IN/OUT			
TOTAL S.P			
Voltage			
Amperage			

REMARKS

TEST DATE_____**READINGS BY** _____

RECTANGULAR DUCT TRAVERSE REPORT

PROJECT_____SYSTEM_____

LOCATION / ZONE_____ACTUAL AIR TEMP._____DUCT S.P_____

DUCT	**REQUIRED**		**ACTUAL**	
SIZE_____SQ.FT._____	**FPM_____**	**CFM_____**	**FPM_____**	**CFM_____**

POSITION	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
VEL1OCITY											
SUBTOTALS											

REMARKS

TEST DATE_____READINGS BY _____

GRILLES AND DIFFUSERS TEST REPORT

PROJECT_____SYSTEM _____

OUTLET_____MANUFACTURER_____

TEST APPARATUS_____

S/N	AREA SERVED	OUT LET NO./TYPE/SIZE	DESIGN CFM/VEL	PRLIMINARY VEL/CFM	FINAL VEL/CFM
1.					
2.					
3.					
4.					
5.					
6.					
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8.					
9.					
10.					
11.					
12.					
13.					
14.					
15.					

REMARKS

TEST DATE_____READINGS BY _____

System Testing, Inspection Procedure & Performance Test Readings

Inspection Procedure For Central Air-Conditioning Plant

All major equipments such as Chilling machine, AHU, Electrical Panel, etc. shall be got inspected & tested before dispatch of equipments by the Engineer in Charge at works if he so desires. All type of routine and type tests shall be carried out at the works. The Engineer shall be free to witness any or all tests if he so desires. In case the Engineer in charge or his representative is unable to witness the test at the manufacturer‘s works, the contractor shall furnish the manufacturers test certificate to the satisfaction of the Engineer in charge. The AC contractor shall intimate the Engineer in Charge in advance about the date of readiness of equipments for inspection & testing. The inspection procedure for testing of AC equipments are given below:-

Initial Inspection

Chilling Machine

Salient features such as model no. of compressor, chiller & condenser, dimension of the machine, microprocessor panel etc shall be verified against the requirement.

Manufacturer‘s internal test certificate shall be scrutinized to check compliance with the requirement as per specification.

Salient features of condenser & chiller such as number of tubes, inside diameter of tubes, tube thickness & material, No. of passes, type of fins, length of condenser & chiller etc. shall be verified.

Cooling Coils:

Salient features of cooling coils such as material of tube, tube diameter, tube wall thickness, fin material & no. of fins per inch, gauge of fins & no. of rows shall be furnished and verified with reference to contract requirement.

Manufacturer‘s internal test certificate indicating results of pneumatic / hydraulic pressure test shall be scrutinized to check compliance with the requirement as per specification.

Air Handling Units:

Salient features such as model, size, physical dimension & other details of various section, fan motor details, fan dimension etc. shall be verified against the contract requirement.

Manufacturer‘s internal test certificate for the motor and air handling units shall be Furnished and scrutinized as per contract requirement.

Test certificate for static and dynamic balancing of the blower should be furnished.

Pumps

Salient features such as model and make shall be checked as per contract requirement.

The manufacturer‘s test certificate will be furnished and verified against contract Requirement.

Switch, Gear, Control Gear, Measuring Instruments & Power / Control Cables

They should be of approved make. For air circuit breakers the contractor shall furnish manufacturer‘s test certificate and the same shall be verified as per contract requirement.

Electric Motor

Electric motor should be of approved make. Test certificate for electric motor shall be furnished & verified as per contract.

Pipes & Valves:

Make of pipe & valves shall be verified as per contract.

Wall thickness of pipes shall be verified as per contract.

Ducting:

The GS sheet used for ducting shall be checked for physical test at site. The physical test should include the sheet thickness, bend test and galvanizing test as per relevant IS specifications.

Thermal Acoustic / Insulation:

Physical verification for thickness and make should be as per contract before application of insulation.

Manufacturer‘s test certificate for density & thermal conductivity should be furnished.

Final Inspection

After completion of entire installation, as per specifications in all respects, the AC contractor shall demonstrate trouble free operation of the AC equipment for a period of 30 working days subject to a minimum of 300 hours of running. Any defects found during this operation shall be rectified immediately before the initial test period of 30 days is over.

The initial test, which has to be carried out by the contractor at his own, expense & shall be as follows but not limited to:

a) To check satisfactory functioning of all major equipments such as Chilling m/c, electrical motors, pumps, cooling tower, switch gear, air handlers etc.

b) To check alignments of motors.

c) To operate chilling m/c, pump sets, air handlers etc. and adjust water flow in all line i.e. chilled water line and in the cooling coils.

d) To check and balance air distribution system.

NOTE: All test instruments such as thermometer, psychrometer, pressure gauges, anemometer, flowmeter, decibel meter or the contractor at his own expense shall arrange any other necessary instrument.

After initial test the plant shall be run continuously for a period of 10 working days before the guarantee comes into force. In addition to the initial test as explained in this section the contractor shall also give the two continuous running test of the system during peak summer, monsoon & winter for 10 hrs. For 3 days when the ambient are closed to the designed conditions.

In case, the peak ambient conditions in the respective seasons are not found to be close to designed ambient conditions, the test shall be conducted on closest ambient conditions and capacity of equipments shall be computed and compared with capacities indicated in the contract. Water and power for testing and commissioning of the system shall be provided free of cost by the Client.

Capacity of Plant

The test readings shall be recorded & capacity of various of major equipments such as, compressor, condenser, chiller, cooling coil, cooling tower, fan coil units, pump sets etc. shall be worked out as per computation formulas given in this section.

1. Power Consumption / Capacity Of Various Equipment.

   a) Compressor

   IKW. / Ton = Power input in KW

   Compressor Cap. in tons

The contractor shall compare the capacity & IKW/TR of compressor from manufacturers computer selections supplied.

b) Condenser / Chiller

Heat Rejection of Condenser =

U**Water flow through condenser (Usgpm) x Temp. Difference Deg.F.**

24

c) Cooling Coils of Air Handlers and Fan Coil Units

Capacity of cooling coil = U**CFM x 60 (he – hl)**

Avg specific volume V x 12000

Where as he = Enthalpy of entering air in btu / lb

hl = Enthalpy of leaving air in btu / il

V = Ve + V1

= Specific volume of air entering CFT /lb of air + specific volume of leaving air CFT / lb of air.

The interlocking connection of compressor motor with condenser and chilled water pumps cooling tower fan etc. shall be checked.

Performance Test Reading

The Test Readings shall be recorded on hourly basis during the summer / monsoon seasons after satisfactory commissioning of AC System at site as per the Performa indicated in Testing, Adjusting and Balancing Section of Tender Document.

I. OUTSIDE DESIGN CONDITIONS

a) Season :

b) Dry bulb temp. °C :

c) Wet bulb temp. °C :

II. INSIDE DESIGN CONDITIONS IN EACH AREA.

a) Dry bulb temp. °C :

b) Wet bulb temp. °C :

c) Relative Humidity % :

III. All electrical panels / cables / starters / single phase preventer etc. shall be tested as per standard code of practice.

List of Abbreviations & IS Codes

Followings List of Abbreviations shall have been used in preparing the EPC Tender Specifications.

AABC	:	AMERICAN AIR BALANCING COUNCIL
ACH	:	AIR CHANGE PER HOUR
AC	:	AIR CONDITIONING
ACMV	:	AIR CONDUCTING AND MECHANICAL VENTILATION
AHU	:	AIR HANDLING UNIT
ANSI	:	AMERICAN NATIONAL STANDARD INSTITUTE
ARI	:	AMERICAN REFRIGERATION INSTITUTE
ASHRAE	:	AMERICAN SOCIETY OF HEATING, REFRIGERATION AND AIRCONDITIONING ENGINEER
ASME	:	AMERICAN SOCIETY OF MECHANICAL ENGINEERS
ASTA	:	ASSOC.CIATION OF SHORT - CIRCUIT TESTING AUTHORITIES
ASTM	:	AMERICAN SOCIETY OF TESTING AND MATERIALS
ATG	:	AIR TRANSFER GRILLE
AWS	:	AMERICAN WELDING SOCIETY
AS	:	BUILDING AUTOMATION SYSTEM
BIS	:	BUREAU OF INDIAN STANDARD
BMS	:	BUILDING MANAGEMENT SYSTEM
BTU	:	BRITISH THERMAL UNIT
CDW	:	CONDENSER WATER

CFM	:	CUBIC FEET PER MINUTE
CHW	:	CHILLED WATER
CMS	:	CENTRAL MONITORING SYSTEM
CRCA	:	COLD ROLLED COLD ANNEALED
CSA	:	CANADIAN STANDARD ASSOC.CIATION
CT	:	COOLING TOWER
CTI	:	COOLING TOWER INSTITUTE
DB	:	DISTRIBUTION BOARD
DDC	:	DIRECT DIGITAL CONTROLLER
DOL	:	DIRECT ON LINE
DFA	:	DELHI FIRE AUTHORITY
DIA	:	DIAMETER
DIDW	:	DOUBLE INLET DOUBLE WIDTH
DX	:	DIRECT EXPANSION
EA	:	EXHAUST AIR
EEPROM	:	ELECTRICAL ERASABLE PROGRAM
ELCB	:	EARTH LEKAGE CIRCUIT BREAKER
ETL	:	ELETRICAL TESTING LABORATORIES
EPA	:	ENVIRONMENTAL PROTECTION ACT
FCU	:	FAN COIL UNIT
F/A	:	FLOOR ABOVE
F/B	:	FLOOR BLOW
FCC	:	FIRE COMMAND CENTRE
FD	:	FIRE DAMPER
FFL	:	FINISHED FLOOR LEVEL
FPM	:	FEET PER MINUTE
FPS	:	FOOT PER SECOND

FRP	:	FIBERGLASS REINFORCED PLASTIC
GI	:	GALVANISED IRON
GPM	:	GALLON PER MINUTE
GSS	:	GALVANIZED STEEL SHEET
H/L	:	HIGH LEVEL
HDG	:	HOT DIP GALVANIZED
HDPE	:	HIGH DENSITY POLY ETHANE
HFC	:	HYDRO FLURO CARBON
HP	:	HORSE POWER
HVAC	:	HEATING, VENTILATION & AIR CONDITIONING
IAQ	:	INDOOR AIR QUALITY
IEC	:	INTERNATIONAL ELECTROCHEMICAL COMMISSION
IKW	:	INDICATED KILO WATT
IPD	:	INITIAL PRESSURE DROP
ISO	:	INTERNATIONAL STANDARD ORGANIZATION
KW	:	KILO WATT
L	:	LITRE
LCD	:	LIQUID CRYSTAL DISPLAY
L/L	:	LOW LEVEL
L/S	:	LITRE PER SECOND
LSZH	:	LOW SMOKE ZERO HALOGEN
LT	:	LOW TENSION
M	:	METER
MAX.	:	MAXIMUM
MCB	:	MINIATURE CIRCUIT BREAKER
MCC	:	MOTOR CONTROL CENTRE
MFD	:	MOTORIZED FIRE DAMPER

MIN	:	MINIMUM
MM	:	MILLIMETER
NBC	:	NATIONAL BUILDING CODE
NC	:	NOISE CRITERIA
NEC	:	NATIONAL ELECTRIC CODE
NFPA	:	NATIONAL FIRE PROTECTION ASSOC.CIATION
NPLV	:	NET PART LOAD VALUE
NIST	:	NATIONAL INSTITUTE OF STANDARDS & TECHNOLOGY
NEMA	:	NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
NPSH	:	NET POSITIVE SUCTION HEAD
NTS	:	NOT TO SCALE
OA	:	OUTDOOR AIR
PHE	:	PUBLIC HEALTH ENGINEERING
PLC	:	PROGRAMMABLE LOGIC CONTROLLER
P.C.	:	PERSONAL COMPUTER
PSIG	:	POUNDS PER SQUARE INCH GAUGE
PUF	:	POLYURETHANE FOAM
RA	:	RETURN AIR
RAD	:	RETURN AIR DUCT
RCC	:	REINFORCED CEMENT CONCRETE
RH	:	RELATIVE HUMIDITY
RPM	:	REVOLUTIONS PER MINUTE
SA	:	SUPPLY AIR
SAD	:	SUPPLY AIR DUCT
SMACNA	:	SHEET METAL & AIR CONDITIONING CONTRACTORS NATIONAL ASSOC.CIATION INC
STD	:	STANDARD

T/A	:	TO ABOVE
TAB	:	TESTING, ADJUSTING AND BALANCING
T/B	:	TO BELOW
TCC	:	TERMINAL CONTROL CENTRE
TFA	:	TREATED FRESH AIR
TOA	:	TREATED OUTDOOR AIR
TP	:	THREE PHASE
TR	:	TONS OF REFRIGERATION
TVOC	:	TOTAL VOLATILE ORGANIC COMPOUNDS
VAV	:	VARIABLE AIR VOLUME
VFD	:	VARIABLE FREQUENCY DRIVES
VIP	:	VIBRATION ISOLATING PAD
VSPS	:	VARIABLE SPEED PUMPING SYSTEM
XLPE	:	CROSS -LINKED POLYETHYLENE
SISW	:	SINGLE INLET SINGLE WIDTH
UL	:	UNDERWRITERS LABORATORIES INC.
WG	:	WATER GAUGE

Followings are the few list of Bureau of Indian Standards Codes for guidelines.

IS : 277 – 1992	Galvanized steel sheet (Plain & Corrugated) wire for fencing.
IS : 554 - 1985 (Reaffirmed 1996)	Dimensions for pipe threads where pressure tight joints are required on the threads.
IS : 655 - 1963 (Reaffirmed 1991)	Metal air ducts.
IS : 659 – 1964	Air conditioning (Safety Code)

(Reaffirmed 1991)	
IS : 660 – 1963 (Reaffirmed 1991)	Mechanical Refrigeration (Safety Code)
IS : 694 - 1990 (Reaffirmed 1994)	PVC insulated (HD) electric Cables for working voltage unto and including 1100 volts.
IS : 732 – 1989	Code of practice for electrical wiring.
IS : 780 - 1984	Sluice valves for water works purposes.
IS : 822-1970 (Reaffirmed 1991)	Code of procedure for inspection of welds.
IS : 1239 (Part - I) - 1990	Mild steel tube
IS : 1239 (Part - II) – 1992	Mild steel Tubulars and other wrought steel pipe fittings.
IS : 1255 – 1983	Code of Practice for installation and maintenance of Power Cables unto and including 33 KV rating (Second Revision)
IS : 1554 - 1988 (Part – I)	PVC insulated (Heavy Duty) electric cables for working voltages unto and including 1100 volts.
IS : 1897 – 1983 (Reaffirmed 1991)	Copper bus bar / strip for electrical purposes
IS : 2379 – 1990	Colour code for the identification of Pipelines.
IS : 2551 – 1982	Danger notice plate
IS : 3043 – 1987	Code of practice for earthing.
IS : 3103 – 1975 (Reaffirmed 1999)	Code of practice for Industrial Ventilation.
IS : 3837 – 1976 (Reaffirmed 1990)	Accessories for rigid steel conduit for electrical wiring.
IS : 4736 – 1986 (Reaffirmed 1998)	Hot-dip zinc coatings on steel tubes.

IS : 4894 – 1987	Centrifugal Fan.
IS : 5133 - 1969 (Part-I)	Boxes for the enclosure of electrical (Reaffirmed 1990) accessories.
IS : 5216 – 1982	Guide for safety procedure and practices (Part-I) (Reaffirmed 1990) in electrical work.
IS : 5312 (Part-I) – 1984	Swing - check type reflux non (Reaffirmed 1990) return valves for water works
IS : 5424 – 1989 (Reaffirmed 1994)	Rubber mats for electrical purposes.
IS : 5578 & 11353-1985	Marking and identification of conductors
IS : 6392 – 1971 (Reaffirmed 1988)	Steel pipe flanges.
IS : 8623 – 1993	Low voltage switchgear and control gear assemblies (Requirement for type / partly type tested assemblies)
IS : 8623 – 1993	Bus Bar trunking system (Part - II)
IS : 8828 – 1996	Circuit Breakers for over current protection for house hold and similar installation.
IS : 9537 – 1981 (Part II)	Rigid Steel Conduits for electrical wiring
IS : 10810 – 1988	Methods of test for cables.
IS : 13947-1993 (Part-I)	General rules for low voltage switch gears and control gears.
IS : 13947-1993 (Part-II)	Circuit Breakers IEC 947 - 2
IS : 13947 - 1993 (Part-III)	Switches, disconnectors and fuse for low voltage switch gear and control gear.
IS : 13947 - 1993 (Part-IV)	Low voltage switch gear and control gear for contactors and motor starters
IS : 13947 – 1993 (Part-V)	Control Circuit Devices.
BS : EN:779 – 1993	Filters
IEC	Relevant Sections.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-9

Electrical Sub StationEquipment

All the works shall be carried out as per CPWD General Specification for **Electrical Works, Part-IV Substation-2013;** as amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable and as amended up to date and SITC of 11/.4 KV SS equipment comprising HT panel, oil type/dry type transformer ,HT cable, Bus turnking to Transformer to LT panel, LT panels' APFC panel, active harmonics filter, TVSS, SPD, essential panel, earthing, required inter connections, SS safety equipment, including LT cabling from SS to buildings fed by SS.

COMMERCIAL AND ADDITIONAL CONDITIONS

1.0 GENERAL

1.1 This specification covers Design, manufacture, testing as may be necessary before dispatch, delivery at site, all preparatory work, assembly and installation, commissioning putting into operation of sub-station equipments consisting of HT panels, transformers, bus ducts, LT panels, HT cabling, LT Cabling etc. and final testing of sub-station equipments at IIT(ISM) Dhanbad**.**

1.2 The contractor is advised to visit the site of work to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

1.3 The work shall be executed as per CPWD General Specifications for Electrical Works Part-I, II & IV, as amended upto date, relevant I.E. Rules, BIS/IEC and as per directions of Engineer-in-charge. These additional specifications/conditions are to be read in conjunction above and in case of variations; specifications given in these additional conditions shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions.

1.4 GUARANTEE

All equipments shall be guaranteed for a period of 36 months i/c annual comprehensive maintenance of all substation equipments, from the date of taking over the installation by the department, against unsatisfactory performance and/or break down due to defective design, workmanship or material. The equipments or components, or any part thereof, so found defective during guarantee period shall be forth repaired or replaced free of cost, to the satisfaction of the Engineer-in-Charge. In case of replacement or repair requiring more than 7 days, the agency shall temporarily install the equipment so that the system becomes operational. In case it is felt by the department that undue delay is being caused by the contractor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of the Engineer-in-Charge in this regard shall be final & binding on the contractor.

1.5 The contractor shall guarantee among other things, the following:

(a) Quality, strength and performance of the material used as per manufacturers standards.

(b) Safe mechanical and electrical stress on all parts under all specified conditions of operation.

(c) Satisfactory operation during the maintenance period.

1.6 ACCEPTABLE MAKES OF VARIOUS EQUIPMENTS

The acceptable makes of various equipments/components/accessories have been indicated in ―Acceptable Makes‖.

1.7 DATA MANUAL AND DRAWINGS TO BE FURNISHED BY THE CONTRACTOR

a) The contractor shall furnish detailed technical literature, pamphlets and performance data after

award of work for approval of the Department.

b) The successful contractor would be required to submit the following drawings before first milestone for approval.

(i) General arrangement drawing of the equipments like HT panels transformers, bus duct, LT panel etc. in the sub-station building, complete dimensions for LT panel & Bus duct. The tenderer shall also give dimensions, details of LT panels and Bus duct and got tested at CPRI for fault stand capacity of 31 MVA for 1 Sec.

(ii) Details of foundation for the equipments and the weights of assembled equipments.

(iii) Cable/bus duct layout between HT panel boards, transformers & LT panel etc.

(iv) Any other drawings necessary for the job.

1.8 The successful tenderer should furnish well in advance three copies of detailed instructions and manuals of manufacturers for all items of equipments regarding installation, adjustments operation and maintenance including preventive maintenance & trouble shooting together with all the relevant data sheets, spare parts, catalogue etc. all in triplicate.

2.0 EXTENT OF WORK

2.1 The work shall comprise of SITC of all equipments complete with entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning, as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation all layout charts whether or not those have been mentioned in details in the tender document in connection this contract as this is a turnkey job.

2.2 The HT/LT cables shall be brought at site after taking correct measurements since no joint shall be permissible. Cable required as per site requirement.

2.3 In addition to supply, installation, testing and commissioning of sub-station equipments, following works shall be deemed to be included in the scope of work to be executed by the tenderer as this is a turnkey job-

(a) Minor building works necessary for installation of equipments, foundation, making of opening in walls or in floors and restoring them to their original condition/finish and necessary grouting etc. as required. The opening in the RCC floor/Slab shall have to be carried diamond core cutting machine and resealing shall have to be done by the tenderer.

(b) All supports for overhead bus ducts, cables and MS channels for erection of panels & transformers etc. as are necessary.

(c) Testing of PTs/CTs for metering and protection purpose and relay calibration and setting.

(d) Getting CEA/Electrical inspector‘s inspection done and obtaining approval for energizing the installation. However, necessary fees for inspection shall be borne by the Department.

3.0 INSPECTION AND TESTING

a) All major equipments i.e. HT panel, transformers, bus duct, LT panel, feeder pillars etc. shall be

offered for initial inspection at manufacturers works. The contractor will intimate the date of testing of equipments at the manufacturer‘s works before dispatch. The successful tenderer shall give advance notice of minimum two weeks regarding the dates proposed for such tests to the department‘s representative to facilitate his presence during testing. Equipments will be inspected at the manufacturer/Authorized Dealers premises, before dispatch to the site by the contractor if so desired by the Engineer-in-Charge.

b) Copies of all documents of **routine and type** test certificates of the equipment, carried out at the manufacturers premises shall be furnished to the Engineer-in-Charge and consignee.

c) After completion of the work in all respects the contractor shall offer the installation for testing and operation.

d) Contractor has to get sample testing of 11KV HT cable from NABL approved laboratory. However, necessary fees for sample & testing shall be borne by the Contractor.

4.0 COMPLIANCE REGULATIONS AND INDIAN STANDARDS

4.1 All works shall be carried out in accordance relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification at his own expenses by the tenderer. In particular, the equipment and installation will comply the following:

(i) Factories Act.

(ii) Indian Electricity Rules and Indian Electricity Act.

(iii) B.I.S. & other standards as applicable.

(iv) Workmen‘s compensation Act.

(v) Statutory norms prescribed by local bodies like CEA, Power Supply Co., etc.

4.2 After completion of the installation, the same shall be offered for inspection by the representatives of the Central Electricity Authority/Local Government Electrical Inspector. The contractor will extend all help including test facilities to the representatives of CEA/Local Government Electrical Inspector. The observations of CEA/Local Government Electrical Inspector will be attended by the contractor. The installation will be commissioned only after getting clearance from CEA/Local Government Electrical Inspector.

4.3 Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment, all accessories in accordance currently applicable statutory regulations and safety codes.

4.4 Successful tenderer shall at his own expenses, arrange for compliance statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed directly or indirectly on the work by the tenderer. Failure to provide such safety requirement would make the

tenderer liable for penalty of Rs. 2000/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

5.0 TRAINING

The contractor shall arrange for at site training by the supplying company of equipments to the staff deployed by him for proper and effective maintenance of the substation equipments.

6.0 Sufficient trained and experienced staff shall be made available to meet any exigency of work during the guarantee period of one year from the handing over of the installation.

7.0 INTERPRETING SPECIFICATIONS

In interpreting the specifications, the following order of decreasing importance shall be followed in case of contradictions:

(a) Technical specifications
(b) General specifications.
(c) Relevant BIS or other international code in case BIS code is not available.
(d) Drawing (if any)

TECHNICAL SPECIFICATIONS

A. TRANSFORMER (OIL TYPE)

1. SCOPE

This section covers the detailed requirements regarding supply and installation of transformer as per specifications. Energy efficiency level – 3, Maximum allowable losses of transformer shall be as per IS 1180 part 1 (2014) or ECBC -2017 as amended up to last date of bid submission whichever is more stringent.

2. GENERAL CONSTRUCTION

a. The transformer shall comply with the following Indian Standards as amended upto date:

1. IS 2026 - Part I to V power Transformers.
2. IS 1886 - Installation and Maintenance of Transformers.
3. IS 2099 - Bushings.
4. IS 2705 - Current Transformers.
5. IS 6600 - Guide for loading of oil immersed Transformers.
6. IS 335 -Transformer Oil.

6. IS 1180 part 1 (2014) – Outdoor type oil immersed Distribution transformer

b. Tanks and Radiators

Tanks shall be of MS plates and structural, electrically welded. The construction shall be robust and substantial, suitable for road/rail transport and to withstand vibration. Radiator tubes shall be electrical resistance welded type, round or elliptical or rectangular. They may be welded to the transformer tank or in case of very large sizes to separate detachable radiator banks connected through intermediate leak proof valves. Detachable radiator banks shall have top and bottom headers with flanged connections, with drain and vent fittings. Tanks shall be provided with lifting lugs and jacking lugs. Inspection hole with cover should also be provided for large transformers. Oil conservators shall be mounted on brackets attached to the top cover on tank. Dimensions of the conservator shall be such as to allow change in volume of oil due to change in temperature from 10^0C to 95^0C.

Tanks shall be thoroughly cleaned, degreased and sand blasted inside and outside. A coat of rust resistance primer shall immediately be given on outside surface. Inside surface shall be painted with oil resistance enamel paint. Tank and radiators shall be hydraulically pressure tested. Tanks shall also be tested for full vacuum. The procedure for testing shall be as follows:

i. Vacuum Test

The tanks designed for all vacuum shall be tested at an internal pressure of 3.33KN/m^2 (25mm of Hg) for one hour. The permanent deflection of flat plates after the vacuum has been released shall not exceed the value specified in Table ‗A' without affecting the performance of the transformer.

ii. Pressure Test

One transformer tank of each size together with its radiators, conservator vessel and other fitting shall be subjected to a pressure corresponding to twice the normal head of oil or to the normal pressure plus 35KN/m^2 (0.35kg/sq.cm) whichever is lower measured at the base of the tank and will be maintained for one hour. The permanent deflection of flat plates after the excess pressure has been released shall not exceed the figure specified in Table' A.

TABLE „A"

Horizontal length of Flat plate (in mm)	**Permanent deflection (in mm)**
Upto and including 750	5.0
750 to 1250	6.5
1251 to 1750	8.0
1751 to 2000	9.5
2001 to 2250	11.0

2251 to 2500	12.5
2501 to 3000	16.0
Above 3000	19.0

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c. Cores

Cores shall be built from cold rolled grain oriented silicone steel laminations. Suitable high temperature resistance, oil proof, and adherent coating materials shall insulate the core laminations from each other. **Core shall have boltless construction** and shall be heavily insulated from the core laminations.

The insulations of core bolt shall be minimum of class ‗A'. The bottom and top frames shall be connected with the tie rods to make a complete structure rigid for carrying the weight of core-oil assembly without unduly stressing the laminations or windings. Lifting eyes shall be provided on the frame for removal of core assembly from the tank. Completed core shall be flash tested for insulation with 2500 Volts between the core and each of the clamps or core bolts (core being connected to earth).

All the core frames shall be bonded together with two metallic strips and connected to the tank for earthing to ensure earth return and operation of protective gear in the event of a fault. Lifting eyes (or any other provision) for lifting the core from the tank shall be provided.

d. Winding and Insulation

Winding shall be three phase with minimum class _A' insulation. High conductivity electrolytic quality copper shall be used for winding. Windings shall be suitably braced to withstand the dynamic forces due to short circuit. Winding insulation shall be uniform and windings shall have full insulation.

Winding shall be individually vacuum dried before assembly as well as after assembly.

f. Insulation Oil

Insulation oil shall conform to IS: 335. Transformers shall be supplied with initial fill of filtered ester oil.

g. Impedance

The transformer impedance shall be as per IS standard.

3. GENERAL REQUIREMENTS

The transformer shall be outdoor type as specified. Unless otherwise specified the transformer in addition shall have thermal and dynamic ability to withstand external short circuit as per clause 9 of IS: 2026 (Part I) 1977.

4. TEMPERATURE RISE

The reference ambient temperatures assumed for the purpose of this specification are as follows: -

a. Maximum ambient air temperature $50^{o}C$
b. Maximum daily average ambient air temperature $45^{o}C$
c. Maximum yearly weighted average ambient temperature $32^{o}C$
d. Minimum ambiant air temperature + $0^{o}C$

The temperature rise at the above conditions and at an altitude not exceeding 1500 meters shall as follows:

By resistance method $55^{o}C$

By thermometer $50^{o}C$.

5. TAP CHANGING DEVICE

Tap changing device shall be provided on H.V. side, On Load Tap Changing (OLTC) device with Remote Tap Changing Control Panel (RTCC) and Automatic Voltage Regulator (AVR) shall be provided. Automatic Tap Changing Arrangement shall be provided with AVR etc. with provision of manual tap changing arrangement. Tap changing arrangement shall be suitable to correct the voltage variation. The tap off changing shall be automatic and correction speed shall be fast.

6. VOLTAGE RATIO

The transformer shall be suitable for a voltage ratio of 11 KV/433 Volts.

7. VECTOR GROUP

The winding connection shall conform to vector group Dyn 11 unless otherwise specified.

8. COOLING

The transformer shall be oil immersed natural air-cooled type (ONAN).

9. ACCESSORIES

The transformer shall be single tank type with termination on bushings for outdoor installation or cable end box for indoor installation as specified on HV side. The MV side shall be suitable to receive sandwhich type Copper Bus Duct cable suitable for full load current of the transformer.

10. FITTINGS

The transformer shall be complete with the following fittings:

a. Oil conservator with oil level indicator, minimum level marking and drain plug for all transformers.
b. OLTC with RTCC & Automatic Change Over with AVR, motor etc. as required complete. Thermometer pocket with plug for all transformers.
c. 3 nos. 150mm dial type/stem type thermometer with metal guard dial type calibrated thermometer may have max. Temperature indicator and resetting device for all thermometers winding temperature alarm/trip and fitted in a marshaling box.
d. Marshaling Box (in a sheet steel enclosure with vision panel) with MRP and RSD with alarm/trip contacts for oil and winding temp. and Buccholtz relay to house.
e. WTI (Winding Temp. Indicator / Gauge) & OTI (Oil temp. Indicator / Gauge) and Control Terminals.
f. Control wiring between Marshalling Box and temp. indicators (oil and winding) and Buccholtz relay.
g. Lifting lugs for all transformers.
h. Bi-directional rollers.
i. Rating diagram and terminal marking plate for all transformers.
j. Explosion vent for transformers.
k. Additional Neutral separately brought out on a bushing for earthing for all transformers.
l. Earth terminals (2Nos) for body earthing for all transformers.
m. Valves for filtration, drainage and filling etc. with necessary plugs for all transformers.
n. Radiator assembly for all transformers.
o. Silica gel breather for all transformers.
p. Air release plug for all transformers.
q. First filling of oil as per IS 335/72 including make up fill during installation for all transformers.
r. Facility to connect up Buchholtz relay for all transformers.
s. Inspection cover on tank cover for access to terminal connections for all transformers.
t. Bushing terminations or cable box terminations as specified.
u. Necessary hardware clamps, lugs etc. for terminations on HV/MV etc. for all transformers.
v. Disconnecting chamber for H.T. and L.T. cable.

11. EXPLOSION VENT

Explosion vent or pressure relief device shall be provided of sufficient size for rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent the ingress of moisture and of such a design to prevent gas accumulation.

12. ACCOMMODATION FOR AUXILIARY APPARATUS

Where specified, such as for restricted earth fault protection, facilities shall be provided for the mounting of a neutral current transformer.

13. RATING AND DIAGRAM PLATES

The following plates shall be fixed to transformer tank in a visible position.

a. A rating plate of weatherproof material bearing the data specified in the appropriate clauses IS: 2026-1977.

b. A diagram plate showing the internal connections and also the voltage vector relationship of the several windings in accordance with IS: 2026 – 1977 and a plan view of the transformer giving the correct physical relationship of the terminals

14. JOINTS AND GASKETS

All gaskets used for making oil tight joints shall be of proven material such as granulated cork bounded with synthetic rubber gaskets of synthetic rubber.

15. GAS AND OIL ACTUATED (BUCHHOLTZ) RELAYS

Buchholtz relay shall be provided for the transformers.

Oil actuated relay equipment shall conform to IS: 3637-1966 and shall be double float type having contacts which close following oil surge or under incipient fault conditions. Each gas and oil actuated relay shall be provided with a test cock to take a flexible pipe connection for checking the operation of the relay.

Where specified to allow gas to be collected at ground level, a pipe approximately 5mm inside diameter shall be connected to the release cock of the gas and oil actuated relay and brought down to a point approximately 1.25m above ground level, where it shall be terminated by a cock. A machined surface shall be provided on the top of each relay to facilitate the setting of the relays and to check the mounting angle in the pipe and the cross level of the relay.

The design of the relay mounting arrangements, the associated pipe work shall be such that mal-operation of the relays shall not take place under normal service. The pipe work shall be so arranged that all gas arising from the transformer shall pass through the gas and oil-actuated relay. The oil circuit through the relay shall not form a delivery path in parallel with any circulating oil pipe, nor shall it be tied into, or connected through, the pressure relief vent. Sharp bends in the pipe work shall be avoided.

All wiring connections, terminal boards, fuse and links etc. connected with gas-actuated relays shall be suitable for tropical atmosphere. Any wiring liable to be in contact with shall have oil resisting insulation and the bared ends of stranded wire shall be sealed together to prevent creep age of oil along the wire. There shall be no possibility of oil entering connection boxes used for cables or wiring.

16. CABLE BOX

Cable box shall not be mounted on the tank covers. It shall be feasible to remove the tank covers for inspection during maintenance etc. without recourse to breaking the joints or disturbing the cables already terminated. Necessary removable links in oil approachable through inspection cover in tank etc. after lowering coil shall be provided for test purpose.

17. TESTS

a) Tests at Works

All routine and other test prescribed by IS 2026 shall be carried out at the manufacturer‘s works before the dispatch of the transformer in the pressure of inspecting officer. Manufacturer‘s Laboratories should be NABL accredited Laboratories. Inspection should be conducted in those NABL Labs only. Copies of the test certificates shall be furnished to the Owner. In addition to the prescribed routine tests, temperature rise test shall be invariably done on one transformer of each design. A copy of the impulse test certificate done on the same type/design of the transformer shall be furnished in accordance with IS for purpose of record. If no impulse test was done in an earlier unit of the same design and capacity, one transformer will be subjected to impulse test in consultation with the Inspector at the firm‘s cost.

Copies of the certificates for pressure test, test for bushings, and type test for short circuit shall be supplied to the Owner.

Temperature rise test shall be conducted on one transformer of each rating. Transformer testing laboratory should be NABL accredited to ensure all equipments are calibrated, verified and test certificate shall be made available on demand.

b) Tests at site

In addition to tests at manufacturers premises, all relevant pre-commissioning checks and test conforming to IS code of practice No. 1886 shall be done before energisation. The following test are to be particularly done before cable jointing or connecting up the bus bar trunking.

- Insulation test between HV to earth and HV to MV with a 5000 volts megger.
- Insulation test between MV to earth with 500 volts megger.
- Insulation test of oil.
- Buchholtz relay operation by simulation test where fitted.

All test results are to be recorded and reports should be submitted to the Owner.

c) Special Test :

Successful Short Circuit Test report on similar or higher rating in compliance with IS 1180 to be submitted. Bidder to produce the test report else cost of the test to be in bidder scope.

d) Installation and Commissioning

i. The transformer shall be installed in accordance with IS:1886. Code of practice for installation and maintenance of Transformer. Necessary support channels shall be grouted in the flooring.

ii. The Transformer shall be moved to its location and shall be correctly positioned. All parts of the transformers which are supplied loose, such as conservator, radiator banks Buch Holtz relay, dial thermometers, bushing etc. shall be fitted on the transformer. Transformer oil supplied in drums shall be topped up into the transformer after duly testing/filtering upto the correct level required.

iii. Wiring of devices such as Buchholtz relay, dial thermometer etc. shall be carried out as per drawings. Earthing of neutral and body of the transformer shall be done in accordance with section (7) of these specifications.

iv. Drying out of transformer winding will be necessary when the insulation value of the oil is lower than the minimum value as per IS-1886 or the transformer has not been energised within 6 months of

leaving the works or where the radiator assembly is done at the site. The transformer shall be dried out by one of the methods specified in IS-1886. Drying out with centrifugal or vacuum type filters will, however, be preferred. The contractor shall carry out the process of drying without interruption and shall maintain a log sheet indicating time, oil temperature and insulation resistance.

v. After complete drying out of the transformer oil sample shall be collected by the contractor and shall be tested for dielectric strength as specified in IS-335-1972 with approved test kit.

vi. All devices such as dial type thermometers, Buch Holtz relay and main alarm and trip contacts shall be checked for satisfactory operation.

vii. All tests specified in 3.19.2 of these specifications shall be carried out by the Contractor in the presence of the inspecting officer/consignee free of cost.

B. **11 KV VCB Panel (Indoor Type)**

General

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB‘s shall be suitable for operation on 11KV, 3 phase, 50Hz, AC supply.

The HT Panel / VCB In the ring main system, outgoing of VCB to next ESS shall be capable to behave like incomer in case of main supply comes from next ESS. (Outgoing VCB functions likes Incomer)

Codes and Standards
The 11 KV VCB Panel shall comply with the following standards as amended up to date.

IS: 2516 (Part I – Set 3) : Indian Electricity Supply and regulations.

IEC 60298& IEC 60694

IS: 3427 & IS 12729 : Vacuum Circuit Breakers

IEC: 298 (1987) (Annex. AA) : Testing for Internal Arc

IEC: 529 : Degree of Protection – IP 54/55

IS: 2544 : Bus Bar Supports

IS: 2705 / IEC – 185 : Current Transformer

IS: 3516 / IEC – 186 : Potential Transformer

Rating
The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 500 MVA at 11 KV. The rated making capacity shall be as per the relevant standards.

Accessories
Circuit Breakers shall be provided with the following accessories.

i. Auxiliary Switch with minimum 6 NO+ 6 NC auxiliary contacts.

ii. Shunt Trip Coil

iii. Mechanical Operation Counter

iv. Spring Charging motor and handle for manual charging.

v. All 11 KV incoming and outgoing feeders shall be suitable for interlocking scheme as per the site requirement.
vi. Current withstand capacity Icw= 3 sec for 21 KA for 11 KV VCB panels.

Submittals
Shop Drawing and Technical Data

The tenderer shall furnish relevant technical data on breakers and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on breakers and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering and relay compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams for control and supervision of circuit breakers.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) Type test certificates required for all 11 KV breakers of identical design.

e) All drawings and data shall be in English.

Type and Construction

The metal clad panel shall be made out of 2.0 mm thick CRCA sheet steel. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid and recognized phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer‘s standard shade**.** The **HT** Switch Board Shall be fully extensible from both end with following compartment.

a. Circuit Breaker Compartment

b. Bus bar Compartment

c. CT and Cable Termination Compartment

The compartments shall be dust & vermin proof and safe to touch. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be mounted on the top / bottom of the panel at the front. The VCB shall consist of three air insulated poles incorporating mechanism of interrupters and suitable clearance between phases. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalized aluminium oxide. The contacts shall be of chromium copper and butt shaped. Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. The draw out carriage shall have two position for the circuit breaker viz isolated/test & service position. Bus bars shall be insulated type made of high conductivity copper supported on cast epoxy mono block designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

It shall be horizontal draw out & isolation type, fully interlocked, with dust and vermin proof construction, suitable for indoor installation**.** The panel shall be supplied with the manufacturer‘s test certificates**.** Certificates with date of manufacture and shall be complete in all respects as per details given in the bill of quantities. The switchgear constructions shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, bus bar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, levelled, flawless finish.

All HT Panels shall have floor mounted horizontal draw out type VCB‘s.

Total height of the H.T. Panel board shall be 2750mm approximately and width 600mm (approx.)**.** On the incoming breaker panel, a 100VA burden and Class I accuracy potential transformer 11KV/√3

/110V/√3 with LT fuses shall be provided. These shall be three single phase PTs cast resin insulated type. Adequate space at the rear of the panel shall be provided for termination of power & control cables. The panel shall be provided with suitable terminating arrangement for termination of cables. The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the bus bars & cable compartment for the fixed contacts. Safety shutters shall be provided to cover up the fixed high voltage contacts on bus bar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the draw out carriage. It shall, however, be possible to open the shutters of bus bars side and cable side individually.

Mechanically operated circuit breaker auxiliary switches of minimum 6 NO + 6 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by using 1.5 sq. mm, 1.1KV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

L.T. Terminal blocks for control wiring shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 2.0KV for one minute. Bus bar compartment shall be provided at the rear. Electrolytic copper bus bars shall be of rectangular cross section and insulated. Bus bars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Bus bars shall be provided with necessary colour coding for phases indication. The bus bars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 50 deg. C. The standard clearance between phase bus bars to be maintained.

Bus Bar and Insulators

Bus bars and connections shall be of high conductivity electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Bus bar cross section shall be uniform throughout the length of switch board. Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance. Bus bar insulators shall be of track-resistance, high strength, non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Bus bar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the bus bars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

Earthing and Protective Earthing

Copper earthing bus shall be provided. It shall be bolted/ welded to the frame work of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting Owner‘s earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of bus bars & feeder circuit.

Metering and Protection

The VCB Panel Board shall be provided with cast resin current transformers for metering and protection. The CT‘s shall conform in all respects to IS 2705-1964 Part-I, II and III. These shall have accuracy class of 1.0 for metering of 5P10 for protection. Potential transformers shall be epoxy cast resin type & conform to specifications of IS: 3156-1965 Part-I, II & III and shall be class-1**.** Electronic digital type Ammeter and voltmeter to be installed on panel**.** Electronic type digital energy analyzer having parameter of KW, KWH power factor, frequency etc. with 30 days memory shall be provided**.** All meters shall be tested for 2000V for 1 minute and shall be 96mm square pattern, flush

mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W)**.** The electronic digital types IDMT relay (2 O/C + 1 E/F) to be provided as per B.O.Q. description.

Interlocking, Safety and Operating Mechanism

Vacuum Circuit Breaker shall have electrically operated mechanism for spring charging. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty. The draw out carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is _On'. The circuit breaker cannot be switched _ON' when the carriage is in any position between test & service position. The front door of the panel cannot be opened when the breaker is in service position or in an intermediate position. The low voltage plug & socket cannot be disconnected in any position except test/isolated position. The door cannot be closed unless the LV plug has been fitted. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed. Individual explosion vents shall be provided for breaker, bus bar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel. Circuit Breaker & sheet metal enclosure shall be fully earthed. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the draw out carriage mechanism.

PROTECTION RELAYS

The Protective IDMT O/C, E/F relays should be of numerical type with the same Technical specification. The relay should have feature for storing fault data, should have site selectable CT secondary relay currents i.e -/5 Amps or -/1 Amps. Should have LED/LCD for each function element of a relay to enable to identify the type of fault condition.

All the switchgears shall be provided with microprocessor based numerical protective relays designed to disconnect faulty circuit with speed and discrimination and shall confirm to latest revision of relevant standards regarding accuracy and other feature. Composite relay unit having O/C, E/F, O/V, U/V etc. shall be preferred. The numerical relays shall be communicable type and shall communicate on IEC61850 protocol dual port. Use of communication protocol converter is not acceptable. Min 10 DI/DO has to be provided.

Every Panel Should have Arc Flash Protection in Cable breaker and Bus Bar Chamber.

Protection of Various type of feeders as follows:

Incomer:

1 No of SCADA Compatible Feeder Protection Relay 50/51(3 phase over current) , 50/51N (Earth over current) , 67P (3 phase directional over current), 67N (Earth fault directional over current) , 51V (Voltage controlled over current) , 37 (3 phase undercurrent) , 46 (Negative phase sequence over current) , 59N (Residual over voltage) , 32 (Directional Power protection (Under/Over active/reactive power)) , 81U/O (Under/over frequency) , 49 (Thermal overload), 79 (Auto reclose), 50BF (Circuit breaker failure detection) , Cold load pick up, Inrush blocking. Relay will be on IEC61850 Protocol

a) Master Trip Relay

1.2 Bus coupler:

a) Master Trip Relay
b) DC Supervision Relay

1.3 Outgoing Transformer Feeder

1 No of SCADA Compatible Feeder Protection Relay 50/51(3 phase over current) , 50/51N (Earth over current) , 67P (3 phase directional over current), 67N (Earth fault directional over current) , 51V (Voltage controlled over current) , 37 (3 phase undercurrent) , 46 (Negative phase sequence over current) , 59N (Residual over voltage) , 32 (Directional Power protection (Under/Over active/reactive power)) , 81U/O (Under/over frequency) , 49 (Thermal overload), 79 (Auto reclose), 50BF (Circuit breaker failure detection) , Cold load pick up, Inrush blocking. Relay will be on IEC61850 Protocol

Master Trip Relay

Transformer Fault Alarm/Trip Aux. Relay. For Transformer Feeder only

1.4 Outgoing Tie Feeder

1 No of SCADA Compatible Feeder Protection Relay 50/51(3 phase over current) , 50/51N (Earth over current) , 67P (3 phase directional over current), 67N (Earth fault directional over current) , 51V (Voltage controlled over current) , 37 (3 phase undercurrent) , 46 (Negative phase sequence over current) , 59N (Residual over voltage) , 32 (Directional Power protection (Under/Over active/reactive power)) , 81U/O (Under/over frequency) , 49 (Thermal overload), 79 (Auto reclose), 50BF (Circuit breaker failure detection) , Cold load pick up, Inrush blocking. Relay will be on IEC61850 Protocol

Master Trip Relay

Tests

Factory tests

The circuit breakers panel shall be subjected to routine tests at manufacturers works in accordance with the details specified in the relevant IS specifications.

The vendor shall submit the type test certificate for following along with the offer.

a. Temperature rise test.

b. Impulse & power frequency voltage test

c. Short time current test on circuit breaker.

Site test

Verification for completion of equipment, physical damage/ deformities.

1. Alignment of panel, interconnection of bus bars & tightness of bolts & connection etc.
2. Interconnection of panel earth bus bar with plant earthing grid.
3. Inter panel wiring between transport sections.
4. Cleanliness of insulators and general Cleanliness of panel to remove traces of dust, water etc.
5. Control wiring verification after interconnecting of panel.
6. Check for free movement of circuit breaker, lubrication of moving part & other Parts as per manufacturers manual.
7. Manual/Electrical operations of the breaker and Functional test as per drawings.
8. Meggar before the Hi Pot test.
9. Meggar after the Hi Pot test.
10. CT/PT ratio/polarity primary injection test.
11. Secondary injection test on relays to practical characteristics.
    These tests as per the clauses above will be witnessed by the IIT / WAPCOS at the works for which necessary information has to be given in advance**.**

C. ELECTRICAL PANELS

1 Particulars of the system

i) Operating voltage : 440V
ii) Frequency : 50 Hz
iii) System : 3 Ph. 4-wire
iv) Neutral : Solidly earthed Fabrication

The MV switch board shall be factory fabricated from 2mm Galvanized sheet steel, totally enclosed, dust tight, vermin proof, indoor free standing, floor mounting and fully compartmentalized cubicle construction.

The panel manufacturer shall have a pre-painting 9-tank facility for sheet cleaning and should have a CPRI approval for similar panel for 50KA fault level and IP 54 for all indoor panel and APFC Panel - IP42 protection & IP 65 protection class for outdoor panels.

All Indoor Panel shall be –IP-54 and Outdoor feeder Panel-IP-65 with canopy and APFC Panel - IP42 protection and the same shall be (TTTA) total type tested panels. The EPC contractor shall submit all type test reports of TTTA panels.

The OEM / Channel partner shall submit certification

IEC 61439 – 1&2 – Integrated test certificate Incomer rating wise
IEC 61441 – value shall not less than 50 KA for 0.5 sec for aluminium busbar
IEC 60068-3-3 - Seismic zone V, but the value shall be not less than 0.4 g
Impulse withstand Capability – not less than 12 KVfor ACB Incomer Panels and Impulse withstand Capability – **not less than 8 KV** for MCCB Incomer Panels
Form of Separation – Form 4B

All the outdoor panels shall be IP 65 weather protection and shall be CPRI approved.

The design and construction of switch-board shall generally conform to relevant IEC61439 – 1 & 2. The bus bar chamber shall be extensible on both sides. The cable alley shall be provided at the back-side. The dimension of the cubicles shall be as per designed quantity.

The successful tenderer shall take prior approval for the panel builder/fabricator along with G.A. drawing, wiring diagrams, single line diagram and all type test reports as per IEC 61439 – 1 & 2 of MV panel before start of fabrication of MV panel.

The L.V. Panel Boards shall be totally enclosed, dust and damp protecting construction, free standing, consisting of vertical sections, housing ACBs as specified, assembled on to common Bus bars. The equipment shall be designed, constructed and tested in accordance with the latest relevant Indian Standard Specifications. MV panel shall be of Form 4b type 5 class of separation. Panel shall be confirming to IEC61439 - 1 & 2 and according to the same all type test reports has to furnished. Panel shall be tested for Internal Arc performance as per IEC 61641. Panel shall be tested for Seismic

compliance for Zone 4 as per IEC standard. In the panel there shall be no live part accessible on opening of feeder / module door. Panel shall be rated for Impulse withstand capability equal to or greater than the switchgears inside the panel. panel shall be suitable for Top or bottom cable/bus bar entry.

The panel shall be front access freestanding suit the site and application conditions. A base channel of size 75mmx40mmx5mm thick shall be provided at the bottom. A minimum of 300mm blank space be provided between the base of the cabinet and cubical having switchgear. There shall be adequate space in front of the panel for working and for any withdrawal sections.

The boards shall be free standing or wall mounting, as required and suitable provision shall be made for the method of fixing.

The board complete with bus-bar and bus-bar supports shall be in conformity with IEC 61439 – 1 & 2 and shall be suitable for an interrupting capacity of 50 kA. The bus-bars shall be colour coded for phase identification. Vertical and horizontal bus-bar sections shall be provided as needed. All inter connection between main and sub bus-bars and outgoing switchgears shall be done with solid electrolytic grade Aluminium conductors of appropriate current rating. Main panel board shall be extensible type. All critical components i.e. load bearing bus bars, hinges, gaskets shall be supplied by OEM.

The earth bar shall be minimum 50x6 mm size running the full length of the switch board and bolted to the supporting frame so as to make good electrical contacts. Solid copper bonding as per code practice for earthing shall be connected between earth bar and each incoming and outgoing cable armour clamp, gland plate or earth tag washer.

Each section shall be provided with a cable alley for termination of outgoing cables.

Provision shall be provided in the compartment/cubical for facilitating control cabling between and within the compartments.

The spare ways if any, shall be provided blanking sheets supplied by the manufacturer.

Operating handle of the highest unit shall be at a height not more than 1.8 mtr. Overall height of the board shall not exceed 2.4 mtr.

Panel boards shall be finished with powder coat of approved shade. The cleaning and protection of the MS sheet work shall be done in 9 tank process before the final powder coat of application.

2 Busbars

2.1 Rating of busbars

i)	No. of busbars	: 3 phase and neutral
ii)	Insulating voltage	: 1.1KV
iii)	Normal current	: as per Design

2.2 Construction of busbars

The busbars shall be air insulated electrolytic grade aluminium conductor enclosed in a sheet steel chamber. Busbar arrangements shall comply with relevant IEC. Busbars connection shall be done with high tensile bolts. Busbar shall be sleeved with heat shrinkable sleevings of red, yellow and blue colours.

3 Painting

The panel shall be give cleaned by 9 tank process and shall be powder coated as per approved paint shade after applying anti corrosive paint.

4 Specification for ACB

i) The Air Circuit Breakers (ACB) shall comply with standards IS/IEC 60947-2 for circuit breaker and IEC 60947-3 for switch disconnector function.
ii) The thermal rating of ACBS shall be as per design.
iii) Rated symmetrical breaking capacity, Ics = Icu = Icw = 50 KA for 1 sec at 440 V AC, 50/60 Hz .

iv) Rated making capacity (peak) shall be minimum 105 KA.
v) Rated insulation voltage shall be 1000V AC, 50/60 Hz & impulse voltage of 12 KV.

vi) Rated operational voltage shall be 440 V AC, 50/60 Hz.
vii) Circuit breaker shall be capable of carrying the full load current defined for 50 degree Celsius without any derating**.**

viii) All ACB shall have common accessories throughout all the ratings.

4.1 Construction

The air circuit breakers shall be of air break, moulded case, horizontal draw-out type fully interlocked or fixed type and 4/3-pole version as per schedule of quantities/Bill of quantities (BOQ). ACB should have RoHS compliance. ACB frame size shall be as per OEM.

4.2 Operating mechanism

ii) The operating mechanism shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 70 milliseconds to ensure faster closing.
iii) Electrical charged spring.

4.3 Draw out mechanism with safety requirements

i) The with-draw able circuit breakers shall have the following three distinct and separate positions, which shall be indicated on the face of the panel

- ―Service‖ – Both main and auxiliary circuits are connected
- ―Test‖-All auxiliary circuits are connected & main circuits are disconnected
- ―Isolated‖ – Both main and auxiliary circuits are disconnected

ii) The automatic shutters should be integral part of breaker.

iii) Door interlock shall be provided as per standard

iv) Locking in isolated position

v) ACB shall be provided with ―Ready to close‖ indication.

vi) ACB should have terminal adaptors at both sides and flexibility in terminal orientation by 90 degree.

vii) ACB should be suitable for switch disconnector function (AC23)

viii) ACB should have continuously rated shunt trip coil & closing coil.

4.4 Mechanical indicators

i) ―ON‘ – Circuit breaker closed.

ii) ―OFF‘.- Circuit breaker open

iii) Spring charged – Ready-to-close

iv) Spring charged – Not ready-to-close

v) Spring discharged

vi) Circuit breaker in ―Service‖ position.

vii) Circuit breaker in ―Test‖ position.

viii) Circuit breaker in ―Isolated‖ position.

4.5 Characteristic of release

Microprocessor based release shall have following inbuilt protections:

i) Adjustable over load current (Ir) settings from 40% to 100 % of rating of ACB (In).

ii) Over load time setting from 0.5s, 1s, 2s, 4s….24s as field selectable curves.

iii) Short circuit setting from 1.5 to 10 times of Ir setting.

iv) Short circuit time delay adjustable from 0 to 400 msec.

v) Instantaneous protection with pick- up and an OFF position.

vi) Earth fault setting adjustable in absolute Ampere with settings from 0 to 400 ms.

vii) ACB should have I2T ON/OFF facility. Shall have Zone Selective Interlocking facility.

viii) ACB should have LED Indication for fault differentiation. release shall have self diagnostic feature.

ix) ACB should have fully rated Neutral with protection against O/L ,S/C with settings at 50%,100% and OFF.

x) ACB should be provided with inbuilt thermal memory before and after Tripping.

xi) ACB are provided with release having EMC compliance

xii) Release should have inbuilt LCD / LED display and current & power parameter available to show in the display.

xiii) ACBs are provided with DIAL type potentiometers or Navigation Keys for Release setting.

xiv) Release shall have trip history for at least 10 nos of fault (O/L, S/C & E/F) with date and time.

5 Specification for MCCBS:

All MCCBs / Outgoing's in MV/LT panel installed in ESS-3 and ESS-4 shall be supplied with motor mechanism and associated accessories as **required for remote / SCADA monitoring and control operation.**

5.1 General

i) The MCCBs shall comply with IS/IEC 60947 – 1 & 2.
ii) MCCBs shall be designed for both vertical and horizontal mounting, without any adverse effect on electrical performance and also for line load reversibility.
iii) The thermal rating of circuit breaker shall be as specified in BOQ.
iv) Rated symmetrical breaking capacity Ics = 100% Icu at 415 V, 50/60 Hz and shall be minimum 36kA/50kA as specified.
v) Rated insulation voltage shall be 690 V AC 50/60 Hz.
vi) Rated operational voltage shall be 415/690 V AC 50/60 Hz.

5.2 Construction

The power contacts shall be insulated in an enclosure made of a thermosetting / Engineering plastic material from other functions such as operating mechanism, case, trip unit and auxiliaries.

i) All poles shall operate simultaneously for circuit breaker opening, closing and tripping.
ii) The MCCB shall have current limiting feature to limit let through energy on the installation.
iii) MCCB shall be suitable for Positive Isolation complying with IEC 60947-2 & 7-27.
iv) MCCB shall offer class II front face as per IEC 60664
v) The trip unit shall be Thermal-magnetic type up to 250A and microprocessor based trip unit for over 250 A. Thermal magnetic release should provide adjustable settings for O/L (80 to 100%) and for Short circuit 6 to 10 times. Microprocessor based release should have inbuilt adjustable settings for O/l, S/c, Instantaneous & Ground Fault protections with adjustable time delays.
vi) All MCCBs shall be equipped with front operated rotary handles
vii) MCCB should have provision of inbuilt ground fault protection.
viii) MCCBs shall have spreader terminals to withstand higher thermodynamic stresses during short Ckt condition
ix) MCCB shall comply with RoHS norms.
x) MCCB shall have spreader termination option for cable connections to with stand higher thermodynamic stress.

5.3 Operation

i) Push to trip facility shall be provided on the panel door

ii) The MCCB should be provided spreader links and phase barriers.
iii) The accessories should be front fit table and shunt coils shall be continuously rated.

MOTOR PROTECTION CIRCUIT BREAKER (MPCB)

a) Motor circuit breakers shall conform to the general recommendations of standard IEC 60947 -1,2 and 4 (VDE 660, 0113 NF EN 60 947-1-2-4, BS 4752). The devices shall be in utilization category A, conforming to IEC 947-2 and AC3 conforming to IEC 60947-4.MPCB shall have a rated operational and insulation voltage of 690V AC (50 Hz) and MPCB shall be suitable for isolation conforming to standard IEC 60947-2 and shall have a rated impulse withstand voltage (Uimp) of 6 kV. The motor circuit breakers shall be designed to be mounted vertically or horizontally without de-rating.

b) Power supply shall be from the top or from the bottom. In order to ensure maximum safety, the contacts shall be isolated from other functions such as the operating mechanism, casing, releases, auxiliaries, etc, by high performance thermoplastic chambers. The operating mechanism of the motor circuit breakers must have snap action opening and closing with free tripping of the control devices. All the poles shall close, open, and trip simultaneously. The motor circuit breakers shall accept a padlocking device in the ―isolated‖ position.

c) The motor circuit breakers shall be equipped with a ―PUSH TO TRIP‖ device on the front enabling the correct operation of the mechanism and poles opening to be checked. The auxiliary contacts shall be front or side mounting, and both arrangements shall be possible. The front-mounting attachments shall not change the breaker surface area. Depending on its mounting direction the single pole contact block could be NO or NC. All the electrical auxiliaries and accessories shall be equipped with terminal blocks and shall be plug-in type. The motor circuit breakers shall have a combination with the downstream contactor enabling the provision of a perfectly coordinated motor-starter. This combination shall enable type 1 or type 2 co-ordination of the protective devices conforming to IEC 60947-4-1.

d) The motor circuit breakers, depending on the type, could be equipped with a door-mounted operator which shall allow the device setting. The motor circuit breakers shall be equipped with releases comprising a thermal element assuring overload protection and a magnetic element for short-circuit protection. In order to ensure safety and avoid unwanted tripping, the magnetic trip threshold (fixed) shall be factory set to an average value of 12 Ir.

All the elements of the motor circuit breakers shall be designated to enable operation at an ambient temperature of 60°C without de-rating. The thermal trips shall be adjustable on the front by a rotary selector. The adjustment of the protection shall be simultaneous for all poles. Phase unbalance and phase loss detection shall be available.

6. MINIATURE CIRCUIT BREAKER (MCB)

The miniature circuit breakers shall conform to IS 8828-1996. The miniature circuit breakers shall be single pole/triple pole or 4 pole as specified and shown in the drawing/BOQ. The breaking capacity of MCBs shall have minimum 10 kA. The tripping characteristics shall conform to classification C.

The MCB shall be of plug in type or din mounted type with individual locking off facility; automatic/manual trip reset facility and a common trip bar on TPMCBs.

MCBs shall be with Trip free mechanism and toggle with positive contact indication.

The MCB shall have self-wiring contacts with full size silver tungsten alloy contracts.

Indications ON/OFF shall be moulded into MCB.

Electrical endurance of the MCB upto 32A shall not be less than 20,000 operations and for higher ratings it shall not be less than 20,000 operations.

Power loss per pole shall be in accordance with IS and the same shall be furnished by the manufacturer.

MCB used for power circuits shall be with tripping characteristics of _C‘ curve whereas MCBs for control transformer circuits shall be with tripping characteristic of _D‘ curve.

7. INSTRUMENTATION

Multifunction meter (96 x 96 mm in size), Ammeter and Voltmeter shall be digital type, in square bezel, flush type cases, and suitable for panel board mounting. Meters shall conform to IS 6769 Part 1and shall have grade 'A' accuracy. Multifunction meter shall have four line LCD display, two digital outputs, RS 485 / Ethernet connectivity ports, 64/128 bit / sec sampling rate, 4nos. time in day metering, individual harmonic measurement harmonics. Digital ammeter and voltmeter shall have inbuilt selector switch. In the case of CT operated ammeters class of accuracy of CTs shall be 0.5 to 1 and protective class shall be 5P10.

CTs used in the work shall be resin cast bar primary or wound primary as the case may be and shall be in conformity with IS:2705- 1992 or IEC 185-1987. The short time rating of the CT shall be 50 KA for one second. The burden of the CT shall be suitable for the application.

Energy meters shall be two element switch board mounting type suitable for unbalanced loads. Meters shall incorporate as KW/KVA maximum demand meter. Meters shall conform to IS 11426.

8. THERMAL OVER LOAD RELAY

Thermal Overload Relay used in the circuit with contactor shall be in conformity with IS: 3842 part 2-1966 and it shall withstand insulation test to IS: 12083 part 2. The relay shall be provided with adjustable current settings and with a provision of sealing the same to make it tamper proof.

The relay shall have built in single phasing protection and over load protection as per IEC947- part 4.

The relay shall have in built NO & NC contact.

The thermal over load relay shall be suitable for Copper / Aluminium termination, with a maximum permissible temperature rise of 65°C, at the terminals, with maximum ambient temperature of 45°C.

INDICATION LAMPS

The indication lamps used in the work shall be LED Type with protection against electromagnetic interference and over voltage. The lamps shall be suitable for operation on 240 Volts. Ingress protection

class of the lamp unit shall be IP: 65. The indication lamp unit shall be in conformity with IEC: 947 part 5 Section 1. The dia of the lamp shall be not more than 22 mm.

9. PUSH BUTTONS

The push buttons shall be in conformity with IEC: 947 part- 5- Section 1 suitable for manual operation. The ingress protection class of the unit shall be IP 65. The push button units shall be suitable for operation on 240Volts and the contacts shall be rated for 3 - 5 amps on 240 volts. The colour of push buttons shall be as follows:

Start PB - Green

Stop PB - Red

Test PB - Black

Reset PB - Yellow

The Diameter of the push button shall not be more than 22mm.

11. BATTERY CHARGER

11.1 Output Voltage

Float mode i) Auto: 32.25 volts (2.15 v/cell)

ii) Manual: 30 volts – 33 volts.

Boost mode: Upto 2.75 volts per cell.

11.2 Output Current

Current: 15 Amps DC (Maximum)

i) Float mode: 30 Amps DC continuous plus trickle charging current of battery bank.

ii) Boost mode

Load Terminal: 12 Amps.

Battery terminals: 14.4 Amps.

11.3 Output ripple

Shall be around 5% R.M.S. measured at 32.25 VDC on full load.

11.4 Mode of operation

Shall be both auto & manual

11.5 Termination of charging

Shall be auto & manual.

11.6 Control configuration

1 phase full wave silicon diode bridge and controlled by high frequency off line switch mode controller with load limiting feature.

11.7 Protections

The following may be incorporated in the system: -

Input MCB

Output fuses

Rectifier MCB

Load limit

DC overload

Connected battery bank

Lead acid tubular battery of 120 AH capacity complete with IR/IT connector, stand, stillage, electrolyte (10% extra) and standard accessories and consisting of 15 Nos. cells of 2 volt.

11.8 Charging system of batteries

The charger can be operated either in float mode to meet DC loads plus trickle charging of battery or in boost mode to boost charge the battery.

12 HYBRID POWER FACTOR CORRECTION PANEL

SCOPE:

Design, assembly / fabrication, installation, testing and commissioning of 3 phase, 440 V, 50 Hz TP&N PFC system (Auto + manual option) with Heavy Duty type capacitors, microprocessor based controller and Copper wound detuned filter. The unit shall improve the monthly average power factor and mitigate harmonic distortion on the LV bus. Hybrid Harmonic filter shall comprise two separate panels for harmonic correction and power factor improvement. Harmonic compensation shall be done through IGBT based Active Harmonic filter and Power factor correction shall be done through Automatic Power Factor Correction panels with passive detuned filters.

Detailed specifications of Active Harmonic Filter and detuned APFC panel shall separate panels as below:

SECTION 1 - ACTIVE HARMONIC FILTER

Active Harmonic Filter to mitigate low voltage system harmonics

The Active Harmonic Filter (Type AHF) is intended to remove harmonic distortion from the phase conductors in a 3-phase electrical system resulting in reduced phase current, reduced current distortion and reduced upstream electrical system harmonic voltage distortion.

Principle of operation

AHF should measure level of harmonics in supply line and eliminate it by generating the counter harmonics. It should employ a DSP which determines the harmonic current amplitude to be injected in the opposite phase angle of each harmonic order. -

The active filter shall not only provide harmonic mitigation, but also, power factor correction and load balancing. Harmonic correction, PF correction and Unbalance correction should be able to set with priority and filter should work to employ the priority as per the user settings.

1. The active harmonic filter shall mitigate harmonics from the 2^{nd} harmonic up to the 50^{th} harmonic and limit harmonic distortion at their point of connection to within the harmonic limits specified herein. The active filter shall be connected in parallel (shunt) to the load.
2. The active filter shall be suitable for connection at an electrical distribution panel, transformer secondary or at an individual load.
3. The active filter shall be suitable for connection to a distorted voltage source and its operation shall not be adversely affected by pre-existing voltage distortion.
4. The active filter shall be suitable for operation on an electrical system having a generator as its power source.
5. AHF should have high attenuation up to 96% of individual harmonics.
6. AHF shall allow user to select any 20 order of harmonics out off 2^{nd} to 49^{th} harmonics order.
7. It should be possible to use filter for single harmonic elimination
8. PF compensation should be leading as well as lagging.

Following features are essential requirements for the point of reliability

1. For capacities from 100 Amp onwards the filter design should adapt modular construction
2. The display should be Touch screen SVGA display with true RMS readout & FFT analysis. The wave form should be visible on the display.
3. High grade cooling fans shall be used.
4. In case of future repair requirements, the same shall be done through card level replacement and not the whole module

Electrical Ratings:

1. System Voltage: 400V AC ± 10%, 3ph 4 Wire/3 wire
2. Line voltage tolerance: ±10%
3. System Frequency: 50 / 60 Hz
4. Frequency tolerance: 50 Hz ± 5%
5. Harmonic Cancellation Current: [30, 60, 100, 150, 200, 300 amps]. Multiple filter units for parallel connection may be used to achieve total current requirements for combined power factor correction and harmonic mitigation.

6. Possible units of same ratings connected in parallel: Up to four (4).
7. Current transformers shall be with Class 1 or better with 15VA rating.
8. Flexibility to select CT ratio shall be also be available.
9. Remote indication contacts: 1No. potential free contact.
10. Surge withstand capability per ANSI/IEEE STD C62.41-1991.
11. Should comply with IEC/IEEE 62040 – 2 category C3

2 – Basic Product Requirements

The active harmonic filter shall meet the following basic requirements:

1. Active filters shall include input surge suppression.
2. Active filters shall include forced air cooling system.
3. Active filter shall be able to connect in both open loop and closed loop configuration
4. Active filter should have a HMI touch screen display having the functionality of a power analyzer and should display Load side, supply side and filter parameters as mentioned below
   (1) Voltage
   (2) Current
   (3) Power factor
   (4) Filter Temperature
   (5) Voltage and current waveforms
   (6) Voltage and current Harmonic spectrum
   (7) Active, Reactive & Apparent Power
   (8) Alarm indications & log details
5. Product warranty period shall be one (1) year.
6. Active filter shall be isolated from the power supply when powered –off‖.
7. IGBT modules shall be self-protected for maximum reliability.
8. Each power module shall have its own independent set of fuses.
9. The response time shall be atleast 1 ms and the correction time shall be 20 to 40 ms
10. AHF shall have inbuilt logic to avoid over-loading without tripping.

Construction:

1. Constructed on metal panel with minimum IP 20.
2. Filter shall be suitable for operation within an ambient temperature between 0^{o}C and 40^{o}C.
3. Shall be able to work with higher temperature with automatic de-rating (80% capacity at 50 ^{o}C).
4. Storage temperature shall be from 0^{o}C to 70^{o}C.
5. Active filters shall be suitable for operation in relative humidity up to 95% non-condensing.

SECTION 2 - APFC Panels with passive filters:

Automatic Power Factor Correction panel shall be totally enclosed, metal clad, sheet steel fabricated, fixed feeder type, dust and vermin-proof, free standing, floor mounting type. The enclosure shall be pre-treated as per 11 tanks process and finished with powder coating of shade RAL 7032. The panel shall be factory build to ensure

- Proper thermal design, by providing louvers and fans in appropriate location,
- Accurate selection of switchgear, capacitors-reactors and others in the panel.
- Safety during operation, inspection and maintenance

BASIC DESIGN SPECIFICATIONS

An automatic power factor correction relay, microprocessor based, with arrangement for sensing the power factor of the inductive load (maximum 14 channels) and giving signal to the feeders of power capacitors as per the setting of P.F. and electronic circuit to ensure that once a capacitor gets cut off, it is not put on at least for a minute. The relay should automatically manage capacitor banks according to the reactive power required to correct the power factor of the load to the power factor set on the relay. The capacitors must be turned ―on‖ and ―off‖ to correct the power factor of the load to the power factor set on the relay. The relay should have automatic and manual mode of operation with an LED to indicate the operating mode. The auto / manual function makes it possible to turn the capacitor banks ―on‖ and ―off‖ manually regardless of the line value measured.

Rated System Voltage	440 V / 415 V / 380 V / 400 V
Rated Frequency	50 Hz
Short Circuit Rating	> 36 kA
Altitude	1000 m
Duty	Continuous
Ambient temperature	-5° C to 45° C
Power Supply	Three phase, four line
Relay current input signal	-- / 5A, from CT on line
Enclosures	The load bearing structure is made of 2 mm sheet steel
	The front door and partition are made of 1.6 mm sheet steel
	The internal switchgear components are accessible on opening the front door and Capacitors & Reactors shall be accessed through back door
	AFPC panel and AHF panel shall be independent cubical panel and shall be IP-42 protection
Installation	Indoor, wall mounted (up to 100 kVAr), floor mounted (100 kVAr and above) in a well-ventilated, non-dusty environment, cable entry from bottom

Control	Auto + Manual
Incomer	3 Pole MCCBs up to 630 A (400 kVAr) , 3 Pole ACBs above 630 A(above 400kVAr)

Other important features required are:

- Various system parameter display on APFC Relay
- Fully automatic / manual setup and operation
- Minimal joining in all the connections to ensure better reliability and lower losses.
- Use of special connecting cables suitable for high temperature withstands.

Flush mounted meter to indicate line voltage and current.

CAPACITOR BANK:

Capacitor voltage shall be minimum 525 V when used with 14% reactors. Capacitors shall be MPP Heavy Duty type/ Gas filled type. The capacitor element used in unit shall have metallized polypropylene film (MPP) having low loss dielectric and impregnated with such impregnate, which shall have high dielectric constant, low viscosity and high chemical stability. The impregnate should be resin filled. The capacitor unit shall have over pressure dis-connector protection. Discharge resistance shall reduce the residual voltage to less than 50 volts within one minute.

General specifications:

- 3 phase, delta connected, 50 Hz
- Overvoltage +10% (for 8h / 24h), + 15% (for 30m / 24h), + 20% (5m/24h), +30% (1m/24h)
- Overcurrent: 1.8 x In
- Peak Inrush current withstand: 250 x In
- Total watt-losses: < 0.45 W / kVAr
- Temperature category: -25° C to 55° C
- 6000 switching operations per year
- IEC 60831

DETUNED FILTER

- Detuned harmonic filter reactors shall be used along with power capacitors to mitigate harmonics amplification and to avoid electrical resonance in LV electrical networks.
- The complete unit shall be impregnated under vacuum and over-pressure in impregnation resin. The insulation shall be Class H.
- The reactors shall be made of high grade aluminum windings, having a three phase, iron core construction suitable for indoor use. The reactor shall be air cooled and the layout shall be in accordance with IEC 60289 / IS 5553.
- The permitted tolerance of inductance is ± 3% of rated inductance value.

- Reactor tuning factor shall be 7 % (189 Hz) and the current rating of the reactor shall include the effects of harmonics and other possible over-currents
- The limit of linearity of inductance of the filter reactor is: $1.8*I_n$ with $L=0.95*L_N$.
- The reactor shall be fitted with a temperature sensitive micro-switch in the center coil (normally open) for connection to trip circuits in case of high operating temperatures.
- Power loss in each reactor shall be less than 5 W/kVAr
- Each reactor shall have routine test certificate for the above tests.

Contactor

- All contactors shall be AC6B duty 3 pole air-break, magnetic, capacitor duty type. The rating of contactor shall be suitably assigned. The contactors shall be so chosen as to withstand inrush current due to parallel switching. Contactor should be with damping resistors to limit capacitor charging current
- The individual capacitor bank/step shall be switched automatically / manually with selector switch as required using magnetic contactors suitable for switching capacitive currents. The contactor coil voltage shall be as specified.
- The minimum life expectancy of the contactor shall be one million switching operations
- Contactor should be with surge suppressor
- Operation voltage up to 690V
- Insulation voltage 1 kV
- Rated impulse withstand up to 8 kV

APFC Controller

The APFC controller should be microprocessor based and should correct power factor with the help of contactors by switching the required no. capacitor banks.
The controller should offer power factor correction without any need for manual intervention. The controllers should decide optimum configuration of capacitor banks in order to achieve desired power factor by taking into consideration the kVAr of each step, no of operations, total usage time, re-connection time of each step etc. Besides manual switching of capacitors should also be possible directly through the controller, The APFC controller should have the following basic features.

- Backlit LCD display with multiple parameters displayed at the same time
- Auto step programmable
- Capable of measuring VTHD and ITHD values at least up to 15^{th} order
- Automatic CT reversal sensing and correction
- Should be 1A / 5A CT selectable.
- Sensing shall be done at LT as well as HT side of the transformer
- Display of average weekly power factor
- Keypad lock feature to prevent operation by unauthorized persons
- Alarms for under/over compensation, high VTHD/ITHD, over temperature, capacitor failure, capacitor over-current, over/under voltage
- Individual capacitor‘s ON/OFF status and capacitor failure indication

- Temperature sensing feature with alarm in case of panel over heating
- Should have RS485 communication protocol.

ENCLOSURE

The panel shall be indoor type, free standing, and floor mounting with IP 54 degree of protection. It shall be completely made of CRCA sheet steel. The enclosure shall have sturdy support structure with angle supports as necessary and shall be finished with powder coating in the approved colour shade/s to match the colour of the other panels. The thickness of powder coating should be minimum 60-80 microns.

Suitable provisions shall be made in the panel for proper heat dissipation. Air aspiration louvers for heat dissipation shall be provided as a necessary.

The front portion shall house the switchgear and the rear portion shall house capacitors and series reactors. The enclosure is to be suitably sized to accommodate all the components, providing necessary air clearance between live and non-live parts, providing necessary working clearance.

There should be compliance for the following:

IS16636/ IEC61921 : Power capacitors–Low voltage power factor correction banks.

IEC 61439-1 : Low-Voltage Switchgear and Control gear Assemblies - Part 1: Type-Tested and Partially Type-Tested Assemblies.

IEC 62208 : Empty enclosures for low-voltage switchgear and control gear assemblies – General requirements
IEC 62262 : Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
IEC 61326-1 : Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements.
IEC 61000-6-4 : Electromagnetic compatibility – Generic standards – Emission standard for industrial environments.

SWITCHGEAR & PROTECTION

Incomer switchgear shall be TP&N breaker appropriate rating. Suitable contactor for each step shall be used and must be capable of capacitor switching duty at each step for short circuit protection.

Bus bars shall be suitably colour coded and must be mounted on appropriate insulator supports.

Power cables used shall have superior mechanical, electrical and thermal properties, and shall have the capability to continuously operate at very high temperatures up to 125 deg.C.

Internal wiring between main bus-bars, breaker, contactor and capacitors shall be made with 1100 V grade, PVC insulated, copper conductor cable of appropriate size, by using suitable copper crimping terminal ends etc.

Suitable bus links for input supply cable termination shall be provided.

CONTROL CIRCUIT & GENERAL PROTECTION

The control circuit shall be duly protected by using suitable rating MCB.

An emergency stop push button shall be provided to trip the entire system (22.5 mm dia, mushroom type, press to stop and turn to reset).

Wiring of the control circuit shall be done by using 1.5 sq.mm, 1100 V grade, PVC insulated, multi-stranded copper control wire.

Inspection terminal strip, number ferruling, labelling etc. shall be provided.

440 V caution board on the panel shall be provided.

vi. Earthing

Two separate earthing terminals shall be provided for earth connection for each bank. All components and frame shall be properly earthed.

Control Panel

The panel shall be provided with necessary MCCB's, contactors, automatic required steps relays with associated CT's and power factor meter, indicating lamps, push buttons etc. Capacitors shall also be housed in the same panel. The panel shall be free standing type, dead front cubicle and shall be constructed from 2 mm thick sheet steel. The degree of protection shall be IP 54. This panel shall be integrated with the main L.T. panel unless specified otherwise.

Painting

As the capacitor panel is integrated with Main LT panel, it shall be painted as per specification in relevant Clause above.

D. CABLES

1 GENERAL

Cables shall be supplied, laid tested and commissioned in accordance with drawing specifications, relevant Indian Standards specification, Indian Electricity Act and manufacturers instructions. The cable shall be delivered at site in original drums with manufacturers name clearly written on the drums.

1.1. MATERIAL

CABLES : All Cables shall be XLPE insulated aluminium conductor armoured cables conforming to IS: 1554 (part I&II)-1976 & IS : 694-1977) with latest amendments. Cables shall be suitable for underground use and laid in trenches, ducts, cable trays, under roads and paved areas. Cables shall be termite resistant and shall be of approved make.

HT Cable shall be 11KV(UE), XLPE armoured, unearthed, shielded & PVC sheathed cable with aluminium conductors.

Size of HT cable shall be 3C X 400 Sqmm.

1.2. JOINTS IN CABLES

The contractor shall take care to see that all the cables are apportioned to various locations in such a manner as to ensure no straight joints in the cable run. If the straight joint in cable is unavoidable due to any specified reasons, prior permission in writing shall be obtained from the Engineer-in- Charge before the use of such straight joints in cable.

1.3. JOINTING BOXES FOR CABLES

Cable jointing boxes shall be of appropriate size, suitable for PVC insulated cables of particular voltage ratings, and shall be manufactured by approved manufacturers.

1.4. JOINTING OF CABLES

All cable joints shall be made in suitable approved cable joint boxes. Jointing of cables in the joint boxes and the filling in of compound shall be done in accordance with the best practice in trade, in accordance with manufacturer‘s instructions and in an approved manner. All straight Joints shall be done in epoxy mould boxes with TROPOLIC/ M-Seal resin or approved equal. All terminal ends of conductors shall be heavily soldered upto at least 50mm length.

All cables shall be jointed colour to colour and tested for insulation resistance and continuity before jointing commences. The seals of cables must not be removed until preparations for jointing are completed. Joints shall be finished on the same day as commenced and sufficient protection from the weather shall be arranged.

1.5. FILLING OF EPOXY COMPOUND

Equal quantities of resin and hardener shall be taken and mixed thoroughly by hand until the mixture is free from white patches and has uniform colour. No water, oil or any other liquid shall be added to the mixture to make it soft as this will affect the properties of the compound. The mixture shall be used within 30-40 minutes of mixing. The surface on which epoxy compound is to be used shall be free from dust, rust, oil, grease and shall be dry. No disturbance or movement of joint shall be made till the epoxy compound has completely hardened. A smooth surface can be made by rubbing a damp cloth smoothly on the compound before it sets. The joints shall be painted after it has completely hardened.

1.6. CABLES TERMINATION

Cable termination shall be done in terminal cable box using cable glands and the cable ends sealed with sealing compound. The cable boxes of transformers shall be filled with bituminous compound manufactured by Messrs. Siemens India Ltd. or INCAB.

1.7. BONDING OF CABLES

Where a cable enters any piece of apparatus, it shall be connected to the casing by means of an approved type of armoured clamps and gland. The clamps must grip the armouring firmly to the gland or casing, so that in the event of ground movement no undue stress is passed on to the cable conductors. The glands shall be either to the lead sheath by means of ‗Plumbing Joint' as on a cone of approved materials, capable of being compressed into lead sheath. The gland or cone shall be capable of effecting a good electrical bond between both the armouring and lead of the cable and the casing.

1.8. LAYING OF CABLES

Cables shall be laid by skilled and experienced workmen using adequate rollers to minimise stretching of the cable. The cable drums shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cable to avoid forming kinks. The drums shall be unrolled and cables run over wooden rollers in trenches at intervals not exceeding 2 meters. At all changes in direction in horizontal and vertical planes, the cable shall be bent smooth with a radius of bend not less than **12 times** the diameter of cable. Minimum 3 M long loop shall be provided at both sides of every straight joint and 5 Meters at each end of the cable. Distinguishing marks shall be made on the cable ends for identification. Insulation tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identification. Aluminium Labels etched with the size of cable shall be provided around the two ends of each cable.

1.9. CABLES INSIDE BUILDING

Cables inside buildings shall be laid on through trays. Where cables run in ducts inside the buildings the cables shall be adequately clamped to angle iron brackets, secured to the wall, as directed and approved by the Engineer-in- Charge. Where cables are suspended from ceilings they shall be carried over troughs or trays as directed and approved by the Architect. The supports shall be placed not more than 1.0 meter apart. Cables running along walls shall be supported and clamped to saddles, or hanger rigidly anchored at close intervals. Clear space between parallel cables shall be equal to the diameter of the cable but not less than 50mm. The contractor shall ensure that hangers, brackets and other supporting arrangements for cables are placed in proper position at the time of building the walls, concreting slabs, etc. cutting holes or opening in concrete may be carried out only with prior permission of the WAPCOS.

1.10. TESTING OF CABLES

Prior to burying of the cables, following tests shall be carried out Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work and jointing the following tests shall be conducted in the presence of the Engineer-in- Charge.

a. Insulation Resistance test (Sectional and Overall)

b. Continuity Resistance Test.

c. Sheath continuity Test.

d. Earth Test.

e. Physical Dimensions Test.

All tests shall be carried out in accordance with relevant Indian Standard Codes of practice and Indian Electricity Rules. The contractor shall provide necessary instruments, equipment & labour for conducting the above test & shall bear all expenses in connection with such tests. All tests shall be carried out in the presence of the Architect.

E. EARTHING

1 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits, trunking, cable sheaths, switchgear, outlet boxes, distribution boards, light fittings, fans and all other parts made of metal or conductive material shall be bonded together and connected by means of specified earthing system.

All earthing will be in conformity with the relevant provision of Rules 33 and 61 of the Indian Electricity Rules 1956 and Indian Standard Specifications IS:3043-1987 with latest amendments.

1.2. EARTHING CONDUCTORS

All earthing conductors shall be of high conductivity electrolytic copper of 99 % purity and shall be protected against mechanical injury or corrosion.

1.3. SIZING OF EARTHING CONDUCTORS

The cross sectional area of copper earthing conductor shall be same as the active conductor for sizes of active copper conductor upto 4.0 sqmm and shall be half the size for 16 sq mm active copper conductor and above. All fixtures, fans, outlet boxes and junction boxes shall be earthed with 2 mm dia bare copper wire. All power sockets and single phase A/C units shall be earthed with 2 mm dia bare copper wires. All Three phase Final Distribution Boards shall be earthed with 2 nos 4 mm/6 mm dia bare copper conductor wires. The sizes of the earth continuity conductors should not be less than half of the largest current carrying conductors.

The Sub-Distribution Board shall be earthed to 2 nos 600mm x 600mm x 3mm copper plate earthing stations through 25m x 3 mm copper strips.

1.4. CONNECTION OF EARTHING CONDUCTORS

Main earthing conductors shall be taken from the earth connections at the main switchboards to an earth electrode with which the connection is to be made. Sub main earthing conductors shall run from the main switchboard to the sub-distribution boards. Final distribution boards earthing conductors shall run from sub-distribution boards.

1.5. PROHIBITED CONNECTIONS

Neutral conductor, sprinkler pipes, or pipes conveying gas, water, or inflammable liquid, structural steel work, metallic enclosures or cables and conductors, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an

earthing system. The electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switchboard and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate fuse or circuit breakers and shall not exceed 1 ohm.

1.6. PROTECTION FROM CORROSION

Connections between copper and galvanized equipment shall be made on vertical face and protected with paint and grease. Galvanized fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamps shall be used for fixing earth conductors. When there is evidence that the soil is aggressive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

1.7. EARTH CONNECTION

All metal clad switches and other equipment carrying single phase current, shall be connected to earth by a single connection. All metal clad switches carrying medium voltage and high voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI Pipe of adequate size.

Earthing conductors outside the building shall be laid 600mm below the finished ground level. The over lapping in copper strips of at joints where required, shall be minimum 75mm. The joints shall be riveted with copper rivets and greased in approved manner. Sweated lugs of adequate capacity and size shall be used for all termination of wires above 1 Sqmm size and bare copper wire above 2.0mm dia. Lugs shall be bolted to the equipment body after the metal body is cleaned of paint and other oily substance and properly tinned. The earth wires entering the Final Distribution Boards shall be terminated with copper sockets crimped to its ends and tightened to the terminal with the help of flat end brass screws.

1.8. EARTH RESISTANCE

The earth resistivity of the soil where the earthing stations are located shall be submitted to the Engineer-in- Charge before the earthing work starts and get the approval of the Engineer-in-Charge. If the earth resistance is too high and multiple electrode earthing does/not give adequate low resistance to earth, than the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions as directed by the Engineer-in- Charge.

1.9. RESISTANCE TO EARTH

The resistance of each earth system shall not exceed 1.0 ohm in the case of MV system and 0.5mm ohm in the case of H.V. system.

F <u>TESTING</u>

1.1. GENERAL

On completion of the work the entire installation shall be subject to following tests:

a) Wiring Continuity Test

b) Insulation Resistance Test

c) Earth Continuity Test

d) Earth Resistivity Test

Besides above, any other test specified by the local Authority shall also be carried out.

Tested & Calibrated instruments for testing, labour, materials and incidentals necessary to conduct the above tests shall be provided by the Contractor at his own cost.

1.2. TESTING OF WIRING

All wiring systems shall be tested for continuity of circuits, short circuits and earthing after wiring is complete and before energizing. The Test Certificates for the complete wiring shall be submitted in the Format and the Total Electrical Installation shall be got approved by the Electrical Inspector.

1.3. INSULATION RESISTANCE TEST

The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof with all fuses in place and all switches closed (except in concentric wiring) all lamps in position of both poles of the installation, otherwise electrically connected together, a direct current pressure of not less than twice the working pressure (provided that it does not exceed 660 volts for medium voltage circuits) be applied.

Where the supply is derived from A.C. three phase system, the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained between the phase conductor and the neutral.

The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuit provided that the whole installation shall not be required to have an insulation resistance greater than one mega ohm. The insulation resistance shall not be measured between all conductors connected to one phase conductor of the supply and all the conductors connected to the middle wire or to the neutral or to the other phase conductors of the supply. Such a test shall be carried out after removing all metallic connections between the two poles of the installation and in these circumstances the insulation resistance between conductors of installation shall not be less than that specified above.

The insulation resistance between the case of frame work of housing and power appliances, and all live parts of each appliance shall not be less than that specified in the relevant Indian Standard Specifications or where there is no such specification shall not be less than half a mega ohm.

1.4. TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES

In a two wire installation a test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor throughout, and such conductor shall be labelled or marked for connection to an outer or phase conductor or to the non-earthed conductor of the supply. In the three or four wire installation a test shall be made to verify that every non-linked single Pole switch is fitted in a conductor to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of the Engineer-in- Charge as well as the local authorities.

1.5. EARTH RESISTIVITY TEST

Earth resistivity test shall be carried out in accordance with Indian Standard code of practice for earthing IS:3043:1987. All tests shall be carried out in the presence of the Engineer-in- Charge.

1.6 TEST CERTIFICATES

The Electrical Installation shall be tested as per relevant Indian Standards and Test Certificate to this effect shall be submitted to the Owner. The Contractor has to get the Total Electrical Installation approved by the Electrical Inspector and the permission to energise the same shall be submitted to the Owner.

G. HDPE PIPES

Specifications of HDPE pipe Electrical Cables should be pulled though Permanently Lubricated HDPE Duct of suitable size conforming to IS 14930.

HDPE Duct Accessories

a) Push fit Coupler Push Fit couplers shall be used for coupling HDPE ducts/coils.

b) End Cap End Cap shall be used for sealing the ends of the empty ducts, prior to installation of the Cable and shall be fitted immediately after laying the duct to prevent the entry of any dirt, water, moisture, insects/rodents etc. The ends of the HDPE ducts/coils laid in the manholes should be closed with End Caps.

c) Cable sealing Plug This shall be used to seal the end of the ducts perfectly, after the cable is pulled in the duct. For pulling the cable through the ducts, it is necessary to provide man holes at that location and also at bends and corners wherever required. The ends of the HDPE ducts/coils are closed with Cable sealing Plugs.

H. SANDWITCH INSULATED BUS TRUNKING AND RISINGMAINS

SUPPLY VOLTAGE

For 3 phase, 4 wire, 50 cycles AC supply, operation voltage 415/440 volts.

STANDARD FORCOMPLIANCE

IS 8623: 1993 / I & II and IEC 61439 -1 &6.

CONSTRUCTION

The enclosure will be made from 16 SWG GI/ CRCA sheet steel powder coated to

shadeRAL7032(or such other shade).Bus bars would be in _Sandwitch' construction and the conductors will be individually insulated as per CPWD GENERAL SPECIFICATIONS FOR ELECTRICAL WORKS PART-IV SUB STATIONS 2013.No drilling of bus bars is permitted. Bus bar shall be of Copper conductor of 99.9% purity and ETP grade with radicalised edges. Length of section will be limited to max. 3 Mtrs. Bus bars of one section will be connected to bus bars of adjacent section by uniblock joint system removable as separate sub-assembly, so that it can be inserted or removed without disturbing the adjacent sections.

Installation*: Normally manufacturer's recommendations should be followed.*

For installation as Rising Mains / Vertical installation, at each floor, a set consisting of twoSpringHangerswillbeprovidedforfixingitonchannelsgroutedinwall.Atthestart of run, Hangers without springs may be used for rigid support. In addition Horizontal supports will be provided (2 Nos. per floor) to hold bus bars in position. On RisingMains,onfrontfaceofthebusbartrunkingtapoffpointswillbeprovidedforinserting plug in boxes. Number of tap off points at each floor will be as per requirement given in BOQ but minimum distance between tap off points may be kept around 500 mm. Each Tap off opening will be closed by insulated shutters forming part of BBT, when not occupied by Plug in Boxes. Neutral cross section will be same as phase cross section.

Enclosure will be tested for protection degree IP – 54 for indoor & IP 65 For outdoor.
Necessary Vertical / Horizontal bends / Tees will be provided as required by layout.
Bus bars trunking will be rigidly fixed to the side walls or suspended from ceiling by supports as per requirement detailed in the layout.

Attheterminationeitheronthetransformersideorongeneratorendoronswitchgear panel, bus duct will be provided with flange ends, adopter box and copper flexible (preferably multi speed types)to connect busbars of busduct to busbars of switchgear panel or transformer terminals or generator terminals.

All the components like Busbar ducting, Bends, hanger ends, Adopter Boxes etc. will be made from CRCA or GI sheets. Two earth strips of copper or aluminum of size as mentioned in IEC 60439, dependent on short circuit withstand capacity required will be provided throughout the length.

Expansion units are to be installed after every uninterrupted run of 50 Mtrs. for composite expansion of complete Bus trunking run.

TECHNICAL PARAMETERS FORCOMPLIANCE

1. Bus trunking will be designed to withstand short circuit current for one second.
2. Bus bar system should be designed for an ambient temperature and temperature rise restriction as per IEC 61439 for Sandwich bus bar. Temperature rise of the enclosure 40 deg. C maximum. Temperature rise at terminals 70 deg. C max.
3. Maximum operating voltage = 1000 Volts. (600Volts).
4. Insulation voltage = 1000 Volts.

5. Bus trunking will be suitably chosen to give permissible voltage drop.

6. Rated impulse withstand voltage 12 KV at 1000 V (600Volts).

7. The bus trunking shall be designed and tested for seismic zone 5.

PLUG IN BOXES

Plug in Boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and withdrawal. Plug in Box will be made from 1.6 mm CRCA sheet steel powdercoatedorGI.InsidethepluginBoxesMCCBorSFUwithfuseswillbelocated as per requirements. The operation handle will be interlocked with plug in Box cover so that MCCB can be operated only with suitable cover in closed position. If required the plug in Box will be interlocked with Bus bar trunking so that it cannot be inserted orremovedwiththepluginBoxlidopened.MCCB/SFUwillbeof4poletypeunless otherwise specified in BOQ. Short circuit breaking capacity of MCCB in PIB should preferably be same as short circuit withstand for one second of Bus BarTrunking.

LIST OF TEST TO BE CARRIEDOUT

Type Tests : Copies of the following certificates should be submitted.

1. Verification of Temperature Rise limits.

2. Verification of dielectric properties.

3. Verification of short circuit strength.

4. Verification of degree of protection.

ROUTINE TESTS

1. Verification of insulation resistance.

2. Inspection of assembly, interlocks, locks etc.

3. Check on wiring if provided.

4. Dielectric test.

I) Sub Distribution Panel

General

Sub Distribution Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, cubicle type for use on 415 volts, 3 phase, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

Standards

The equipment shall be designed to conform to the requirements of:

IS 8623 – Factory Built Assemblies of switchgear and control gear.

IS 4237 – General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

IS 2147 – Degrees of protection provided by enclosures for low voltage switchgear and control gear.

IS 375 – Marking and arrangement of bus bars.

Individual equipment housed in the sub distribution boards shall conform to the following IS specifications:

a)	Moulded Case Circuit Breakers	-	IS: 13947-2/IEC 947-2
b)	Miniature Circuit Breaker	-	IEC - 60898
c)	Contractors	-	IEC – 947-4-1, IS:13947-4-1
d)	Current Transformers	-	IS: 2705
e)	Indicating Instruments (Analogue)	-	IS: 1248,
f)	Indicating Instruments (Digital)	-	IS: 13875
g)	Integrating Instruments (Analogue)	-	IS: 722, IS: 13779-1999
h)	Integrating Instruments (Digital)	-	IS: 13779- 1999, IS:14697
i)	HRC fuse links	-	IS: 13703 / IEC 269

Submittals

Shop Drawings And Technical Data

The tenderer shall furnish relevant technical data of switchgears and associated equipment along with the offer.

The Contractor shall furnish relevant descriptive and illustrative literature on switchgears and associated equipment and the following for approval before manufacture of the panel.

a) Complete assembly drawings of the panel showing plan, elevation and typical section views and locations of cable boxes, bus bar chamber, metering compartment and terminal blocks for external wiring connections.

b) Typical and recommended schematic diagrams and control wiring.

c) Foundation plan showing location of foundation channels, anchor bolts and anchors, floor plans and openings for cables etc.

d) All drawings and data shall be in English.

Constructions

Sub Distribution boards shall be metal enclosed, indoor, floor mounted free standing and/or wall mounted type made up of the required vertical section, which when coupled together shall form continuous dead front. Sub distribution boards shall be dust and damp protected, the degree of protection being no less than IP: 54 to IS:2147. Sub distribution boards shall be fabricated with a framed structure with rolled/folded sheet steel channel section of Sheet steel shroud and partitions shall be of minimum 2mm thickness, doors and covers shall also be of 2mm thickness. All panel doors shall be pad lockable type. All sheet steel work forming the exterior of sub distribution boards shall be smoothly finished, levelled and free from flaws. The corners to be rounded. Front and rear doors to be fitted with dust proof including neoprene gasket with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

Minimum clearance to be maintained after taking into account connecting bolts, clamps etc. as per relevant IS Code / IEC Standards. i) Between Phases

i) Between Phases and neutral
ii) Between Phases and earth
iii) Between Neutral & earth –

All insulating, materials used in the construction of the equipment shall be of non hygroscopic materials, duly treated to withstand the effect of high humidity, high temperatures, tropical ambient service conditions. SMC (Sheet Moulded Compound) supports & shrouds shall be used.

Functional units such as moulded case circuit breakers shall be arranged in multi-tier formation. The design of the sub distribution boards shall be such that each MCCB unit shall be fully compartmentalized.

Insulated barriers shall be provided with vertical section and between adjacent section to ensure prevention of accidental contact with main bus bars and vertical risers during operation, inspection or maintenance of functional units. All doors/covers providing access to live power equipment/circuits shall be provided with tool operated fastness to prevent unauthorized access. Sub distribution boards shall be so constructed that the cable alley shall be sufficient enough to accommodate all the outgoing and incoming cables.

For each cable alley, there shall be separate cable gland plate of detachable type at the bottom and/or top of the panel as required. Gland plate shall be 3 mm thick.

A base frame shall be as per OEM tested design as per IEC61439.

Metal Treatment and Finish

All metal work used in the construction of the sub distribution boards should have under gone a rigorous metal treatment process as follows:

a) Effective cleaning by hot non alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution

b) Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

c) A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

d) Passivating in de-oxalite solution to retain and augment the effects of phosphating.

e) Drying with compressed air in a dust free atmosphere.

f) A finishing coat of powder coating of Siemens grey colour and thickness of powder coating shall not be less than 50 micron.

Bus Bars

The bus bars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade E-91E.

The bus bars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity shall be as per actual calculation.

The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent bus bars. Large clearances and creep age distance shall be provided on the bus bar system to minimize the possibility of fault. The main phase bus bars shall have continues current rating throughout the length of the panel. The cross section of neutral bus bars shall be same as that of the phase bus bar for bus bars of capacity up to 250 Amp; for higher capacities, the neutral bus bar shall not be less than half (50%) the cross section of that of the phase bus bars. Connections from the main bus bars to functional circuits shall be so arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Bus bars shall be colour coded with PVC heat shrinkable sleeves.

The sub distribution boards shall be designed that the cables are not directly terminated on the terminals of MCCB etc. but are terminated on cable termination links. Current density shall be as be per OEM type tested design, & bus bar should be tested for rated current as per IEC 61439. Calculation considering all the derating factor shall be submitted along with GA drawing.

MOULDED CASE CIRCUIT BREAKERS

GENERAL

Moulded Case Circuit Breakers shall be incorporated in sub distribution boards wherever specified. MCCB‘s shall conform to IS 13947-2 and / or IEC 947-2 in all respects. MCCB‘s shall be suitable either for single phase AC 230 volts or three phase 415 volts.

FRAME SIZES

The MCCB‘s shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i)	Up to 100A rating	…….	100Amp frame.
ii)	Above 100A to 200A	…….	200Amp frame.
iii)	Above 200A to 250A	…….	250Amp frame.
iv)	Above 250A to 400A	…….	400Amp frame.
v)	Above 400A to 630A	…….	630Amp frame.

CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermo magnetic type up to 250 A for adjustable overload & short circuit protection and shall be microprocessor type above 250 A for adjustable overload, short circuit & earth fault protection. MCCB shall be line load reversible type. Device shall have IDMT characteristics for sustained overload, and short circuits. MCCB shall be current limiting type.

Contacts trips shall be made of suitable are resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

Protection Functions

(i) MCCBs with ratings up to 250 A shall be equipped with adjustable Thermal-magnetic (thermal for overload and magnetic for short-circuit protection)/microprocessor based trip units.

(ii) Microprocessor MCCBs with ratings above 250A shall be equipped with microprocessor based trip units. (both variable setting).

(iii) Microprocessor units shall be adjustable as per OEM.

(iv) Thermal-magnetic trip units shall also be adjustable as per OEM .

(v) Microprocessor trip units shall comply IEC 60947-2 standard (measurement of rms current values, electromagnetic compatibility, etc.)

(vi) Protection settings shall apply to all poles of circuit breaker.

(vii) The trip command shall override all other commands.

(viii) The setting of release shall be provided to make the system working with discrimination as per actual load coming at site.

(ix) MCCB shall comply to ROHS norms. Terminals shall be such designed to withstand higher thermodynamic stress cross bolted/circular as per OEM standards. It shall be invariably

be used with spreader terminals. MCCB shall have min. 8000 electrical operations upto 250A and shall be available in frame sizes of 160A & 250A upto 250A.

RUPTURING CAPACITY

The Moulded Case Circuit Breaker service breaking capacity (Ics) shall be based on actual calculation.

TESTING

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished. Pre-commissioning tests on the sub distribution boards incorporating the MCCB shall be done as per standard.

Measuring Instruments for Metering

GENERAL

Direct reading electrical instruments shall be in conforming to IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments direct reading shall be 1.0 for voltmeter and 1.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be of flush mounting type of 96mm square pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories with in the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein-after laid down shall also cover all the meters, instrument and protective devices required for the electrical works. The ratings, type and quantity of meters, instruments and protective devices shall be as per the bill of quantities.

DIGITAL AMMETERS

Digital Ammeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition.

DIGITAL VOLTMETERS

Digital Voltmeters shall be confirmed to IS: 13875. It shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.2 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The meter shall be suitable for working in ambient temp 0 degree to 50 degree and 95% humidity condition. The voltmeter shall be provided with protection MCB of suitable capacity.

CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1KV Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 15A unless otherwise specified. The acceptable minimum class of various applications shall be as given below.

Measuring : Class 1.0

Protection : Class 5 P10

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault on medium voltage system. Terminals of the current transformer shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT‘s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

Control switches

Control switches shall be of the heavy duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.

Push buttons shall be on the momentary contact, push to actuate type fitted with self reset contacts & provided with integral escutcheon plates marked with its functions.

Cable Terminations

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be brass compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

Control Wiring

All control wirings shall be carried out with 1100V grade single core ZHFR cable conforming to IS 694/IS 8130 having stranded copper conductors of minimum 1.5 sq. mm for potential circuits and 2.5 sq. mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

Terminal Block

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

Labels

Labels shall be of anodized aluminium, with white engraving on black background. They shall be properly secured with fasteners.

Testing at Manufacturing Work

All routine tests specified is IS: 8623-1977 shall be carried out and test certificates submitted to the Engineer – in –Charge.

Testing and Commissioning

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

a) Operation checks and lubrication of all moving parts.

b) Interlocking function check

c) Insulation test: When measured with 500 V meggar, the insulation resistance shall not be less than 100 mega ohms.

d) Trip tests & protection gear test.

Automatic transfer switch

General requirements

The following covers the Automatic Transfer Switch Equipment (ATSE) and its By-Pass equipment.

The ATSE shall be composed of

- two separate Load Break Switches,
- a mechanism to operate and mechanically interlock the switches,
- an actuator made of a motorized unit or a double solenoid mechanism (both momentarily energized)

- a 3 phases monitoring device and control module (MDCM) for monitoring supply circuits and for transferring the load circuit from one supply to another.

The ATSE shall be fully integrated in one device. No additional wiring other than the power connection shall be allowed to facilitate the proper functioning of the ATSE with the MDCM.

All the elements of the transfer switch equipment and control module shall be of the same manufacturer.

The ATSE shall be of the PC type.

The ATSE shall have 3 stables positions: Normal, Isolated and Emergency.

The ATSE shall be of a Disconnector type with fully visualized breaking.

The ATSE shall be able to do On Load Manual switching.

The ATSE must be proposed in 3 and 4 poles versions.

Design requirements

The transfer switch unit shall be electrically operated and mechanically held.

It shall be no power consumption while in a stable position other than the one required for the control unit.

The electrical actuator shall be a motorized unit or a double solenoid mechanism, which is momentarily energized.

The switches shall be inherently mechanically interlocked to ensure at any moment only one out of the three stable positions.

The system shall incorporate a position indicator for the 3 stable positions.

To prevent source overlapping the transfer is operated through distinct isolated positions. The sensing and logic shall be built-in microprocessor for maximum reliability and with option of serial communications feature. To facilitate flexibility of installation there shall be provision of Line/ Load reversibility.

The switching contact shall be silver plated and maintenance free in various environments. It shall be of self-cleaning capability to optimize the quality of the contact during operation

The Neutral pole of ATS shall be fully rated (100% rating as that of all 4 poles).

The 4 poles shall switch simultaneously.

Standards & Codes

The ATSE shall conform to the requirements of the IEC Standard 60947-6-1 for the source transfer function and 60947–3 for Disconnection and manual on load switching.

The MDCM shall comply with the following standards:.

Emission General standard

- EN 55022 Conductor Emission
- EN 55022 Radiated Emission

Immunity General standard

- EN 61000-4-2 Electrostatic Discharge (ESD)
- EN 61000-4-3 Radiated electromagnetic field
- EN 61000-4-4 Electrical fast transient (EFT)
- EN 61000-4-5 Surges
- EN 61000-4-6 Conducted radio frequency field
- EN 61000-4-8 Power frequency magnetic field
- EN 61000-4-11 Voltage dips, short interruptions and variations
- EN 61000-4-13 Harmonics and inter harmonics
- IEC 61010-1 Electromagnetic compatibility

Safety requirements & features

The ATS shall be of Disconnector type as per IEC 947-3

It shall not be possible to mix the two supplies (Normal supply and Emergency supply) in case of any failure of the equipment. This characteristic must be guaranteed by a proper design of the mechanism.

Opening and Closing operations of the contacts must be independent from the driving mechanism. The speed of the contacts shall be independent of the speed of motor or manual operation to ensure the safety of the operator.

In case of contacts welding, the ATSE must remain in its actual position, in Manual or Automatic operation, according to IEC 60947-3. Neither the manual nor the automatic operation can lead to a failure of the mechanism or of the interlocking. The mechanical indicator shall show the actual position in contact welded situation.

The ATSE shall have a Manual and Automatic mode: the swap between both modes shall be possible only with a key or selector on the front face. Manual operation shall be prohibited in automatic and Automatic operation shall be inhibited in Manual mode.

The ATSE shall have a built-in provision for padlocking in the Isolation position for the safety of the operators. A provision for a padlocking in Normal or Emergency positions shall also be provided.

Automatic commands shall be inhibited when the product is padlocked

The padlocking shall be possible only in Manual position.

The ATSE shall be able to accommodate up to three padlocks at the same time.

A handle for manual operation shall be provided for emergency transfer purposes.

The handle shall be located on the ATSE itself to ensure a safe and quick operation during power outages. The handle shall be easily removable for automatic operation.

Manual transfer shall be possible on load, without any upstream disconnection, with respect to the safety of the operator. This feature is essential in case of emergency and panic.

It shall be possible to block the re-transfer process via programming. When selected, retransferring to the Main source must be validated locally or remotely via keypad or external contact.

The replacement of the motor operated actuator shall be possible under live condition with respect to the operator safety (isolation distances, easy access to the fixing elements).

Operations

The ATSE shall be supplied by any present source. It shall allow the ATSE to be controlled in the 3 positions with only one source present.

The ATSE shall have high short time current withstand capability (Icw 1 second in accordance to IEC 60947-3).

Manual retransfer function can be inhibited and must be possible either locally or from remote.

The ATSE shall have the possibility to be electrically controlled in any of the 3 positions by mean of dry contacts. It overrides the automatic sequence. Once back in Auto mode, the ATSE shall come back to the proper position.

Automatic operation via the MDCM

The monitoring device and control module (MDCM) must be integrated within the ATSE.

Electrical Control of the product position must be possible and controlled locally or remotely. Any automatic command must be inhibited during control operation (takeover).

Parameters sensing & setting

The MDCM shall include 3 phases sensing for monitoring of voltage and frequency to detect the presence and loss of the power supply for activation of the automatic transfer. The settings are as following:

PARAMETER	SOURCES	THRESHOLD	HYSTERISIS
Under voltage	Mains and Backup, 3 phases	80 to 98%	81 to 99%
Over voltage	Mains and Backup, 3 phases	102 to 120%	101 to 119%
Under frequency	Mains and Backup	80 to 99%	80.5 t0 99.5%
Over frequency	Mains and Backup	101 to 120 %	100.6 to

			119.5%

Voltage settings shall be field adjustable in 1% increments either locally with the display and keypad, or remotely through serial communication. Frequency settings shall be adjustable in 0.1% increments either locally with the display and keypad, or remotely through serial communication. All settings shall be adjustable directly from the front face, opening of the MDCM is strictly forbidden for obvious reasons of safety and possible damages. The MDCM shall have a phase sequence detection to ensure the proper voltage vectors sequence on both power supplies. The MDCM shall have programming for selection of network type 4NBL/41NBL/42NBL/3NBL/2NBL/2BL/1BL and capability to monitor the minimum and maximum voltages and frequencies threshold and hysteresis. The MDCM shall allow the setting of the sources priority. The MDCM shall be equipped with the activation of manual re-transfer mode. The MDCM must be equipped with a permutation counter to enable to record the life span of the ATSE represented by the number of transfer operations. Resetting of this counter shall be conditioned by 4 digits numerical password with 2 levels of security. Interface with the MDCM The MDCM must be easily configurable via a HMI dialogue interface complete with a 2 levels security 4 digits numerical Password for programming access right. The MDCM shall be equipped with local visualization of three phase currents, powers (P, Q, S), frequency and power factor through 3 current transformers measurement from the 2 sources. Source status shall be clearly visible on the front of the unit for both normal & emergency, stated in a clear schematics diagram. The controller shall provide digital readout of voltage on all 3 phases, frequency and phase rotation. Inputs/outputs, communication.

The MDCM shall be able to provide up to four Inputs (Programmable NO or NC) and four Outputs (NO Type) for interfacing with control system. The inputs and outputs functions shall be versatile (no unique function), the assignment being done by the HMI or the communication. The MDCM can be equipped with an option to enable communication via RS485 module MODBUS protocol with a transmission speed up to 38400 bps. The link shall be capable of reading the voltages, timers and inputs values, setting all parameters values and inputs/outputs functions.

Timers settings

An adjustable timer of 0 to 60 seconds shall be provided to detect the priority network failure, to override any transient outages of the normal supply. (Main Failure Timer, MFT). A timer of 0 to 60 seconds shall be provided to validate the stability of emergency network before transfer, once the Generator Set supply is available. (Delay To Transfer, DTT). While transferring to emergency, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Failure timer, 0MF). An adjustable timer of 0 to 30 minutes shall be provided to detect priority network return to normal, to override any false availability of the normal supply. (Main Return Timer, MRT). While transferring back to primary source, a possibility to stay in position 0 shall be provided from 0 to 20 seconds (O Main Return timer, 0MR). An adjustable timer of 0 to 30 minutes shall be provided to allow the generator cooling down after load retransfer from standby source to Mains source (Cool Down Timer, CDT). The controller shall provide the ability to prevent retransfer to Mains from happening, except if the user validates manually the retransfer. (Manual Re-Transfer).

Maintenance & testing

The MDCM shall provide the possibility to run a test ON load and OFF load.

It shall be possible to actuate these sequences from the front face HMI or via the Modbus link.

Maintenance of the electrical parts (Controller or Motorization unit) shall be possible without disconnection of the power conductors.

It shall be possible to change any actuator unit based on a motor technology in less than 10 minutes without disconnection of the power conductors. During this operation, it shall still be possible to operate manually the switch with the MDCM and motorization removed.

Both Local and Remote control of test sequences shall be possible on the Switch.

Inspection at factory

The inspection / testing of all the ATS / STS shall be done at manufacturer works before dispatch by engineer in charge.

Factory testing and certification

The complete ATSE shall be factory tested to ensure proper operation of the individual components together and correct overall sequence of operations. The test must also ensure that the operating transfer time, voltage, frequency and time delay settings are incompliance with the specification requirements.

The manufacturer shall be certified ISO 9001 : 2003 International Quality Standard and the manufacturer shall have third party certification verifying its quality assurance in design / development, production, installation and servicing in accordance with ISO 9001.

J) SAFETY PROCEDURE

1. The Indian Electricity Rules 1956, as amended upto date, are to be followed in their entirety. Any installation or portion of installation which does not comply with these rules should be got rectified immediately.

2. The detailed instructions on safety procedures given in B.I.S. Code No. 5216-1969-"Code of Safety Procedures and Practices in Electrical Works" shall be strictly followed.

3. No inflammable materials shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of Indian Explosives Act. If such storage is unavoidable, it should be allowed only for a short period and in addition, special precautions, such as cutting off the supply to such places at normal times, storing materials away from wiring and switch boards, giving electric supply for a temporary period with the permission of Engineer-In-Charge shall be taken.

4. The electrical switchgears and distribution boards should be clearly marked to indicate the areas being controlled by them.

5. Before energizing an installation after the work is completed, it should be ensured that all tools have been removed and accounted, no person is present inside any enclosure of the switch board etc., any earthing connection made for doing the work has been removed.

ENERGY METERS.

HT Panels

Power Quality Analyser - High end power quality analyser with Class 0.2 active energy Accuracy with Sag/Swell - Waveform capture and Individual harmonics monitoring upto 63rd. Power Quality analyser needs to be capable of Disturbance direction detection with on-board dual ethernet Port communication.	
Basic Parameters	* Current, voltage, frequency * Active, reactive, apparent power Total and per phase * Power factor Total and per phase * Current measurement range (auto ranging) 0.05 - 10A
Energy Parameters	* Active, reactive, apparent energy * Settable accumulation modes
Demand Parameters	* Current Present and max. values * Active, reactive, apparent power - Present and max. values * Predicted active, reactive, apparent power * Synchronization of the measurement window * Setting of calculation mode - Block / sliding
Power Quality Parameters	* Total Harmonic Distortion Current and voltage * Individual harmonics - Upto 63rd * Waveform capture * Detection of voltage swells and sags * Disturbance Direction detection
Sampling Rate / Cycle	Minimum 128 Samples / Cycle
Data Recording	Minimum 256 MB of standard non-volatile memory. 10 MB of standard non-volatile memory dedicated to capture billing data, events, and waveforms. Logs of Min/max of instantaneous values, Event logs, Trending/ forecasting, SER (Sequence of event recording).
Class Accuracy	Active Energy - Class 0.2S IEC 62053-22 , Reactive Energy Class - 0.5S IEC 62053-24, Power Factor - Class 0.5 as per IEC 61557-12
PQ Standards	PQ compliance reporting as per IEC 61000-4-30 Class S, - IEC 62586

	PQI-S
Communication	On-board Dual ethernet port for daisy chaining over ethernet. Meters need to have Modbus Mastering capability by connecting Slave devices over RS485 port
Time Synchronization	GPS clock (RS485) or IRIG-B (digital input) to +/- 1 millisecond.
Digital IO	Standard: 3 digital status inputs for Breaker ON/OFF/ Trip monitoring & 1 KY (form A) energy pulse output for interfacing with other systems. Expandable DI/DO, ADI/ADO capability
Display	Bright LCD colour display with meter dimension 96 X 96 mm only

FOR LT PANEL other than Main LT Panels

Multifunction Meter - Multifunction meters with Power and harmonics monitoring capturing abnormalities in the system with date and time stamp	
Basic Parameters	* Current - Average line current of 3-phase, per-phase, and calculated neutral current * Voltage Average voltage of L-L, L-N parameters, and per-phase * Frequency * Displacement power factor Average and per-phase signed * True power factor Average and per-phase signed * % unbalance among the phase for I, V L-N, V L-L
Energy & Power Parameters	* Real, reactive, and apparent power Total and per-phase value * Accumulated Active, Reactive and Apparent Energy, Received and Delivered registers , Net and absolute energy values, time counters
Demand Parameters	* Current average, Active power, Reactive power, Apparent power - Present, Last, Predicted, Peak, and Peak Date Time * Demand sync methods Thermal, Timed, Command Sync, and Clocked Sync * Demand calculation mode Sliding, fixed and rolling block * Demand intervals - settable from 1 to 60 minutes

Power Quality Parameters	THD as per IEC 61557-12 for THD and individual harmonics up to 15th over communication
Sampling Rate / Cycle	Minimum 64 Samples / Cycle
Class Accuracy	Active energy - Class 0.5S as per IEC 62053-22
Communication	RS 485 port Modbus RTU and disabling RS485 port against unauthorized access.
Calibration LED	As per OEM standard of approved makes.
Min/Max values	instantaneous parameters with timestamp
Display	Bright red colour LED display with meter dimension 96 X 96 mm only

F) Safety Materials

Description of Work

A. Insulation Mats

B. First Aid charts and First Aid Box

C. Danger Plate

D. Fire Extinguishers

E. Fire Buckets

F. Tool Box

G. Caution Board

H. Key Board

Applicable Codes & Standards

A. IS : 15652 Insulation mats

B. IS : 2878 Portable C02 Fire Extinguisher

C. IS : 2546 : Fire Buckets

D. ANSI/NFPA 70 - National Electrical Code.

Submittals

A. Product Catalogues.

Specification

Insulation Mats

A. Insulation mats conforming to IS: 15652 shall be provided in front of main switch boards and other control equipment as specified.

First Aid Chart and First Aid Box

A. Charts (one in English, one in Hindi, one in Regional Language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate places. Standard First Aid Boxes containing materials as prescribed by St. John Ambulance brigade or Indian Red Cross should be provided in sub-station.

Danger Plate

A. Danger plates shall be provided on HV and LV equipments. LV danger notice plate shall be 200 mm x 200 mm made of mild steel at least 2 mm thick vitreous enamelled white on both sides and with inscriptions in signal red colour on front side as required.

B. Size of the HV Danger Notice plate shall be 250 mm x 200 mm and 2 mm thick.

Fire Extinguishers

A. Portable CO_2 conforming to IS: 2878-1976 dry chemical (conforming to IS 2171-1976) extinguishers shall be installed in the sub-station at suitable places (like HT/LT panel rooms) as specified.

B. Foam type fire extinguisher shall be installed in Transformer Room.

Fire Buckets

A. Fire buckets conforming to IS: 2546-1974 shall be installed with the suitable stand for storage of water and sand.

Tool Box

A. A standard tool box containing necessary tools required for operation and maintenance shall be provided in sub-station.

Caution Board

A. Necessary number of caution boards such as "Man on Line" "Don't switch on" etc. shall be available in the sub-station.

B. The Caution Board shall be of size 300 mm x 200mm made of mild steel, 2mm thick, vitreous enamelled white on both sides and with inscriptions in original red colour on front side as required.

Key Board

A. A key board of required size shall be provided at a proper place containing castle keys, and all other keys of sub-station and allied areas.

B. The Key board shall be made of 12mm thick first class teak wood shall be of size 400 mm x 300m and with adequate depth to hold the keys. It shall be provided with a lockable type hinged glass door made of 12 mm. thick first class teakwood frame with 3 mm thick sheet glass fixed with piano hinges. The key board shall enough number of hooks for hanging the castle keys and all other keys of the sub-station and allied areas. It shall be painted with one coat of wood primer and two coats of white enamel paint.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in Indial and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E- 10

DG Set

TECHNICAL SPECIFCATIONS FOR DIESEL GENERATOR SET

1. INTRODUCTION

- DG Set

  SITC of DG sets, AMF panel, bus ducting/cables from DG sets to essential panel, DG set enclosure room sound insulation/ventilation/smoke exhaust as required, earthing of DG set system, control cabling, fuel tank/piping, DG set exhaust piping/ exhaust chimney as per CPCB norms, civil works connected with DG sets and synchronizing panels (whereever required) including foundation as required.

Technical data for 500KVA DG set

S.NO		
1.	Model	
2.	Duty	Prime
3.	Power Rating kVA / kWe	500/400
4.	No. of Phases	3
5.	Output Voltage and Frequency (V and Hz)	415 V, 50 Hz
6.	Power Factor	0.8 (lagging)
7.	Current (A)	695
8.	RPM	1500
9.	Engine Specification	Engine Specification
10.	Make	
11.	Model	
12.	MoEF Certified Power (hp)	587
13.	Required Power for Rated kVA (hp)	587
14.	Cooling	Liquid Cooled (EG Compleat 50:50)
15.	Aspiration	Turbocharged, Charge air Cooled
16.	No. of cylinders	6, In-line
17.	Bore(mm) x Stroke(mm)	159 x 159
18.	Compression ratio	16.7:1
19.	Displacement(litre)	19
20.	Fuel	High Speed Diesel
21.	Fuel consumption @75% load with radiator and fan*(litre/hr)	
22.	Fuel consumption @100% load with radiator and fan*(litre/hr)	
23.	Performance class of genset	ISO 8528-5 G2
24.	Starting system	24 V DC Electrical
25.	Lube oil specification	CH4 15W40
26.	Lube oil sump capacity, High-Low level (litre)	38-32
27.	Total lubrication system capacity (litre)	50
28.	Total coolant capacity (litre)	85
29.	Exhaust pipe size (inch)	10
30.	Total wet weight (Engine+Radiator) (Kg)##	As per standard

31.	Length x Width x Height (Engine) (mm)	As per standard
32.	Mean piston speed (m/s)	7.95
33.	Combustion air intake @100% load (±5%) (cfm)	1278
34.	Exhaust Temperature (°C)	464
35.	Alternator specification	Alternator specification
36.	Make	
37.	Alternator frame	HCI544D
38.	Enclosure	IP 23
39.	Voltage regulation (Max.)	±1%
40.	Class of Insulation	H Class
41.	Winding Pitch	2/3
42.	Stator Winding	Double layer lap
43.	Rotor	Dynamically Balanced
44.	Waveform distortion/ Total Harmonic Distortion	No load < 1.5 %, Non distorting balanced linear load < 5 %
45.	Maximum Unbalanced Load across phases#	less than or equal to 25%
46.	Telephonic Harmonic factor	< 2%
47.		
48.		

Rating Definitions

Prime Power (PRP):
Applicable for supplying power to varying electrical load for unlimited hours. Prime Power (PRP) is in accordance with ISO 8528.

Conformance Standards

- IS/IEC 60034-1
- IS 1460
- ISO 8528
- ISO 3046
- ISO 9001
- IS 13018

Typical Enclosed Genset Dimensions

Genset Model	Rating (kVA)	Length (mm)	Width(mm)	Height (mm)	Wet Weight## (kg)	Standard Fuel tank Capacity (litre)
C500D5P	500/700/800					690

Technical data for 70& 800KVA DG set

S.NO			
1.	Model		
2.	Duty	Prime	Prime
3.	Power Rating kVA / kWe	700/600	800/640
4.	No. of Phases	3	3
5.	Output Voltage and Frequency (V and Hz)	415 V, 50 Hz	415 V, 50 Hz
6.	Power Factor	0.8 (lagging)	0.8 (lagging)
7.	Current (A)	974	1112
8.	RPM	1500	1500

9.	Engine Specification	Engine Specification	Engine Specification
10.	Make		
11.	Model		
12.	MoEF Certified Power (hp)	1069	1069
13.	Required Power for Rated kVA (hp)	891	960
14.	Cooling	Liquid Cooled (EG Compleat 50:50)	Liquid Cooled (EG Compleat 50:50)
15.	Aspiration	Turbocharged, After Cooled	Turbocharged, After Cooled
16.	No. of cylinders	12, Vee	6, In-line
17.	Bore(mm) x Stroke(mm)	159 x 159	159 x 159
18.	Compression ratio	16.7:1	16.7:1
19.	Displacement(litre)	38	38
20.	Fuel	High Speed Diesel	High Speed Diesel
21.	Fuel consumption @75% load with radiator and fan*(litre/hr)		
22.	Fuel consumption @100% load with radiator and fan*(litre/hr)		
23.	Performance class of genset	ISO 8528-5 G2	ISO 8528-5 G2
24.	Starting system	24 V DC Electrical	24 V DC Electrical
25.	Lube oil specification	CH4 15W40	CH4 15W40
26.	Lube oil sump capacity, High-Low level (litre)	140-114	140-114
27.	Total lubrication system capacity (litre)	155	155
28.	Total coolant capacity (litre)	330	330
29.	No of banks x Exhaust pipe size	2x8	2x8
30.	Total wet weight (Engine+Radiator) (Kg)##	As per standard	As per standard
31.	Length x Width x Height (Engine) (mm)	As per standard	As per standard
32.	Mean piston speed (m/s)	7.95	7.95
33.	Combustion air intake @100% load (±5%) (cfm)	2011	2103
34.	Exhaust Temperature (°C)	520	521
35.	Alternator specification	Alternator specification	Alternator specification
36.	Make		
37.	Alternator frame		
38.	Enclosure	IP 23	IP 23
39.	Voltage regulation (Max.)	±1%	±1%
40.	Class of Insulation	H Class	H Class
41.	Winding Pitch	2/3	2/3
42.	Stator Winding	Double layer lap	Double layer lap
43.	Rotor	Dynamically Balanced	Dynamically Balanced
44.	Waveform distortion/ Total Harmonic Distortion	No load < 1.5 %, Non distorting balanced linear load < 5 %	No load < 1.5 %, Non distorting balanced linear load < 5 %
45.	Maximum Unbalanced Load across phases#	less than or equal to 25%	less than or equal to 25%
46.	Telephonic Harmonic factor	< 2%	< 2%
47.			
48.			

2. Ratings:

Control panel for D.G. Set shall be programmable microprocessor based control panel with control and monitoring facilities of engine and alternator parameters and also auto synchronizing and load sharing facilities.

Auditorium-800KVA

Lecture hall- 700KVA

The contractor is advised to visit the site of work to have an idea of the execution of the work; failureto do so shall not absolve their responsibility to do the work as specified in agreement.

2.1.1 The EPC contractor shall submit detailed schematic diagram for the approval of the Engineer-in-charge. He will make sure that the equipment offered shall fulfil the design conditions. All the equipments and their installation shall be suitable for the environmental conditions encountered at the location as indicated in specifications.

2.1.2 The acoustic enclosure (Canopy) shall be manufactured by respective engine OEM/OEA and should be CPCB norms compliant. Only model Numbers having Type Approval and valid conformity of production certificate for noise level as per CPCB norms shall be accepted. Copies of Type approval and COP certificate have to be submitted at the time of submission of drawings for approval.

2.1.3 The number and size of the MS pipe for exhaust piping shall be as per the recommendation of the engine manufacturer. Wherever 2 numbers exhaust pipes are recommended by the engine manufacturer, the number of silencer shall also be 2 numbers.

2.2.1 CPWD Specifications & Standards

The entire work shall be carried out as per following CPWD General

a) CPWD General Specification for Electrical works (Part-VII) DG Set *2013*

b) CPWD General Specification for Electrical works (Part-I) Internal – *2013*

c) CPWD General Specification for Electrical works, (Part-II) External -*1994*

d) CPWD General Specification for Electrical works, (Part-IV) Sub-Station- *2013*

Specifications for Electrical work wherever applicable and as amended up-to-date.

The tender specifications wherever they differ from these specifications as indicated above, shall have overriding value and shall be followed for this work. The design, material, construction, manufacture, inspection, testing and performance of the Engine/ Generator sets shall comply with all currently applicable standard, regulations and safety codes in the locality where the equipment shall be installed.

Standards to which the equipment covered in this tender shall be designed, manufactured, inspected and tested are listed below:-

ISO – 3046 Parts 1 to 4

BS – 4999 all parts including part 71 / equivalent standards.

IEC Standards for electrical and electronic equipments.

A.S.M.E. Boiler and pressure vessel code for welding procedures and welder

Qualification for all diesel engine sub systems.

TEMA Standards for tubular heat exchangers.

2.2.2 Indian Electricity Act and Rules:

All electrical works in connection with installation shall be carried out in accordance with the provision of Indian Electricity Act 2003 and Indian Electricity Rules 1956, both amended up-to date.

2.2.3 Indian Standards:

All the components shall confirm to relevant Indian Standard specifications, wherever existing, amended to date. A list of such standards is appended in appendix V in specification.

2.2.4 Fire Regulation:

The installation shall be carried out in conformity with the local Fire Regulations and Rules there under wherever they are in force and the provisions in local bye-laws, if any.

2.2.5 Guarantee

The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee of material from the manufacturer to the department. AMC of DG sets during the defect liability period will be in the contractor scope, nothing extra payable for AMC during defect liability period.

2.3 Scope of work

WORKS TO BE DONE BY THE CONTRACTOR

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost-whether specifically indicated in the schedule of work or not: -

(i) Foundations for equipments including vibration isolation springs/ pads, Making good all damages caused to the structure during installation and restoring the same to their original finish.
(ii) Minor building works necessary for installation of equipments, foundation trench for fuel line & cable, making of opening in walls or in floors and restoring them to their original condition/finish and necessary grouting etc. as required.
(iii) All supports for exhaust & water pipes, chimney, bus trunking (if included in scope of contract), cables, anti- vibration pads etc. as are necessary.
(iv) All electrical work and neutral earthing, body earthing, required for engine & alternator, main board/ control panels, and control wiring including loop earthing, if specified in Schedule of Work.
(v) All pipes, bus trunking and/ or cable connections.
(vi) Painting of all exposed metal surfaces of equipments and components with appropriate colour.
(vii) Clearance/ Approval of the complete installation from CPCB/ State Pollution Control Board, Central Electricity Authority (CEA)/ Local Bodies and other licensing authorities, wherever required.

2.4 Acceptable make: Approved makes of materials to be used in the work have been appended with tender Document.

Complete design, manufacturing, supply erection, painting, testing & commissioning etc. of fuel storage tank & distribution system along with all other accessories like piping instrumentation, controls and safetyof the complete system.

Preparation of layout plans/ scheme for fuel storage tank as per requirement of statutory petroleum Rules and regulation.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART C-11

BMS & SCADA SYSTEM

GENERAL TERMS & CONDITIONS AND TECHNICAL SPECIFICATIONS FOR BMS & SCADA SYSTEM

General Terms & Conditions

1. Introduction

These conditions are intended to amplify the General Conditions of Contract, and shall be read in conjunction with the same. For any discrepancy between the General Conditions and these Special Conditions, the more stringent shall apply.

2. Scope

The general character and the scope of work to be carried out under this contract is illustrated in Specifications. The Contractor shall as a System Integrator for providing an end to end Solution for the above, including but not limited to design, supply of the required BMS equipments and installation, performance testing, commissioning, warranty, etc. The bidders have to ensure the planning and smooth execution of the project. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer in charge. The contractor shall furnish all labours, materials and equipment as listed and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system through as described in the Specifications.

3. Related Documents

These additional specifications are to be read in conjunction with the specification given in the tender. In case any item/ items or part thereof are not covered under these specifications, the same shall be carried out as per relevant part of the CPWD General Specification for Electrical Works Part-I Internal -2013, Part –II External -1994, amended upto dates, relevant electricity act BIS/IEC and as per direction of Engineer –in - Charge. These additional specifications are to be read in conjunction with above and in case of variations; specifications given in this additional condition shall apply. However, nothing extra shall be paid on account of these additional specifications and conditions, as the same are to be read along with schedule of quantities for the work. In case of discrepancy among the specifications/conditions as mentioned above the precedence given in general condition of contract shall be followed.

4. Site Information

The work shall be executed **at IIT(ISM), JHARKHAND.** The tenderer should, in his own interest, visit the site andfamiliarize himself with the site conditions before tendering.

Safety Codes and Labour Regulations

i) In respect of all labour employed directly or indirectly on the work for the performance of contractor's part of work, the contractor at his own expense, will arrange for the safety provisions as per the statutory provision, B.I.S. recommendations, factory act, workman's compensation act, CPWD code and instructions issued from time to time. Failure to provide such safety requirements would make the tenderer liable for penalty for Rs. 2000/- for each violation. In addition the Engineer-in- charge, shall be at liberty to make arrangements and provide facilities as aforesaid and recover the cost form the contractor.

ii) The contractor shall provide necessary barriers, signals and other safety measures while executing the installation or wherever necessary so as to avoid accident. He shall also indemnify WAPCOS against claims for compensation arising out of negligence in this respect. Contractor shall be liable, in accordance with the Indian law and Regulations for any accident occurring due to any cause. The department shall not be responsible for any accident occurred or damage incurred or claims arising there form during the execution of work. The contractor shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the contractor due to the above provisions thereof.

5. Works to be done by the contractor

Unless otherwise mentioned in the tender documents, the following works shall be done by the contractor and therefore, their cost shall be deemed to be included in their tendered cost- whether specifically indicated in the schedule of work or not: -

i) Complete wiring.

ii) Making good all damages caused to the structure during installation and restoring the same to their original finish.

iii) Minor building work necessary for installation of equipments, making opening in the wall/floors/slabs/tables or modifications in the existing openings wherever provided and restoring the same to their original condition/ finish and necessary grouting etc. as required. Opening in the slab/retaining walls/brick wall etc. shall be made by means of core cutting machines only.

iv) Sealing of all floor slab/wall openings provided by the Department or made by the contractor for laying cables from fire safety points of view.

v) Suspenders, brackets and floor/wall supports for suspending/supporting cable tray, cables etc.

vi) Removal & disposal of the all the malba/ debris occurs during the execution of work from the site.

6. Acceptable Makes

The acceptable makes of the various equipments/ components/ accessories have been indicated in list of ―Acceptable Makes‖ annexed with this document. The bidders shall work out the cost of the offers on this basis. Alternate make/ model is not acceptable.

7. Machinery for Erection

All tools and tackles required for unloading/ handling of equipments and materials at site, their assembly, erection, testing and commissioning shall be the responsibility of the contractor.

8. Completeness of the Tender, Submission of Programme, Approval of Drawings and commencement of work

i) Completeness of the tender:-

All sundry equipments, fittings, assemblies, accessories, hardware items, foundation blots, supports, termination lugs for electrical connections connecting wires/ cables, cable glands, junction boxes and all other items which are useful and necessary for proper assembly and efficient working of the various equipments and components of the work shall be deemed to have been included in the tender, irrespective of the fact whether such items are specifically mentioned in the tender or not.

ii) Submission of program:-

The successful tenderer, after receipt of the letter of award, shall submit his program for submission of drawings, supply of equipment, installation, testing, commissioning and handing over of the installation to the Engineer-in –charge.

iii) Commencement of Work

The contractor shall submit the complete scheme and drawings etc. of the complete system and shall commence work as soon as the drawings submitted by him are approved either in full or in part as the case may be.

9. Dispatch of Materials to Site and their Safe Custody

The contactor shall dispatch material to site in consultation with the Engineer-in-Charge. Suitable accommodation and arrangement to make it lockable/secure by means of partitions, locks etc. shall be responsibility of the contractor. Watch and ward however, shall be the responsibility of contractor. Program of dispatch of material shall be framed keeping in view the safe custody of all machinery and equipment supplied by the contractor shall be the responsibility of the contactor till final taking over by the department.

10. Compliance with Regulations and Indian Standards:

i) All works shall be carried out in accordance with relevant regulation, both statutory and those specified by the Indian Standards related to the works covered by this specification. In particular, the equipment and installation will comply with the following:

- Factories Act.
- Indian Electricity Rules.
- B.I.S. & other standards as applicable.
- Workmen‘s compensation Act.
- Statutory norms prescribed by local bodies like CEA, Power Supply Co., etc.

ii) Nothing in this specification shall be construed to relieve the successful tenderer of his responsibility for the design, manufacture and installation of the equipment with all accessories in accordance with currently applicable statutory regulations and safety codes.

iii) Successful tenderer shall arrange for compliance with statutory provisions of safety regulations and departmental requirements of safety codes in respect of labour employed on the work by the tenderer. Failure to provide such safety requirement would make the tenderer liable for penalty of Rs. 50/- for each default. In addition, the department will be at liberty to make arrangement for the safety requirements at the cost of tenderer and recover the cost thereof from him.

11. Indemnity:

The successful tenderer shall at all times indemnify the department, consequent on this works contract. The successful tenderer shall be liable, in accordance with the Indian Law and Regulations for any accident occurring due to any cause and the contractor shall be responsible for any accident or damage incurred or claims arising there from during the period of erection, construction and putting into operation the equipments and ancillary equipment under the supervision of the successful tenderer in so far as the latter is responsible. The successful tenderer shall also provide all insurance including third party insurance as may be necessary to cover the risk. No extra payment would be made to the successful tenderer on account of the above.

12. Co-Ordination with other Agencies

The contractor during the execution of the works shall co-ordinate with other agencies associated work with the project and shall work in harmony with them without causing any hindrance or obstruction on the progress of work in any way.

13. Insurance and Storage :

All consignments are to be duly insured upto the destination from warehouse at the cost of the contractor. The insurance covers shall be valid till the equipment is handed over duly installed, tested and commissioned.

14. Verification of Correctness of Equipment at Destination:

The contractor shall have to produce all the relevant records to certify that the genuine equipments from the manufacturers has been supplied and erected.

15. Painting:

This shall include cost of painting of the entire installation. The agency shall be required to do only touching to the damages caused to the painting during transportation, handling & installation at site, if there is no major damage to the painting. All iron works shall be painted at the work before dispatch to the site with two coats of anti-corrosive primer paint. One coat of final finishing of approved colour may be done at the factory before dispatch if considered necessary by the tenderer on such components, which will not need removal of such parts at site during assembly/erection work. Marking of identification of each equipment as per direction of engineer-in-charge shall be got done.

16. Quality of Materials and Workmanship

i) The components of the installation shall be such design so as to satisfactorily function under all conditions of operation.

ii) The entire work of manufacture/fabrication, assembly and installation shall conform to sound engineering practice.

iii) All equipments and material to be used in work shall be manufactured in factories of good repute having excellent track record of quality manufacturing, performance and proper after sales service.

iv) All equipments and materials to be used in the work shall be brand new having its date of manufacturing not more than 6 month old from the date of delivery at site with manufacturer‘s certificates, warrantee cards, technical catalogues, instructions, manuals and wiring diagrams etc.

v) In order to ensure genuineness of equipments/materials, copy of invoice of each equipments/materials, custom clearance paper in case of imported materials duly authenticated by bidder shall be invariably produce to engineer-in-charge.

17. Care of the Building

Care shall be taken by the contractor during execution of the work to avoid damage to the building. Care shall also be taken by the contractor to avoid the damage to any of these existing service/service lines, any part of the building etc. If any damage is caused to any of the existing services/service lines, or any part of the building the same shall be repaired/rectified and made functional or restored so its original finish by the contractor immediately at his own expenses failing which the same shall be repaired/ rectified and made functional by department at the risk and cost of the contractor. The decision of the Engineer-in-charge in this regard shall be final & binding. He shall also remove all unwanted and waste materials arising out of the installation from the site of work from time to time.

18. Inspection and Testing

i) Initial Inspection and testing

i) Initial inspection of material and equipments at manufacturer‘s works in India may be done by the Engineer-in-Charge or his representative, if so desired. For item/ equipment which require initial inspection at manufacturer‘s works, the contractor will intimate the date of testing of equipments at the manufacturer‘s works before dispatch. The contractor shall give sufficient advance notice of minimum two weeks regarding the dates proposed for such tests to the department‘s representative(s) facilitate his presence during testing. The Engineer-in-Charge at his discretion may witness such testing. Equipments will be inspected at the manufacturer/ authorized dealer‘s premises, before dispatch to the site by the contactor. The manufacturer‘s works implies the manufacturer of respective items mentioned in the list of acceptable makes..

ii) The department also reserves the right to inspect the fabrication job at factory and the successful tenderer has to make arrangements for the same.

iii) The materials duly inspected by Engineer-in-Charge or his authorized representative shall be dispatched to site by the contractor.

iv) Copies of all documents of routine and type test certificates of the equipments carried out at the manufacturer works shall be furnished to Engineer-in-charge and consignee.

v) No additional payment shall be made to the contractor for initial inspection/testing at the manufacturer‘s works by the representative of the Engineer-in-Charge. However, the department will bear the expenses of its representative deputed for carrying out initial inspection/testing.

ii) Final Inspection and Testing

Upon completion of work the performance test shall demonstrate the following among other things:-

i) Equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.

ii) All items operate efficiently and quietly to meet the specified requirements as per the warranty /guaranty.

iii) All circuits are correctly protected /modify as per the site protective devices are properly coordinated.

iv) All non-current carrying metal parts are properly and safely grounded in accordance with the specifications and appropriate codes of practice.

v) The contractor shall provide all necessary instruments and labour for testing. He shall make adequate records of test procedures and readings and shall repeat any tests requested by the Engineer in charge. Test certificate duly signed by authorized person shall be submitted for scrutiny.

vi) If it is proved that the installation or part thereof is not satisfactorily carried out then the contractor shall be liable for the rectification and retesting of the same as called for by the Engineer in charge. All tests shall be carried out in the presence of representative of Engineer in charge.

vii) The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere. All tests shall be carried out by a test house approved by the Engineer in charge.

viii) The system shall be tested in the presence of Engineer in charge‘s representative at Supplier‘s works in accordance with latest prevailing standards and codes. The successful passing of any such tests will not however prejudice the right of Purchaser to reject the system and its accessories, if they do not comply with specifications when erected or perform complete satisfactory operation as intended.

ix) Final Inspection and testing will be done by the Engineer-in-Charge or his representative as per details indicated in relevant section of Technical Specifications.

iii) Safety Measures

All equipments shall incorporate suitable safety provision to ensure safety of the operating personnel at all times. The initial and final inspection reports shall bring out explicitly the safety provisions incorporated in each equipment.

19. Guarantee

i) The contactor shall guarantee the complete system to maintain the specified conditions under all conditions of ambient temperature.

ii) All equipments shall be guaranteed for a period of 36 months from the date of acceptance and taking over of the installation by the department against unsatisfactory performance and/or breakdown due to defective design, material, manufacture, workmanship or installation. The equipment or component or any part thereof so found defective during the guarantee period shall be repaired or replaced free of cost to the satisfaction of the Engineer-in-Charge. In case it is felt by the department that undue delay is being caused by the contactor in doing this, the same will be got done by the department at the risk and cost of the contractor. The decision of Engineer-in-Charge in this regard shall be final.

iii) The AMC of entire BMS System during the defect liability period shall be in the scope of contractor, nothing extra shall be paid for AMC during this period.

ii) Completion drawings

Contractor shall periodically submit completion drawings as and when work in all respects is completed in a particular area. These drawings shall be submitted in the form of four sets of CD‘s and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed. These drawings shall clearly indicate following:

i) Location and details of each item

ii) Complete wiring diagram, as installed and scheduled showing all connections in the complete electrical system.

20. After Sales Services

The contractor shall ensure adequate and prompt after sales service free of cost during guarantee period, and against payment after guarantee period is over, in the form of maintenance, spares and personal as and when required during normal life span of the equipments and shall minimize the breakdown period. In

case of equipment supplied by other manufacturers, the firm shall submit the guarantee from manufacturer for the same before the entire installation is taken over.

21. The contractor shall submit at the time of approval of association, an undertaking from the OEM regarding:-

i) Authorization Certificate from OEM of all the major Equipments.

ii) An undertaking from OEM of all the major equipments that

- The OEM shall unconditionally support the lowest tenderer technically throughout the execution of contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of system, and
- OEM shall provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment.

22. The items supplied by the contractor should have specifications compatible with each other required for satisfactory operation of the system.

23. Liaisoning and Co-operation with other agencies:

a. The successful tenderer shall co-ordinate with other contractors and agencies engaged in the operation and maintenance of the building so as to make the execution of this works contract smooth. If any unreasonable hindrance is caused to other agencies / damage is caused to the existing installation resulting in loss of work or disruption in services during the course of work, such expenditure incurred upon restoration and loss of work shall be recovered from the successful tenderer. Water proofing of pits shall not be damaged under any circumstances.

24. Verification of correctness of Equipment at Destination :

All the materials are to be purchased from OEM / Authorised Distributor / dealer of OEM only. The contractor shall have to produce all the relevant records to certify that the genuine equipment from the manufacturers has been supplied and erected. They have to submit proof like copy of bill / P.O. etc. in support.

Scope of Work :

1. IP based BMS & SCADA system is proposed to monitor and operate the all activities of MEP Services of pkg-2.
2. The BMS system covers all the MEP services (except indoor lighting) i.e. HVAC, MRL Lifts, Substation equipments, DG Sets & Fuel storage tank, Fire Fighting, Fire

Alarm and PA System, UPS System, Access Control System, t etc.

3. The BMS system shall be integrated with SCADA system and also shall have provision of integration with existing BMS system (IF Available)
4. The SCADA system shall be integrated with institute SCADA system and capability to provide a single platform for both SCADA systems.

Specification and Scope of work of BMS and SCADA for MEP Work

a) The scope of BMS is for Air-conditioning applications and all other E & M services. The Building Management System (BMS) is to be provided to perform the following general functions as per CPWD General specification of HVAC-2017: HVAC (Low & High Side) Management and Control Other E & M installations like Sub-Station, DG Sets, floor panels, UPS, Lifts, Water supply system, compound lighting, CCTV, Fire Fighting System , Fire alarm System, etc as per the scope of buildings work.

b) The EPC contractor shall necessary arrangement such as Level sensors /switches, necessary piping, valves, digital BMS computable water meter etc to integrate the following buildings to BMS and SCADA compatible for previous system. Necessary equipments for BMS compatible are included in the scope of work.

> HVAC system

> Air Cooled DX System

> Hot water system

> Water supply system

> BMS compatible Digital Water Meters at all water generation and consumption points. For residential, each flat shall have 02 nos. of digital water meters for Domestic & Flushing Water Line. For Academic & Hostel Cluster, each building block shall have 02 nos. of digital water meters for Domestic & Flushing Water Line.

> Water softening plant

> Fire fighting system

> Fire alarm system

> BMS compatible Digital Energy Meters at all energy generation and consumption points including LT panels / each building block for Academic & Hostel Cluster panel / each flat of residential unit energy consumption parameters

> Lifts

> UPS

> VFD integration

> Fire alarm integration

> Air handing unit & Forced cooling unit

> Public Address System & CCTV System

> All Panels inside the building and substation should be suitable for monitoring and control with BMS / SCADA System. Suitable BMS / SCADA Integration Cards shall be provided to achieve BMS /SCADA compatibility of HT & LT Panels. SCADA System shall be provided for all substations and further hooked up/ integrated to BMS System.

The Agency shall visit the site before quoting the tender.

Monitoring and Control of Controllers, Remote Devices and Programmable Logic Controllers

Operator Interface

Video display integration

Data collection, Historization , Alarm Management & Trending

Report Generation

Network Integration

Data exchange and integration with a diverse range of other computing and facilities systems using industry standard techniques.

The BMS software and supervising should have the capability to expand the system at least upto 50% of the present capability.

Controls for HVAC Heating Ventilation and air-conditioning system:

The automatic controls shall include the following minimum works:

- Starting and protection of air conditioning plant equipment.
- Microprocessor based centrifugal with VFD type, water cooled chillers& Heat pumps to be controlled and integrated with BMS.
- Starting and protecting of cooling water / chilled water/Hot water pumping system.
- Control of cooling towers.
- Starting, protection and control of Air handling units, Fan coil units, AH section.
- Starting, protection & control of Ventilation Fans.
- Interlocks and alarms as required for safe operation of system.

Controls for Plumbing System

- Starting, Protection & Control of Filter Feed Pumps, Transfer Pumps, Softener Feed Pumps, drain pumps, sewage treatment pumps etc.
- Maintaining the Level in various Water Tanks.
- Monitoring and Measuring the Flow at Various locations.

Monitoring of Lifts

- Monitoring of the Various Lift Parameters through Software on MODBUS RTU.

Controls for Electrical System:

- Monitoring/control of Various parameters of the LT panels through software integration (RTU MODBUS).
- DG Set Monitoring/control through software Integration (RTU MOD BUS).

Controls for Fire Alarm & CCTV Systems

- Fire Detection System for the complete Building.

Public Address System for complete Building.

Emergency Talk Back System.

Monitoring & control of building lighting and external Lighting

General

The Building Automation System for all three phase MEP Equipments (BAS) supplier shall furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, suitable for the building usage. The

control strategies shall be developed to ensure that the specified environmental conditions are maintained, whilst giving due regard to minimizing of energy consumption.

The system design shall utilize the latest technology in ―open‖ network architecture, distributive intelligence and processing, and direct digital control. The BACS system offered should be from the latest offerings and should be of freely programmable management and automation stations for the full spectrum of today‘s building application services.

All peripheral equipment e.g. sensors, pressure switches, control valves and actuators, shall be of the same manufacture as the direct digital control modules and outstations.

The system offered shall be completely modular in structure and freely expandable at any stage from the smallest system through to large distributed systems. Each level of the system shall operate independently of the next level up.

The system shall fully be consistent with the latest industry standards, operating on Windows 2000, Windows XP or later, allowing the user to make full use of the features provided with these operating systems.

To provide maximum flexibility and to respond to changes in the building use, the system offered shall support the use of BACnet, LON, Profibus and Ethernet TCP/IP communication technologies.

The contractor shall establish the number of equipment to be controlled / monitored by the BMS from the drawing/ schedule/ specifications. This information shall be furnished to the BMS supplier. All plant and equipment requiring control and / or monitoring functions shall be fitted with all necessary interfacing equipment readable by the BMS network. The contractors shall co-ordinate and ensure that this equipment shall provide the required signals to the BMS.

DATA ACQUISITION SYSTEM / PLANT MONITORING

Web based remote monitoring which shall also be linked with servers of client / Board or software such as SCADA monitoring system must be provided by Bidder. If needed access to MNRE/CREST shall also be provided.

SYSTEM ARCHITECTURE

The BMS shall provide for monitoring, data acquisition, control and optimization of all the building‘s technical plant, monitoring and control of connected subsystems.

The system structure shall be as follows:-

- True IP based, Networkable, Open protocol standard based Building Automation Controllers. The controller should be connected to modular IOs (digital, analog inputs & outputs, impulse inputs). The IOs should have expansion capability. The remote IOs can used to connect to the field devices as near as possible to reduce the cabling cost. The front end GUI software for control, alarms, limit-value monitoring, formation and processing of historical data.
- True IP based, Networkable, Open protocol standard based Controllers for AHU‘s, FCU, control system for individual temperature control of individual conditioned areas.

- All other services eg. Plumbing, lifts, electrical system including DG sets, Fire alarm, CCTV, PA & Emergency talk back system etc. shall be integrated with the BMS. These systems will be directly integrated to the process data manager through the software protocol or through the communication modules with required software. The Plumbing system which will be through controllers as hard IOs.
- Standard Ethernet IP protocol from IT world should be used as Bus link to the central station (BMS PC). Proprietary Bus Link shall NOT be acceptable.

Essential functions of system

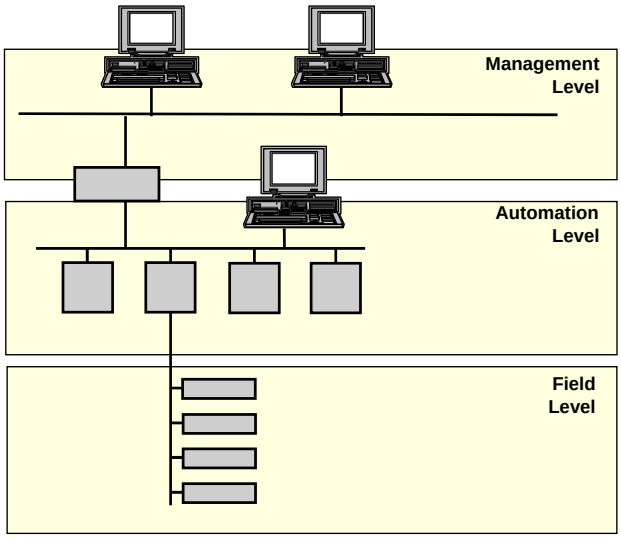
The system comprises the supply, engineering, testing and commissioning of an integrated building management system by a specialist manufacturer.

The essential functions of the system are as follows:

- Centralised operation of the plant (remote control)
- Dynamic and Animated Graphic details of Plant and building
- Tenant Billing for BTU Consumption
- Early recognition of faults
- Faults statistics for identification
- Trend register to identify discrepancies, energy consumption, etc.
- Preventive maintenance and plant servicing
- Optimum support of personnel
- Control optimisation of all connected electrical and mechanical plant
- Prevention of unauthorised or unwanted access
- Own error diagnose.,is integrated system
- AutoCAD integration

General System Architecture

The system shall be logically structured into three distinctive levels, which are Management Level, Automation Level, and Field Level. Each level shall be autonomous from the other. Peer to peer communication shall be possible on all system levels and the system design shall be modular in structure to allow straightforward extensions.



Use of communication standards

Only the following standards are appropriate to be used at the three levels.

- Management level - BACnet, Ethernet TCP/IP
- Automation level - BACnet on LonTalk
- Field level - LonTalk with LonMark profiles

Management Level

The head-end management and operation of the plant shall include process visualization, data analysis, and exchange of data with 3rd parties. At the management level, it shall be possible for communication to flow in all directions, across networks and via direct connections.

Personal computer based operator management stations shall be provided for plant supervision and operation, alarm management, information and database management function. All real-time control functions shall be resident in the DDC controllers to facilitate greater fault tolerance and reliability.

The operator management station should be capable of multi-tasking 32-bit programs by utilising a Microsoft Windows 2000/ XP or later version of operating system.

The management level of the system shall consist of one, and shall be capable of handling more management station PCs and the Associated software modules. The number of total number of management station PCs shall be as described elsewhere in the specifications.

The management station shall be capable of the following:

- Display of graphical representations of the plant overlaid with live data

- High quality dynamic graphics with true multitasking of all active pages
- Monitor and operate / influence process devices
- Receiving of alarm messages from the process level and directing them to the appropriate reporting device e.g. printer, pager, fax, e-mail
- Monitor process devices for communication problems and other device faults.
- Alarm handling – all the alarms shall be displayed in a graphical tree structure in order located alarms quick and easily.
- Adjusting time strategies in the process level.
- Long term storage of logged data from the process devices
- Multi-level user access control for individual access to sites, applications, functions and objects
- Display graphically the logged data
- Custom application programming
- Use of graphical genies to allow manipulation of data.
- The user interface shall be based on a basic taskbar, which is always visible.
- History logging for alarms, user actions, system events and messages
- Alarm handling – all the alarms shall be displayed in a graphical tree structure in order located alarms quick and easily.
- Simultaneous connection of at least of 4 sites via serial connections / 50 sites via LAN/WAN connections for a comprehensive overview on geographically distributed projects

For maximum fault tolerance, the management stations connect to the process level via point-to-point communications. This shall be via RS232, Ethernet/TCP/IP LAN / WAN or via AutoDial links.

Automation Level

General Purpose controllers shall be used for monitoring / controlling equipment which have to perform based on a customized logic, such as AHUs, Chillers, Chilled water pumps, Cooing towers, Lifts, signals from Fire Alarm panels, generators, transformers etc.,.

At the heart of the DDC system shall be the Microprocessor based modules, which can be individually programmed according to the functional requirements.

The automation level DDC controllers shall monitor and control the main plant in the building. The DDC controller outstations shall be freely programmable and have the ability to perform all the following routines

- Process control & interlock functions.
- Generate alarms/events based on comparing measured values against know parameters.
- Time control strategies
- Runtime totalisation
- Trend logging of specific data-points with transmission of the logged values to the management level
- Energy calculations

- Backup of the data/program

The DDC controllers shall be selected from either a modular or compact type of unit to suit the most economic inclusion of all the data points specified. Each control module shall be capable of operating on a stand-alone basis without control from a central computer..

The input/output connection to Modular controllers shall be via individual plug-in modules suitable for the particular peripheral device. The digital modules shall have visual indication of the status of the input/output. Digital input modules shall be capable of accepting control voltages up to 230vac and will have integral status indication.

It shall be possible to integrate both types of control module onto the same BACnet communication network. Each controller performance shall be to 0.5% control accuracy with sample rates of less than one second.

Main plant DDC controllers shall be 16 / 32 bit freely programmable. Controllers meant for VAV controls cannot be used as DDC controllers.

All DDCs must be UL approved, must have an in-built real time clock and be suitable for PID control.

The products used in constructing the BMS management and automation levels shall conform to BACnet protocol on a LONtalk data communications network, for building automation and control networks. All product types shall have attained a BACnet Testing Laboratories (BTL) listing and display BTL logo.

Room units shall utilize a two-wire communication link at each controller for the acquisition of room temperature and local set point. These will also provide an integral temperature/set point digital display

The system shall have the facility for a Web server to be added to allow full operation of all automation station control modules connected to the LonTalk BACnet network via a standard thin client/web browser. Functions to include

- Display of graphical representations of the plant overlaid with live data
- Data point display and operation of all measured values, set points, plant states, operating states and parameters
- Alarm monitoring with acknowledgement and visual and audible alarm indication.
- Alarm and event history
- Alarm transmission via SMS and e-mail
- Operation of all time schedules, exception calendar and heating curves.
- Reading of trend data with facility to export data to Microsoft Excel.
- Multi user level access protection
- Ethernet or Modem connection

DDC Control Module Specification

The DDC controllers shall be selected from either a modular or compact type of unit to suit the most economic inclusion of all the data points specified. The DDC controllers being used should confirm to the following specifications as a minimum:

- Based on ANSI/ASHRAE standard 135-2001 (BACNet), ENV13321-1
- Operation standalone or as part of LonTalk (clause 11) system network TP/FT-10, 78kBits with Built in BACnet/Lontalk interface
- Optional connection to operator terminal, management station and via Web browser with Web server device.
- Freely Programmable
- Flash ROM, real time processing and multi tasking
- 32 bit dual processor system, 1.5 MB program memory
- Supply voltage AC 24V +/-20% 50/60 Hz
- Event driven data transmission
- Automatic mains recovery
- PPS2 connection for up to five two wire QAX room units
- Digital output to be 250V 2A rated changeover contacts
- Historical data memory storage
- Software application stored in non volatile memory
- Battery back up

For the generation of the application programs, the following function elements are required as a minimum.

- Reset functions
- Set point jump
- Positioning time
- P-controller (reverse or direct acting)
- P1-controller (reverse or direct acting)
- PI-controller with I-deletion (reverse or direct acting)
- PID controller (reverse or direct acting)
- 2-point controller (reverse or direct acting)
- Proportional additional sequences (reverse or direct acting)
- Data transmitter (digital or analogue)
- Data converter (analogue-digital or digital-analogue)
- Ring Counter
- Timer (switch on or switch off)
- Logic operations:
    - logic "AND" (2,3 or 4)
    - logic "OR" (2,3 or 4)
    - logic "EXOR"

  - logic "NOT"
- Comparative operations:
  - Maximum values (2,3 or 4)
  - Minimum values (2,3 or 4)
  - Average values (2,3 or 4)
- Enthalpy calculation
- Optimiser
- Mean value calculation
- Hysteresis
- Output steps (digital or analogue)

Digital outputs shall be potential free outputs. Analogue outputs shall be true analogue outputs (0-10 V DC, 0-20 V DC, 0-20 ma & 4-20 ma)

Above blocks shall be resident in the DDC Controllers and independent of any high level interfaces/controllers.

Further, the DDC unit software must have the following additional functions:

Free selection of range and unit (dimension) of all signals (measured values, accumulated values, calculated values, etc.)

Free allocation of access protection in accordance with operating priorities

Free definition of manual override priorities (software) from operator terminal and/or management station.

Each DDC Controller shall have a resident real time clock with a battery backup.

All DDC controllers shall be housed in IP 54 enclosures with proper termination of peripheral devices at the terminal strip and not directly to the controller.

Field Level

Individual terminal unit controllers for autonomous room – by – room comfort control, based on application specific logic written on the controllers. All the terminal unit controllers shall fulfil following general requirements:

- LONMARK communication
- AC230 V power supply
- Mountable with screws or DIN rail
- Optional terminal cover for local installation without cabinet
- Downloadable application software /adjustable parameter set, the type of use shall be defined by downloadable pre-tested application software.

Common functions like grouping, scheduling, etc., shall be realised within a master controller on automation level.

All terminal unit controllers supplied on the project shall have the facility for local set point adjustment via a room unit.

Application specific controllers shall be used for terminal devices such as Fan Coil Units and the like. These controllers shall be with LonMark compatible bus communication. Any failure problem in communication bus should not affect the working of the FCU controller. A dedicated standalone controller shall be provided for each FCU. A common controller for FCUs serving different areas shall not be acceptable. These controllers shall be looped with a bus cable and connected to the BMS via an interface unit.

In general they shall comply with the following specifications

- For 2 or 4 pipe FCUs, with or without changeover
- PID control
- Downloadable application software
- LonMark compatible bus communication
- To be integrated to the management station software
- Control of AC 24 V PWM valve actuators, 3 point AC 24 V valve and damper actuators, or electric heating coils
- Volt-free relays for fan control
- Operating Voltage 230 V
- Internal fuse, thermal, automatic reset
- Connectable to 1 room unit via PPS2, 4 wire unscreened twisted pair @ 4.8 KBPS

The application specific controllers shall be capable of working in conjunction with the following type of room controllers. The specific type of room controller to be used in specific applications shall be selected from any one of the following types to meet the description written in the sequence of operation.

TYPE 1

- Integrated room temperature sensor

TYPE 2

- Integrated room temperature sensor
- Dial for temperature set point

TYPE 3

- Integrated room temperature sensor
- Dial for temperature set point
- Rocker switch for off/auto1 mode (single speed fan)

TYPE 4

- Integrated room temperature sensor
- Dial for temperature set point
- Rocker switch for off/auto1 mode and fan speeds (3 speed fan)

TYPE 5

- Integrated room temperature sensor
- Dial for temperature set point
- Rocker switch for off/auto1 mode and fan speeds (3 speed fan)
- LCD display of measured temperature

TYPE 6

- Integrated room temperature sensor
- Rocker switch for temperature set point (raise/lower)
- Rocker switch for off/auto1 mode and fan speeds
- LCD display of measured temperature
- Communication with controllers via Lon bus
- Exchangeable rocker switches for lighting and blinds
- Selection of downloadable software applications for the operation of lighting and blinds
- Operating mode ‗auto‖ –comfort, ‗off‘ – standby or economy

FCUs FOR CORRIDOR/ LOBBY AREAS / ROOM

Each FCU control assembly shall consist of a dedicated controller mounted near the FCU and temperature sensor mounted in the return air path.

The FCU controller shall automatically change the FCU motor speed based on the temperature deviation. The FCU shall continue to operate at the low speed when the temperature conditions are achieved. It shall be possible to switch OFF the FCU motor either from the ON/OFF switches of the room unit or via BMS PC.

The temperature set point shall be selected through the set point provided on the controller fascia or via communication bus/ BMS PC. It shall also be possible via the communication bus to operate the controller in comfort mode (normal operation) stand-by mode (short break periods like lunch time etc.) and energy hold off mode (night mode or non-office hours) through time channel programming.

The FCU controller shall modulate the modulating valve to meet the desired temperature condition.

In case multiple FCUs are serving the same common area/ lobby a common controller can be used if suitable from the site conditions.

Networks & File Servers

Wherever the building configuration supports in - built network cables, the system shall be able to accommodate several PCs hooked up at locations designated by the user at a later date. The

management station software shall support the two leading network systems, Windows NT Advanced Server and NOVELL NetWare.

The management station(s) shall be set up on the network in two different ways, either operating independently or as client management stations in conjunction with an (optional) file server.

To facilitate central storage of data and programs, the file server is envisaged. Central management of user-specific information such as passwords and protected access to data and programs shall thus be made easily possible. The file server shall also support software updates and changes in the project data. The file server shall also support consistent central archiving of alarms, off-line trend data, log data, graphics, data backup etc.

Printing

It shall be possible to connect printers either directly to the management station or to the file server.

Remote Monitoring and Control

It shall be possible, with additional hardware if necessary, to interrogate the system remotely via the following possible methods:

- Telephone connection
- Building IT network
- Web browser technology with password access via IT networks accessing information stored on dedicated embedded web server device installed on automation controller network.
- Alarm reporting to mobile pagers/phones/e-mail etc
- Energy usage monitoring and control via Design Insight Building Management Systems.

BMS – Records

General

The details of the building automatic system shall include all the manufacturers Technical Data Sheets and User Manuals. Control valve schedules shall be provided the flow rates; valve pressure drop and system design basis on which the particular valve type was selected.

DDC Control System Software Strategies

Controller strategies shall be provided, in both hard copy and on CD-ROM, for inclusion in the Operating & Maintenance Manuals.

Copies of all the preliminary strategies, in both hard copy and on CD-ROM, shall be supplied to the Engineer prior to commencement of control systems commissioning.

Copies of all the ‗As Installed' strategies, in both hard copy and on CD-ROM, shall be supplied to the Engineer within three months of hand over of control systems.

BMS Software and Licenses

All License rights to the control systems manufacturers software packages shall be transferred to the client at the time of hand over. User Registration must be made on behalf of the client, direct to the control system manufacturer by the specialist System House Partner.

Copies of all of the control system manufacturers Monitoring or BMS software shall be provided on CD-ROM, or other mass storage device, together with copies of any graphics and databases that may be required to re-install the system after a fatal computer failure.

Integration of secondary systems

Integrations shall be carried out at the most appropriate level within a system, depending on the functions and interaction required. The following integrations must be possible.

- LonWorks
- LonMark
- BACNet /LonWorks
- BACNet/IP
- OPC
- Integration of standard proprietary buses: Modbus, M Bus, KNX.

As part of the requirements for an open system devices with a Native BACnet protocol shall be connected onto a common field bus backbone network directly without any Gateway/Protocol converter device. If interaction is required between different sub-systems, the integration shall be carried out at either the automation or field level. The integration must not occur at the management level. Link to a third party software package such as a Planned Preventive Maintenance package or an Energy Monitoring package shall be carried out at the management level. When sharing alarm and historical information with Maintenance Management and Energy Management packages, the management system shall provide the information in a standard commercially available format e.g. MS Access and using standard mechanisms e.g. ODBC. Real-time ―live‖ information shall be transferred form the management system to a third party package e.g. MS Excel, either by a standard inter-application mechanism e.g. DDE or OPC or by developing a connection by using a documented API for the management system. Where a physical connection is required between a 3rd party device and the management system, the sub-system supplier shall provide the necessary line drivers and cables, documentation and support to make the connection into the device that will provide the protocol conversion.

Software Modules

The management station software shall be modular; object oriented, clearly structured and shall be based on Windows 2000 and Windows XP (or later) standard 32-bit technology.

The main software applications shall, as a minimum, include

- Plant Viewer : Graphics based operation of the plant
- Trend Viewer : Logging and display of measured values
- Alarm Viewer : Display of alarm messages
- Alarm Router : Automatic routing of alarms
- Log Viewer : Logging of alarms, system events and user activities

The Task Bar

The task bar shall be the 1st and last point of contact for all the interactions between user and system.

In addition to obtaining quick overview of vital system information, users shall be able to click on various icons in the task bar to switch from one program to another in the multi-tasking operating system. In systems, which include remote sites, the task bar shall be used to switch between sites (subject to user's access privileges).

To make the system easier for new users, the system shall support user-specific start-sequences with access to selected programs.

Features of the Task Bar

- Control of access privileges and security mechanisms for access to program modules and 3rd part software at login and log-out.
- User-and-password dependent access to systems and sub-systems
- Automatic user-specific start sequences
- Display of alarm and system message status, site connection status, time and date
- Facility to connect and terminate connection at various sites
- Simultaneous connection to a maximum of 4 sites

Plant Viewer

The plant viewer shall support the following features

- Hierarchically linked, animated high-resolution bit-map colour graphics (XGA 1024 x 768 pixels)
- Choice of 2D and 3D symbols with animation based on status
- Direct access to set points, parameters, operating modes, alarms, time-programs, on-line and off-line trend data features
- Dynamic multi-tasking with all active pages
- Monitoring and operation of plant at several levels
- Flexible operation of multiple pages using plant viewer navigation bar combined with standard handling of windows
- Navigation to all other management station software applications
- User-definable page size
- Jump tags for jumps on the same level or between levels
- ToolTips for all dynamic objects, with the option of 'User', 'Technical' or System' information
- Context-specific information (eg. data sheets) can be attached to any dynamic object
- Capable of graphics to be printed in colour or monochrome
- All 32 bit graphic file formats supported by Windows can be imported (eg AutoCAD, PCX etc.,)
- Dynamic display of the Psychrometric chart, enabling easy simulation of the air - conditioning processes.

Alarms Handling & Alarm Viewer

As a minimum, the system shall support the following features

- Operation and manipulation of alarms (based on user privileges)
- Alarm message printing
- Alarms printed independently of the management station (direct connection at automation level)
- Automatic pop-up windows for immediate display and operation of alarms (including pop-ups in 3rd party programs)
- Audible or multi-media alarm indication
- Continuous overview of all active alarms from site (updated automatically, displayed in order of priority, option of personalized view)
- Graphics based topological view of alarms
- Chronological alarm view
- Option of displaying detailed information
- Direct access to Associated plant graphics
- Comprehensive filter and search criteria (time, date, priority, discipline, alarm status etc.,)

- Colour coding based on alarm priority / alarm status (screen and printer)
- Alarms for out of limit values (high, low), change of state, run-time limits exceeded etc.
- Option of repeating unacknowledged alarms at regular intervals
- Creation of reports, with facility to print or export alarm data to 3rd party programs for further analysis
- Facility to save user-defined filter criteria
- User-specific configuration of the alarm view including on-line configuration

Alarm Routing

In order to monitor alarms round – the – clock, alarm routing is an important feature of the BMS. The BMS shall have the following features

- Routing of alarms to alarm printer, fax, pager or mobile phone
- Time schedule for each message recipient
- Alarm routing based on priority
- Alarm routing based on discipline (HVAC, Security etc.,)
- Alarms routing to person responsible at site
- Alarm routing based on text
- Alarm routing to person(s) responsible for specific equipment or systems
- Option of manual transmission of messages from the management system

Time Scheduling

The time-scheduler shall have the following features

- 7 day time programs
- Exception programs (local, building-wise or system-wise)
- Direct display of time programs within Plant viewer graphics
- Simple graphics programming of switch times
- Graphics based overview of all time programs in the system
- Graphics based overview of a 7 day programme including all exception programmes
- Graphics based overview of all plant points affected by a time programme
- Direct entry of various operating modes (comfort, stand-by, energy hold-off)
- Easy creation, modification and deletion of all time programmes
- Scroll features for fast access to specific weeks or days
- Storage and processing independent of management station
- Automatic synchronization of all time programmes in a system
- Support of different time zones (remote managed sites0
- Option of synchronization via radio clock
- Printed reports in various display forms

Trend Viewer

The Trend Viewer shall have the following features

- On-line or off-line real-time data
- Simultaneous display of up to ten signals per window
- Absolute or relative time intervals
- Zoom, scroll and cursor features for faster data analysis
- Flexible, easy-to-use scaling feature with charts displayed in 2D or 3D
- Drag-and-drop feature for trend views with automatic scaling and data export
- Off-line data logging triggered manually, automatically, or on a time or event basis
- Logging and intermediate storage of off-line trend data operates independently of the management
- Automatic upload from automation level to local or remote management stations
- Management station display and archiving of on-line and off-line trend data
- Print-outs of trend data
- Easy export of data to 3rd party software
- Facility to export trend data directly to auxiliary programs such as ADP (Advanced Data Processing) or to 3rd party software such as MS-Excel
- Trend Viewer time base can be used directly as a filter creation in Log Viewer

Log Viewer

The Log Viewer shall be categorized into the following sections

ALARM LOG → contains all incoming alarms in chronological order

SYSTEM LOG → shows at a glance if a printer somewhere in the system has run out of paper, or a hard disk is full. Communication events are also recorded here, showing for example when communication was established or terminated

USER LOG → lists al the activities carried out by the user at the management station, unauthorized attempts, modification of parameters, set points etc.,

STATUS LOG → to check the status of all incoming messages

The Log Viewer shall have the following features

- Storage of alarms routed to the management station
- Storage of all system messages (from printer, communications, management station, modem etc.,)
- Storage of all user activities performed at the management station
- Facility to enter and store user comments on events and activities
- Facility to display, at a keystroke, detailed information on every entry
- Extensive filter options to focus and reduce the volume of information displayed
- Comprehensive search features for fast access to information
- Facility to display an overview of data for a given day or week

- Once defined, filter and search criteria can be saved for future re-use
- Compact archiving of virtually un-limited number of entries (depending on hard-disk capacity)
- Automatic data management and archiving functions
- Facility to create and print log summaries
- Export of log entries for further analysis with 3rd party software (eg –MS access)
- User specific configuration of log view can be adapted directly on line

Internet Log Viewer (Optional)

This is an optional application, which offers users even greater freedom in the management of a site. A browser such as Microsoft Internet Explorer or Netscape Navigator, for example, provides the user with access to the log database from any PC with an Internet connection. Just as with standard log viewer, the user can then obtain an overall view of all the plant and events stored or monitored by the system.

The Internet Log Viewer shall be started without any special management station software on the user‘s PC. Access to the Log Viewer can be password protected.

A Web Control

The system shall have the capability to connect to remote sites through a web control module. Individual DDC general-purpose communication trunks (described elsewhere) shall have the feature to be connected to this web control module. This should facilitate viewing and controlling the DDC general-purpose controllers trunk via a remote PC / laptop. All parameters as appearing in the Portable Operator Terminal (described elsewhere) shall be available from this remote PC / laptop. The system offered shall have the facility to control / monitor the plant and equipment connected to these communication trunks via password protection.

Integration of 3P^{rdP} Part Software and Exchange of Data

The system shall support the use of standard interfaces and drivers that make it easy to integrate to 3rd party software directly at the management station level, or to make common use of data from the system, eg via ODBC (Open Database Connectivity). DDE (Dynamic Data Exchange) shall enable current data to be loaded continuously into a spread sheet program such as MS Excel, so that constantly updated graphs can be created for further processing.

Object Viewer

To make operations easier, the software shall have two viewing modes.

System View Provides hierarchical view of the system network.

User Designation View Gives a hierarchical breakdown of user addresses based on the system database.

In general, the system shall support the following features

- Fast navigation through the system
- Fast location of objects and alarms
- Detailed information of all objects
- Display of current values from the process level
- Modification of set points and parameters
- Users with appropriate access levels can also override outputs manually
- Two display modes system view and user designation view
- Search features
- Jump features and bookmark features as in various internet browsers
- Modification of users designation and alarms texts
- Customization of users addresses with a maximum of 10 hierarchical levels and up to 40 characters
- ―Find‖ function to locate system objects

Reports

Reports shall provide the user with the latest information from the system at specific times or when specific events occur. The following features shall be supported

- Reports routed on basis of time and / or priority
- Manual or automatic triggering
- User-definable or standard reports
- Facility to integrate 3rd party report programs into the management station software

Access Protection

The management station shall grant access to the system only to authorized users. The system administrator shall tailor an environment to match the individual requirements of each user. The access protection facility shall define the buildings (sites) and equipment to which a given user has access, the software modules and functions available to that user within the site. The system shall support the following features

- User name / password
- Individual access privileges covering access to sites, subsystems, program functions down to individual objects in Plant Viewer
- Up to 1000 users grouped into 100 user groups
- Automatic log – out (after period of inactivity0
- Encrypted passwords
- Network security provided by Windows NT access control

Hardware Requirements

Desktop Computer & Printer

It shall be as per the latest configuration available in the market. Printer shall be Laser Jet with black and white printing facility.

BACnet Routers

In addition to exchanging data with the management station and the other Controllers in the same network, a further capability of transferring non-critical, global data between DDC modules in different groups (i.e. on different buses).

The BMS offered must be capable of being extended with controllers on the BACnet protocol and the LON bus.

The BMS must allow integrating future BACnet controllers on the process level and providing inter-process communication with existing controllers.

The BMS must allow to be extended with controllers on the BACnet protocol and the LON Talk technology.

The BMS must allow for integration of BACnet devices on the process level via LON bus and on the management level via Ethernet TCP/IP.

DDC LON network

This network shall allow the DDC modules to communicate with each other and provides the user with access via the operator terminal to all the connected DDC controllers.

The DDC controllers, wherever used, within the same enclosure, should be connected to each other via flat bus cable and it should have the DATA network cable between distant controllers.

Upto 30 DDC modules, and a maximum of 10 operator terminals may be connected to one DDC LON network.

Data must be kept even in the event of power failure. Power failures and peak loads must not cause data loss.

Permanent self-monitoring of the system must be ensured by integrated test and service functions.

Suitable interfaces and appropriate in/outputs must allow the integration of all electrical and mechanical plants.

Central setting of parameters/structuring and programming

It must be possible to enter and/or amend all parameters (setpoints, control algorithms, time, etc.) and the structure diagrams (control and interlock programs) into the lower levels system controllers and DDC units-centrally from the management station and/or the operator terminal from the system controller with a download function. The system manager must be able to read and write all data centrally.

It must be possible to set the parameters and structure the application programs by using a graphic and element oriented programming language.

Portable Operator Terminal (Pot)

Each DDC Controller shall have a dedicated service port to plug in the portable operator's terminal (POT). It shall be possible to read, write and change any parameters on a bus by plugging the POT to any one of the Controllers on the communication trunk. The portable operator's terminal shall have facility on its fascia. The POT shall have minimum three password levels. Separate cabling for connecting the POT shall not be acceptable. Changing the parameters locally from any Outstation shall be done by POT, which is truly portable, and hand held and not via Laptops.

A local operator terminal shall allow full operation of all DDC control modules connected to the LonTalk BACnet network. Functions to include

- Alarm monitoring with acknowledgement and visual and audible alarm indication.
- Pop up window with detailed message for alarms and events
- Alarm and event history
- Data point display and operation of all measured values, setpoints, plant states, operating states and parameters
- Graphic based display and operation of all time schedules, exception calendar, online trending and heating curve.
- User specific configurable overview of main values in plant
- Multi user level access protection

The operator terminal shall have a high resolution six line illuminated display for graphics and text, keys for operation and a visual and audible common alarm indication. The textual information displayed must reflect the layout of building and plant with clear text English descriptions of up to 40 characters

Documentation

In order to have clear system documentation, the following documents have to be provided:

- System diagram
- Wiring diagram
- Lists of parameters

For hand-over all documents must be up to date and provided with the date.

Services

The type and scope of the required services are described below.

The rates for engineering, commissioning and adjustment must contain all services required to ensure optimum operation of the plants.

Engineering/Planning

In addition to the required, complete documentation, the service must include:

- Analysis of all functions together with the contractor
- Binding information about conditions of connection of equipment
- Scheduling and co-ordination with the contractor and design engineer

Commissioning/Adjustment

Function-oriented commissioning includes the following services, which are to be provided by BMS specialist:

- Verification of the external connections of the equipment
- Verification of the data transfer channels of the system
- Loading and testing of all basic and user programs belonging to the equipment
- Optimisation of the control parameters

Electric & Electronic Related Equipments

Ambient Conditions

All controls shall be capable of operating in ambient conditions varying between 0-40oC and 90% r.h. non-condensing.

Conduit Entry

All control devices shall, unless provided with a flying lead, have a 20 mm conduit knockout. Alternatively, they shall be supplied with adapters for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below the BMS/ Control Specialist shall include the following ancillary items:

Weather Protection

All devices, which are exposed to the atmosphere, are to be weather proofed. All controls, peripherals and associated accessories serving Chillers, Roof Mounted Air Handling Units and other equipment, which are exposed, shall be protected from Dust, Rain and Solar Radiation. Adequate protection shades etc., shall be provided by the EPC contractor

Pipe work Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed 1/2" or 3/4" BSPT suitable for the temperature, pressure and medium.

Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, lock nuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device, shall be provided by the MEP contractor.

Samples

Samples of all types of room mounted equipment (i.e. detectors, thermostats, etc.) shall be provided by the BMS/Controls Specialist for approval by the Engineer-in- Charge.

Accuracy

Control and measuring devices shall have the following limits of accuracy:

Temperature	:	+/- 1P^{0P}C over the range of 0P^{0P}C to 50P^{0P}C
Pressure	:	+/- 1.5% of measured value
Humidity	:	+/- 5% RH over the range of 10 to 90% r.h.

Averaging Elements

Averaging elements shall be used on supply air ducts having a cross-sectional area exceeding 1.6m2 and shall have a minimum capillary length of 8.2 m.

The capillary element shall be serpentined across the whole duct.

Where the span of the element is less than 1 m then it shall be fixed with purpose-made clips and may be unsupported across the duct.

Where the span of the element is above 1 m then it should be supported on Unistrut or similar rigid support. The element shall be clipped every 200m and the supports and hangers shall be adequate to prevent vibration of the element.

Pressure switches for Air Systems

Pressure switches for Air Systems shall be diaphragm operated. Switches shall be supplied with air connections permitting their use as static or differential pressure switches.

The switch shall be of differential pressure type complete with connecting tube and metal bends for connections to the duct. The housing shall be IP54 rated. The pressure switches shall be available in minimum of 3 ranges suitable for applications like Airflow proving, dirty filter, etc. The set point shall be concealed type. The contact shall be SPDT type with 250 VAC, 1A rating.

Shall be supplied suitable for wall mounting or mounting on ducts in any plane. It should be mounted in such a way so that the condensation flow out of the sensing tips. Proper adapter shall be provided for the cables.

The set point shall fall within 40%-70% of the scale range.

Shall have differentials adjustable over 10%-30% of the scale range.

Air flow Switches

The Airflow switches shall be selected for the correct air velocity, duct size and mounting altitude.

Where special atmospheric conditions are detailed in the Motor Control Panel Equipment Schedules, the parts of the switches shall be suitably coated or made to withstand such conditions. Any variations from standard shall be detailed in the Tender.

Shall be suitable for mounting in any plane.

Water flow switches

Water flow switches shall be selected for the correct water velocity and pipe size and mounting attitude.

Room Temperature / Humidity Detectors

The temperature sensor shall have sensitivities such that a change at the detector of 0.2oC from the stabilised condition is sufficient to start modulating the corrective element.

The temperature sensor shall be with silicon/ Ni sensor. The sensor shall be field wired using an unscreened cable to a base plate. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The protection standard shall be IP42/IP54 in accordance with IEC 529. These should be generally mounted 1.5 m above the floor level. These should not be mounted near the heat sources such as windows, electrical appliances, etc. The final location shall be as per the consulting engineers' approval. The sensor shall be linear over 0oC to 50oC.

Shall operate on extra-low voltage and be suitable for mounting on British Standard conduit boxes.

The humidity sensor shall be in an independent housing or be combined with the room/duct type temperature sensor in the common housing. The sensor should be electronic type with capacitive sensing element. As a minimum it should have a range of 10 to 90% RH.

Immersion/temperature detector and duct mounted temperature / humidity detectors

The temperature sensor shall have sensitivities such that changes at the detector, for $0.3P^{0P}C$ and $0.2P^{0P}C$ respectively, from the stabilised conditions, are sufficient to start modulating the corrective element.

The humidity sensor shall be in an independent housing or be combined with the room/duct type temperature sensor in the common housing. The sensor should be electronic type with capacitive sensing element. As a minimum should have a range of 5 to 95% RH & 0-35 Deg C for temperature.

The temperature sensor shall be with silicon/ Ni sensor. The sensor shall be field wired using an unscreened cable to a base plate. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The protection standard shall be IP54 in accordance with IEC 529.

The wiring terminals shall be plug-in type for easy installation and maintenance. The sensor shall be mounted in the duct based on the guidelines given by the specialist control supplier. The sensor shall be linear over 0oC to 50oC.

Pressure Detectors (for Liquids and Gaseous Media)

Pressure detectors shall be suitable for the suitable for the medium and the working temperatures and pressures. The pressure detector shall be capable of withstanding a hydraulic test pressure of 2 times the working pressure.

Connections shall be suitable for 1/2 to $1/8P^{thP}$ in O.D. copper tube.

Ductwork versions shall be supplied with the air connections permitting their use as static or differential pressure detectors.

The set point shall fall within 40%-70% of the sensing range of the detector.

The detector shall have sensitivity such that a change of 1.5% from the stabilised condition shall cause modulation of the corrective element.

The static pressure sensor shall be rated for IP65 and the differential pressure sensor shall be as a minimum IP54.

The principle of operation should be based on a hall-effect transducer. The diaphragm should be copper beryllium type.

The sensor must be pressure compensated for a medium temperature of -10 to 80oC with ambient ranging between -25 to 60oC.

Air Pressure sensor:

The pressure sensor shall be differential type. The construction shall be spring loaded diaphragm type. The movement of the membrane in relation to the pressure should be converted by an inductive coupling, which would electro magnetically give an output suitable for the controller. The pressure sensor shall in a housing having IP54 ratings in accordance with IEC529. Suitable mounting arrangement shall be available on the sensor. The sensor shall come complete with the PVC tubes, probes, etc.

Actuators

Shall be installed in accordance with the manufacturers' recommendations.

Shall have a sufficient torque to open and close valves and dampers against the maximum out of balance pressure across them.

Control Damper Actuators

Control Damper Actuators shall be of the type where the damper spindle passes through the actuator and is secured by a U clamp.

Rotary type damper actuators shall be used on the project. The actuators shall not require any maintenance. The actuators shall have sufficient torque ratings to operate the dampers of various sizes.

These should be available in spring return versions as specified elsewhere in the document. Limit switches, if required/specified shall be provided for.

The actuators shall be suitable for On/Off and modulating operations.

Actuator Additional features

Actuator Additional features are required when detailed in the Motor Control Panel Equipment Schedules or the Performance Section of the Specification.

Auxiliary Switches:

For On/off applications, the actuators shall have changeover contacts suitable for 220 VAC. 2 amp rating.

Auxiliary switch packs containing at least one, if specified two, electrically independent switches one for each end of the motor travel, adjustable for operation over at least half the motor travel.

Feedback signal

0 to 10 V dc. signal should be available from the modulating damper actuator for parallel operation or as feedback. Please refer the data point schedules / sequence of operation/ drawings to incorporate this feature wherever asked for.

Control Valves (Modulating)

General

All control Valves with KV lesser than or equal to 4 shall have RG5 gunmetal / red bronze body. Actuators shall be PWM or 0-10v dc modulating motor type or 3 point reversible motor type. PWM actuators shall be used in conjunction with controllers having in-built PID algorithm.

Control Valves with KV = 6.3 shall have RG5 gunmetal / red bronze body. Actuators shall be 3 point reversible motor type or 0 – 10 V dc modulating motor type. Actuators shall have manual override hand-wheel.

Control valves with Kv >6.3 shall have RG5 gunmetal / CI. Actuators shall be magnetic / or 0 – 10 V dc modulating motor type. Actuators shall have manual override hand-wheel.

Valves up to including 40 mm shall be rated for 16 bar Nominal Pressure. Valves for 50 mm and above shall be rated for nominal pressure of 10 bar, provided the operating pressure of the system is not greater than 6 bar. Valves above 100 mm shall be rated for 16 bar Nominal Pressure and actuators shall for these valves be magnetic / electro–hydraulic / motoric working a 0-10v DC modulating signal. Actuators for valves 100 mm dia and above shall have spring return feature as well as manual override hand-wheel.

All valves 15mm and above shall have range ability > 100.

Authority

All 3 port modulating valves shall be selected to have an authority between 0.4 and 0.68.

For systems using 2 port modulating valves, the EPC contractor shall furnish the controls‘ supplier details such as

Pressure drop across the index circuit based on which the pump head was calculated, the pump head calculation, the design head of the pump ordered for the project, the available pressure on the system and the nodal pressures on each branch circuit of each AHU / FCU.

Based on these data, the controls‘ supplier shall submit the working principle for valve selection.

Butterfly Valves

Butterfly valves shall be manufactured by the Controls Manufacturer or alternative, approved by the Engineer-in- Charge.

Occupancy Detector

The occupancy detector should be microprocessor based passive infrared detector for control of lighting equipment and VAV boxes in the room. The detector shall operate at 230VAC and will give a potential free output of minimum rating of 2 amps at 230VAC for control of lighting and VAV boxes for maximum energy savings and demand dependant controls. It should have an adjustable switch on delay of minimum 0…300 sec and an adjustable switch off delay of minimum 0.5…30 minutes. The detector should cover a minimum zone of 6 X 12 meters. The detector should be capable of detecting a

moving infrared source. It should be optimized to detect the low level of sedentary workers. The detector should have minimum sensitivity of 50cm physical movements. The detector should be minimum IP50 with CE conformance.

BTU Meters:

The flow meter used in the above meter should be based on the ultrasonic principle with no moving parts. The temperature sensors used in the above meter should have a measuring range of 0…130 deg C with a resolution of 0.1 deg C. The BTU meter should have a built in minimum 8 digit LCD display for display of parameters, values and faults. The meter should be compatible with the BMS system. The minimum functions to be provided by the BTU meter is as under:

- Calculation and storage of maximum values
- Storage of billing data
- Measurement of tariff dependent data
- Storage of 13 monthly cumulative energy/volume values in EEPROM.
- Detection of faults
- Display of values, parameters and faults
- Selectable scope of display
- Test and service functions.

The BTU meter should have a minimum sampling time for flow every 3 seconds and temperature 24 seconds. Possible displays to be indicated are KWH, MWH, GJ, MJ, KW, m3, m3/hr, h and Deg C. The heat meter should have a minimum accuracy of class 2 with CE conformance.

DDC Panels

The out-station panel housing the DDC controllers shall be located inside the conditioned area. Proper care shall be taken to ensure that there is no induction problem between the control and power cables. These panels shall be IP54 and supplied by the specialist controls supplier.

The DDC controllers located inside these out-station panels shall provide the required signals to the various equipments connected to these DDC controllers. The DDC controllers shall be capable of accepting digital input signals in the form of volt-free contacts from Motor control centres. The EPC contractor shall co-ordinate this activity.

All these outstations shall be connected with a communication bus cable and terminated to the BMS central station. The BMS supplier shall supply these bus cables.

It should be possible to connect the Portable hand held terminal to be connected to any of these panels and talk to any other DDC controllers on the same bus.

The Chillar Control center shall be capable to interface with a building automation system to provide for operation through BMS system.

The necessary gateway card /Chiller system manager for transmitting the Chiller Control center data to the BMS including any software development/ configurations shall be provided along with the chillers to get all operation data, alarms, alarm history, temperatures, pressures, amps, run hrs, remote chiller start/stop, reset of chilled water temperature, reset of current limit and status messages indicating chiller is ready to start, chiller is operating, chiller is shut down on a safety requiring reset, and chiller is shut down on a recycling safety etc.

The protocol for the gateways shall be Modbus-RTU / Modbus-TCP or BacNet IP / (MS/TP) as per the requirement. Cost of necessary hardware / software to integrate the chiller panel to BMS system shall be included by the chiller manufacturer / supplier. And the Subcontractor shall provide all data & access on to BMS for control and monitoring of entire HVAC system.

The HWG shall be BMS compatible and RS-485 Communication port shall be provided for remote programming and control.

Indoor Air Quality Monitoring Unit

Latest generation digital display type BMS compatible Indoor Air Quality (IAQ) Monitoring Unit to monitor and display PM 2.5, PM 10, CO2, RH etc for various air handling Units for return air. It shall include all necessary item and accessories as required such as sensors, control / communication / power cabling, transformer and adaptor etc. Display unit shall be mounted outside the AHU room. Unit shall display data in various colour for easy identification of Excellent / Good / Slight / Moderate / Heavy / Serious range limit.

Open Comms NIC Card

The Open Comms NIC (Network Interface card) shall transform the controls into manageable nodes within a Network, NMS and BMS system. This interface card shall communicate with external systems via the following industry standard open Protocols:

- Modbus RTU over EIA-485
- SNMP vI
- HTTP vI.L

The NIC card shall provide redundant paths for communications, making it possible to connect to existing BMS systems using Modbus while simultaneously communicating to the NMS through SNMP and HTTP.
All starter shall be compatible for Auto / Manual operation (BMS Compatible)

All incomer ACBs shall have following additional protections other than mentioned above.

On/ OFF, Trip and Ready to close status of each breaker should be available over modbus for BMS communication.

Features Requirements for Passenger Lift

Intercom link & parallel signals with BMS Room/ Control Room at Ground Floor level and one at Reception Lobby. Emergency alarm bell to Control Room/ BMS Room Hook up lifts on BMS which shall include potential free contacts for elevators for

b) Lift Direction
c) Lift Position
d) Lift not working/ under maintenance
e) Parking of lift at desired floor

Contractor shall provide diagrammatical representation of interface provision for BMS & provision mode in the controller

Digital BMS Computable Water Meters

Water meters of approved make and design shall be supplied for installation at locations as per approved drawings. The water meters shall meet with the approval of the local municipal authorities. Suitable valves and chambers to house the meters shall also be provided along-with the meters.

All meters shall conform to Indian Standard IS: 779-1978 (Water meters-domestic type) and IS: 2373-1981 (water meters-bulk type). Where called for water meters shall be located in masonry chambers of appropriated size.

All AC equipments shall be provided with permanent mounted identification labels and unique tagging numbers. The shop drawings shall also include these tagging numbers for easy identification on site. It should be co-ordinated with BMS also to ensure consistent equipment tagging among drawings, BMS display and site installation.

Extent of work

The work shall comprise of entire labour including supervision and all materials necessary to make a complete installation and such tests and adjustments and commissioning as may be required by the department. The term complete installation shall not only mean major items of the plant and equipments covered by specifications but all incidental sundry components necessary for complete execution and satisfactory performance of installation with all layout charts whether or not those have been mentioned in details in the tender document in connection with this contract.

Minor building works necessary for installation of equipment, foundation, making of opening in floors and restoring to their original condition, finish and necessary grouting etc. as required.

The work is EPC project. Any item required for completion of the project but left inadvertently shall be executed with-in the quoted amount.

Note:- EPC contractor shall have to prepare the I/O summary based on the Shop Drawings and submit it for approval from Engineer-in- Charge.

SCADA System

Supervisory Control and Data Acquisition (SCADA) System shall be provided with control system architecture using computers, networked data communications, graphical user interfaces for high-level process supervisory management, other peripheral devices such as programmable logic controller(PLC) and discrete PID controllers to interface with the various equipment, panels etc in all Electrical Substations.

The SCADA System comprising of complete Hardware & Software (latest version), wiring & cabling, allied accessories etc. along with facility to hook up / integrate through BMS communication cards shall be provided in Substation Building. Data from substation will be fetched through Network/ Cabling system. This system shall monitor & Control various Electrical parameters of all Substations equipment like HT / LT panels (VCB, ACB, Energy Meters, Relays etc.), Transformer (Temperature Parameters, RTCC panel etc.), DG Sets (Engine / Alternator Parameters, Synchronising Relay / PCCM parameters, Fuel Level etc.), Capacitor Panels (APFC relay parameters, Harmonic filters monitor panel parameter etc.), HSD Storage & Pumping system (Level of Storage Tanks, , Buffer tanks, Overflow Tanks Pumps etc) HSD consumption data generated on daily / monthly basis.

Power factor Correction Panel shall be BMS/SCADA Compatible.

LAN Infrastructure at different Floors of various building shall be used commonly for IPABX, BMS, Access Control System, CCTV etc. along with LAN.

UPS shall be equipped with communication card for data monitoring on SCADA & BMS System.

Full compatibility with BMS System of all three phases equipments shall be made.

Parameters to be controlled, monitored& programmed

S. No.	Description / Ranges	Function
1		**Chiller**
1	Start/ Stop	Chiller On / Off command
2	On / Off	Chiller Run Status
3	Local - Remote	Chiller local / remote status
4	Normal / Tripped	Chiller Trip / Fault status
5	Deg C	Chilled water supply header temperature
6	Deg C	Chilled water return header temperature
7	USGPM	Chilled water return header flow rate
8	Deg C	Chilled water outlet supply temperature at each chiller
9	Open / Close	Chiller isolation valves open / close command
10	Open / Close	Chiller out valves open / close status
11	Open / Close	Condenser isolation valves open / close command
12	Open / Close	Condenser out valves open / close status
13		Chiller microprocessor (software) integration for Chiller-intrinsic parameter monitoring
14	% RH	Outside air relative humidity monitoring
15	Deg C	Outside air temp monitoring
2		**Primary Chilled Water Pumps**
1	Start/ Stop	Chilled Water Pump on / off command
2	Auto-Manual	Chilled Water Pump auto manual status
3	On / Off	Chilled water Pump run Status
4	Normal / Tripped	Chilled water Pump trip Status
3		**Condenser Water Pumps**

S. No.	Description / Ranges	Function
1	Start/ Stop	Condenser Water Pump on / off command
2	Auto-Manual	Condenser Water Pump auto manual status
3	On / Off	Condenser water Pump run Status
4	Normal / Tripped	Condenser water Pump trip Status
4		**Secondary Chilled / Variable Hot Water Pumps**
1	Flow Status	S Chilled / Variable Hot Water Pump Flow Status
2		VSPS Microprocessor (Software) For Integration / Parameter Monitoring
5		**Tertiary Chilled Water Pumps**
1	Flow Status	T Chilled Water Pump Flow Status
2		VSPS Microprocessor (Software) For Integration / Parameter Monitoring
3	Open / Close	Pump main header isolation valves open / close command
4	Open / Close	Pump main header out valves open / close status
5	Deg C	Pump main header supply water temperature
6	Deg C	Pump main header return water temperature
7	USGPM	Pump main header return water flow rate
6		**Cooling Tower with Multiple Fan**
1	Start/ Stop	Cooling Tower fans on / off command
2	On / Off	Cooling Tower fan run status
3	Low / normal	Cooling Tower sump water low level
4	Open / Close	CT inlet isolation valves open / close command
5	Open / Close	CT inlet isolation valves open / close status
6	Open / Close	CT outlet isolation valves open / close command

S. No.	Description / Ranges	Function
7	Open / Close	CT outlet isolation valves open / close status
7		**Hot Water Generator**
1	Start/ Stop	Hot Water Generator On / Off command
2	On / Off	Hot Water Generator Run Status
3	Local - Remote	Hot Water Generator local / remote status
4	Normal / Tripped	Hot Water Generator Trip / Fault status
5	Deg C	Hot water supply header temperature
6	Deg C	Hot water return header temperature
7	USGPM	Hot water return header flow rate
8	Deg C	Hot water outlet supply temperature at each Generator
9	Open / Close	Hot Water Generator isolation valves open / close command
10	Open / Close	Hot Water Generator out valves open / close status
8		**AHU**
1	Start/ Stop	AHU on / off command - Supply Blower
2	Auto-Manual	AHU auto manual status - Supply Blower
3	On / Off	AHU air flow status - Supply Blower
4	On / Off	AHU Pre filter status
5	Deg C	Return air temperature monitoring
6	% Open	CHW modulating valve control
7		VFD for AHU Microprocessor (Software) For Integration / Parameter Monitoring
8		VAV Box Microprocessor (Software) For Integration / Parameter Monitoring
9		**AWS / Scrubber / Fan Section**

S. No.	Description / Ranges	Function
1a	Start/ Stop	AWS / Scrubber / Fan Section fans on / off command - Test Run
1b	Auto-Manual	AWS / Scrubber / Fan Section fans auto manual status
1c	On / Off	AWS / Scrubber / Fan Section fans run status
1d	On / Off	AWS / Scrubber / Fan Section Pre filter / Pad status - Supply Side
10		**Air Cooled Packaged / Precision AC Unit**
1	Start/ Stop	ACPU on / off command
2	Auto-Manual	ACPU auto manual status
3	On / Off	ACPU air flow status - Supply Blower
4	On / Off	ACPU Pre filter status - Supply Side
5	On / Off	ACPU Fine filter status - Supply Side
6	Deg C	Return air temperature monitoring
7		ACPU Microprocessor (Software) For Integration / Parameter Monitoring
11		**Axial Fan**
1a	Start/ Stop	Lift / Staircase Pressurisation fans on / off command - Test Run
1b	Auto-Manual	Lift / Staircase Pressurisation fans auto manual status
1c	On / Off	Lift / Staircase Pressurisation fan run status
12		**Fire Fighting System (Fire Pump House)**
1	psig	Hydrant pressure monitoring
2	On / Off	Jockey Pump run status
3	On / Off	Sprinkler Pump run status
4	On / Off	Fire Pump Run Status (Electrically driven)

S. No.	Description / Ranges	Function
5	On / Off	Fire Pump Run Status (Diesel driven)
6	Voltage	Diesel Engine Pump Battery Status
13		**Fire Fighting System (Terrace Pumps)**
1	On / Off	Fire Pump Run Status (Electrically driven)
14		**Water Supply System, WTP**
1a	Start/ Stop	Raw Water Feed pumps on / off command
1b	On / Off	Raw Water Feed pumps run status
1c	Auto-Manual	Raw Water Feed pumps auto manual status
2a	Start/ Stop	Treated Water Transfer pumps (Domestic & Flushing) on / off command - 2 Set or as required
2b	On / Off	Treated Water Transfer pumps (Domestic & Flushing) run status
2c	Auto-Manual	Treated Water Transfer pumps (Domestic & Flushing) auto manual status
3a	Start/ Stop	Soft Water Transfer pumps on / off command
3b	On / Off	Soft Water Transfer pumps run status
3c	Auto-Manual	Soft Water Transfer pumps auto manual status
4a	Start/ Stop	R/O Water Transfer pumps on / off command - 1 Set or as required
4b	On / Off	R/O Water Transfer pumps run status
4c	Auto-Manual	R/O Water Transfer pumps auto manual status
5	Start/ Stop	Chlorine dosing pumps on / off command - 1 Set or as required
6a	Low / High	Low/High level in Raw water tanks
6b	Low / High	Low/High level in Treated water tanks
6c	Low / High	Low/High level in Soft water tanks
6d	Low / High	Low/High level in fire water tanks

S. No.	Description / Ranges	Function
6e	Low / High	Low/High level in R/O water tanks
6f	Low / High	Low/High level in flushing / irrigation water tanks
7a	High / Normal	High/Normal Level in Sump
7b	Start/ Stop	Sump Pumps on / off command, (1W+1S), 2 Set or as required
7c	On / Off	Sump Pumps run status, (1W+1S), 2 Set or as required
7d	Auto-Manual	Sump Pumps auto manual status, (1W+1S), 2 Set or as required
15		**STP / ETP**
1	Start/ Stop	Blower on / off command
2	Auto-Manual	Blower auto manual status
3	On / Off	Blower run status
4	Start/ Stop	ETP & STP Feed Sump pump on / off command
5	Auto-Manual	ETP & STP Feed Sump pump auto manual status
6	On / Off	ETP & STP Feed Sump pump run status
7	Start/ Stop	Screw pump on / off command
8	Auto-Manual	Screw pump auto manual status
9	On / Off	Screw pump run status
10	Start/ Stop	Sludge recirculation pump on / off command
11	Auto-Manual	Sludge recirculation pump auto manual status
12	On / Off	Sludge recirculation pump run status
13	Start/ Stop	Chlorine dosing pump on / off command
14	Auto-Manual	Chlorine dosing pump auto manual status
15	On / Off	Chlorine dosing pump run status
16	Start/ Stop	Filter & Softener Feed pump on / off command

S. No.	Description / Ranges	Function
17	Auto-Manual	Filter & Softener Feed pump auto manual status
18	On / Off	Filter & Softener Feed pump run status
16		**Solar Recirculation Pump**
1	Start/ Stop	Solar Water Pump on / off command
2	Auto-Manual	Solar Water Pump auto manual status
3	On / Off	Solar water Pump run Status
4	Normal / Tripped	Solar water Pump trip Status
17		**Water Tanks**
1a	Low / High	Low/High level in Domestic water tanks - Overhead
1b	Low / High	Low/High level in Flushing water tanks - Overhead
18		**Plumbing Heat Pump System**
1	Start/ Stop	Heat Pump on / off command
2	Auto-Manual	Heat Pump auto manual status
3		Heat Pump Microprocessor (Software) For Integration / Parameter Monitoring
19		**Hydro pneumatic Pump**
1	Start/ Stop	Hydro pneumatic Pump on / off command
2	Auto-Manual	Hydro pneumatic Pump auto manual status
3	On / Off	Hydro pneumatic Pump run Status
4	Normal / Tripped	Hydro pneumatic Pump trip Status
20		**Lift**
1	Fault / Normal	Monitor fault status of all lifts
2	Floor level	Monitor floor positions status of all lifts per floor
21		**Electrical System**

S. No.	Description / Ranges	Function
1	On / Off	HT breaker on / off status
2	On / Off	HT trip status
3	On / Off	Transformer status (nos.)
4	On / Off	LT panel on / off status
5	On / Off	DG Set I/C Breaker status
6	On / Off	DG Synchronisation Panel status
7	On / Off	Change Over Panel status
8	Parameters	MFM with Harmonic measure
9	Parameters	MFM for LT Panel
10	On / Off	Chiller Panel I/C Breaker
11	On / Off	Main DG Backup Panel I/C Breaker status
12	On / Off	Non DG Backup Panel I/C Breaker status
13	Parameters	MFM for Panels I/C (Integration)
14	Parameters	Energy Meters for Lighting & AHU (Integration)
15	On / Off	Rising Main End Feed Panel I/C Breaker status
16	On / Off	Common Area Panel I/C Breaker status
17	Parameters	Energy Meters for Flats (Integration)
18	Parameters	UPS (Integration)
19	Parameters	Fire Detection & Alarm System (Integration)
20	Parameters	PA System (Integration)
21	Parameters	CCTV System (Integration)
22	Parameters	Lighting Automation (Integration)
23	Parameters	Solar Power System (Integration)
24	Electrical parameters	LT Panel / Transformer Electrical Parameter monitoring (metering feeders qty.) - KW / A / V /

S. No.	Description / Ranges	Function
		Hz / KVAR
25	Electrical parameters	UPS Panel Electrical Parameter monitoring (metering feeders qty.) - KW / A / V / Hz / KVAR
22		**DG System**
1		DG microprocessor (software) integration for DG-intrinsic parameter monitoring
2	Low / normal	DG Fuel Storage tank low level
3	Voltage	DG Battery voltage status
23		**HSD System**
1	Oil Level	Oil level monitoring
2	Start/ Stop	Transfer / Overflow Pump on / off command
3	Auto-Manual	Transfer / Overflow Pump auto manual status
4	On / Off	Transfer / Overflow Pump run Status
5	Normal / Tripped	Transfer / Overflow Pump trip Status
6	Flow	Incoming diesel flow monitoring

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Note:- BMS system of existing facility shall also be hooked with the proposed IBMS system of Pkg-2. EPC contractor is required to collect the existing system status and incorporate all necessary item as required for successful hook and commissioning of entire IBMS System.(if available)

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-12

ACCESS CONTROL SYSTEM

GENERAL COMMERCIAL & TECHNICAL CONDITIONS:

1.0 All the works shall be carried out as per CPWD General specification for Electrical Works, Part-I (Internal) 2013 & Part-II (External) 1994, amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable, amended up to date.

2.0 The contractor is advised to visit the site of work to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

3.0 **Rates:**

3.1. The work shall be treated as on works contract basis and the rates tendered shall be for complete items of work (except the materials, if any, stipulated for supply by the department) inclusive of all taxes (including works contract tax, if any), duties, and levies etc. and all charges for items contingent to the work, such as packing, forwarding, insurance, freight and delivery at site for the materials to be supplied by the contractor, watch and ward of all materials (including those supplied by the department, if any) for the work at site etc

3.2. Prices quoted shall be firm.

4.0 **Completeness of Tender:**

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

5.0 **Works to be arranged by the department:**

Unless and otherwise specified in the tender documents, the following works shall be arranged by the Department:

(ii) Supply of materials to the contractor if stipulated in the tender documents.

6.0 Works to be done by the contractor:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

(i) Foundations for equipments and components where required, including foundations bolts.

(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubical switchboard etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.

(v) Testing and commissioning of completed installation.

(vi) Storage space for all equipments, components and materials for the work

7.0 **Storage and Custody of Materials:**

The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra payment will be made on this account.

The main contractor shall arrange for proper storage of the equipments at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

8.0 **Electric Power Supply and Water Supply:**

Power and water supply will be arranged by the contractor at the site for installation purpose.

However, for final testing purpose after complete installation of the electrical items, electricity supply will be made available free of cost to the contractor. Contractor will take due care to ensure safety of electrical installation during execution of work.

9.0 **Tools for handling and Erecting:**

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

10.0 **Payment Terms:**

Payment shall be made as per the relevant clauses of forming part of the tender documents.

11.0 **Co-ordination with other agencies:**

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work. Recessed conduit and other works, which directly affect the progress of building work, should be given priority.

11.1. **Care of buildings:**

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

12.0 Structural Alterations to Buildings:

(i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge.

(ii) Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these required modifications, or fresh provisions are required to be made, such contingent works shall be carried out by the contract at his cost.

(iii) All such openings in floors provided by the department shall be closed by the contractor after installing the cables/conduits/rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.

(iv) All chases required in connection with the electrical works shall be provided and filled by the contractor at his own cost to the original architectural finish of the buildings.

13.0 **Addition to an installation:**

Any addition, temporary or permanent, to the existing electrical installation shall not be made without a properly worked out scheme/design by a qualified Electrical Engineer to ensure that such addition does not lead to overloading, safety violation of the existing system.

14.0 Drawings:

(i) The work shall be carried out in accordance with the approved drawings and the tender documents and also in accordance with modification thereto from time to time as approved by the Engineer-in-charge.

(ii) All wiring diagrams shall indicate the main switch board, the distribution boards (with circuit numbers controlled by them), the runs of various mains and sub mains and the position of all points with their controls.

(iii) All circuits shall be indicated and numbered in the wiring diagram and the points shall be given the same number as the circuit to which they are electrically connected.

(iv) After award of the work, the firm will be required to submit the drawings for the proposed work including layout plan, conduit routes etc. Work will be carried out as per the approved drawings.

15.0 **Conformity to IE act, IE Rules, and standards:**

15.1. All electrical works shall be carried out in accordance with the provisions of Indian Electricity Act, 1910 and Indian Electricity Rules, 1956 amended up to date (Date of call of tender unless specified otherwise). List of rules of particular importance to electrical installations under these General Specifications is given in Appendix C for reference.

16.0 **General requirements of components:**

16.1. **Quality of material:** All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

17.0 **Inspection of materials and equipments:**

17.1. Materials and equipments to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:

(i) Inspection of materials / equipments to be witnessed at the Manufacturer‘s premises in accordance with relevant BIS /Agreement Inspection Procedure.

(ii) To receive materials at site with Manufacturer‘s Test Certificate(s)

(iii) To inspect materials at the authorized dealer‘s go downs to ensure delivery of genuine materials at site.

(iv) To receive materials after physical inspection at site.

17.2. Adequate care to ensure that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall ensure that:

(i) Material will be ordered & delivered at site only with the prior approval of the department to ensure timely delivery.

(ii) As and when the order is placed for equipments its copy shall be endorsed to the WAPCOS Engineer-in-charge.

(iii) The firm will be required to procure material directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the contractor before installation at site to the department.

(iv) Inspection at factory or at godown of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the fittings shall have to provided duly signed by the manufacturer‘s officer not below the rank of Regional Manager.

(v) Delivery of material shall be taken up only with the consent of department, after clearance of the material.

(vi) Department shall reserve the right to waive inspection in lieu of suitable test certificate, at its discretion.

17.3. Similarly, for fabricated equipments, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.

18.0 **Ratings of components:**

18.1. All components in a wiring installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.

18.2. All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

19.0 **Conformity to standards:**

19.1. All components shall confirm to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.

19.2. Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

20.0 **Interchangeability:**

Similar parts of all equipments and all other fittings of the same type shall be interchangeable in each installation.

21.0 **Workmanship:**

21.1. Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall confirm to sound engineering practice.

21.2. Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out

instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

21.3. Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.

21.4. Fabrication in reputed workshop: Switch boards and LT panels shall be fabricated in a factory/workshop having modern facilities like quality fabrication, seven tank process, powder/epoxy paint plant, proper testing facilities, manned by qualified technical personnel. These shall be as per make / item approved.

22.0 **Testing:**

All testes prescribed in this General Specification, to be done before, during and after installation, shall be carried out, and the test results shall be submitted to the Engineer-in-charge in prescribed Performa, forming part of the Completion Certificate.

23.0 **Commissioning on completion:**

After the work is completed, it shall be ensured that the installation is tested and commissioned.

24.0 **Completion plan and completion certificate:**

24.1. For all works completion certificate after completion of work as given in Appendix –E of CPWD Specification shall be submitted to the Engineer-in-charge.

24.2. Completion plan drawn to a suitable scale in tracing cloth with ink indicating the following, along with three blue print copies of the same shall also be submitted.

(i) General layout of the building.
(ii) Locations of main switchboard and distribution boards, indicating the circuit numbers controlled by them.
(iii) Position of all points and their controls.
(iv) Types of fittings, viz. fluorescent, pendants, brackets, bulk head, fans, exhaust fans etc.
(v) Name of work, job number, tender reference, actual date of completion, names of Division/ Sub-division and name of the firm who executed the work with their signature.
(vi) Cable layout showing general distribution diagram along with position of cable joints, if any.

25.0 **Guarantee**

The installation will be handed over to the department after necessary testing and commissioning. The installation will be guaranteed against any defective design/workmanship. Similarly, the materials supplied by the contractor will be guaranteed against any manufacturing defect, inferior quality. The guarantee period will be for a period of 36 months including AMC from the date of handing over to the department. Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit guarantee of material from the manufacturer to the department.

ACCESS CONTROL SYSTEM:

Supplying installation,testing and commissioning of acess control system for building security comprising of controller, E&M locks, reader, smart cards, cabling, recording,display system,hardware software system as required.

1.0 SYSTEM OVERVIEW

1.1 The Integrated Security Management System (ISMS) shall be a modular, networked access control system capable of handling large proprietary corporations with multiple remote sites, alarm monitoring, video imaging, badging, paging, guard tour. The system shall allow for easy expansion or modification of inputs, outputs, and remote control stations.

1.2 The system control at the central computer location shall be under a single software program control, shall provide full integration of all components, and shall be alterable at any time, depending upon the facility requirements. Reconfiguration shall be accomplished online through system programming, without hardware changes.

1.3 The software program shall be a true 32-bit, 3-tier client/server. The software program shall operate in one of the following environments; Windows 2003 Server, Windows Vista Business, Windows XP Professional SP2, Windows 2000 Professional or Server using Service Pack 4.

1.4 The system shall support multiple communication servers on a LAN/WAN, to provide distributed networking capabilities, which significantly improve system performance.

1.5 The database architecture shall be MSDE 2000 as standard with the capability to utilize Microsoft SQL Server 2005; SQL Server 2005 Express Edition or SQL Server 2000.

1.6 The system shall have the capability to communicate with the control panels via LAN/WAN connections utilizing industry standard communication protocol.

1.7 The software program shall use Abstract Devices (ADV) for representing hardware devices in the system. The ADVs shall be used in Floor Plans to provide the user interface to control and monitor the system, and shall also be used in the Data Trees to organize, display, and control system information.

1.8 The system shall support both manual and automatic responses to alarms entering the system. Each alarm shall be capable of initiating a number of different actions, such as activation of remote devices, door control, and activation of WAV files.

1.9 The system shall provide both supervised and non-supervised alarm point monitoring. Upon

recognition of an alarm, the system shall be capable of arming or disarming alarm points both manually and automatically, by time of day, and by day of week.

1.10 Access control functions shall include validation based on time of day, day of week, holiday scheduling, site code and card number verification, automatic or manual retrieval of cardholder photographs, and access validation based on positive verification of card, card and PIN, card or pin, pin only and Site Code only.

1.11 Alarm events with defined priorities shall be able to pop-up automatically in an Alarm event window for operator attention. The pop-up shall display the name of the event (reader, alarm point, cardholder or system alarm), time, date, site, account, if a card event the card number, type of event and cardholder name. An event counter shall also display the number of times the event was reported to the Alarm event monitor prior to Acknowledgement or Clearing the event. Event instructions shall be made available by double clicking on the event.

1.12 The Alarm event window shall allow the operator to initiate a physical response to the event as well as a written response. Responses shall include but not be limited to: acknowledge, clear, open a pre-programmed floor plan, energize, de-energize, pulse, time pulse, add comment, shunt or un-shunt.

1.13 Assigned passwords shall be possible to define the levels of system operation for each individual operator. System operation for individual operators shall include, but not be limited to, restricted time periods for login, available accounts and default language selection at login. Operator actions range from no view or control rights to basic monitoring including the ability to block the viewing of card and or personal identification numbers, to full control of the system including programming.

1.14 The system programming shall be user friendly, and capable of being accomplished by personnel with no prior computer experience. A quick start wizard shall allow the operator to easily program a system including basic time zones, access panels (IP connection, Modem Pools or direct connections to an RS-232 port), card activation to a general purpose access area and deactivation date. The software shall utilize drop boxes for all previously entered system-required data. The programming shall be MENU driven and include online –Help‖ or –Tutorial‖ information, as well as online data entry examples. The Help shall be available by using the F1 key. When using the F1 help access, the help menu will provide detailed information relative to the operation that the user is performing without the need to key in additional search parameters. An operation Tutorial shall also be provided with the access control software. The contents of the Tutorial shall include, but not be limited to: Floor plan setup and control, Visitor management integration, and Intrusion integration and operation.

1.15 After installation, the Customer shall be able to perform hardware configuration changes. These hardware configuration changes shall include, but not be limited to, door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases as desired; For the intrusion system, any function that can be programmed from a

physical keypad shall also be available from the system's virtual keypad, without the services of the Contractor or Manufacturer.

1.16 Equipment repair shall be able to be accomplished on site, by module replacement, utilizing spare components.

Basic System Capabilities

The following functional capabilities are considered essential for the system described in this specification. The capabilities are to be considered standard, without the need for add-on software or hardware.

- **General**

i. All databases will have the ability to ADD, DELETE, REPORT, VIEW or EDIT information.

ii. Provide storage of all system transactions in a retrievable file.

iii. Log all events by time and date with reference to GMT.

iv. Provide capability to store all or selected system transactions to a disk file.

v. Provide ability for CUSTOMER to make system configuration changes such as, but not limited to door open time, door contact shunt time, point and reader names, when and where a cardholder is valid, and the ability to add or modify card databases at any time.

vi. Support ―Global Anti-pass back‖, allowing cardholder to enter/exit any card reader on the same RS485 drop line.

vii. Duress feature where when a PIN is used in conjunction with a card read, the number of digits are selected at the keypad where the PIN number is a value of one different from the normal PIN.

viii. Provide mode of system operation that stores system commands that were not accepted by the hardware.

ix. Provide mode of system operation that requires the operator to enter a response to an event when acknowledging it from the alarm view window.

x. Provide mode of system operation that allows acknowledged alarms to be automatically cleared.

xi. Provide mode of system operation where un-acknowledged events will cause the computer to continuously emit a pulsating beep until all un-acknowledged alarms are acknowledged. A momentary silence feature shall allow the beeping to cease for up to 60 seconds. The silence feature shall also provide a visual countdown to when the beeping will begin again.

xii. Provide mode of system operation where when an acknowledged, but not cleared event will be reissued requiring acknowledgement when the event changes to an alarm or trouble state.

xiii. Provide mode of system operation that does not allow the operator to clear an alarm prior to it being restored to normal.

xiv. Provide ability for manual operator control of system output relays. The manual functions shall include the ability to energise, de-energise, return to time zone, or pulse the output relay. The pulse time shall be a programmable setting.

xv. Provide ability for manual operator control of system doors. The manual functions shall include the ability to Lock, Un-Lock, Shunt, Un-Shunt and Return to Time Zone.

xvi. Provide ability to automatically display stored –video image‖ of cardholder

xvii. The cardholder ―video image‖ pop-up shall be activated based on a priority level set to the cardholder or reader. Information in the pop-up shall include, but not be limited to the cardholder‘s primary image a live video pop-up showing the person who initiated the pop-up, entrance name, time, date, cardholder name, and status. User shall be able to display up to 40 note fields. The size of the pop-up(s) shall be adjustable by the operator.

xviii. Support multiple card reader technology including Proximity, Wiegand effect, Biometrics, Magnetic stripe, Bar Code, Keypad, Card/keypad (PIN), High-speed long range Vehicle ID, Smart Card

xix. Provide a means for scheduled automatic backups of any or all database system files. A means to restore these files from a simple menu shall exist.

xx. Provide the ability to address up to 2 serial communication ports, where each port can be configured for either hardwired or dial-up. When configured for dial-up, any one port can support multiple dial-up locations.

xxi. Communication from the access control server to the remote control panels shall be selectable. Communication options shall be via RS-485 converter, dial-up, leased line from a defined communication port or by LAN/WAN using an IP address for direct connection to the remote RS-485 converter via network interface card. When using IP addressing it shall be un-acceptable to use a communication port converter device on the communication server side of the transmission. A minimum of 64 such IP connections shall be allowed.

xxii. All commands and updates to the panels shall be verified and shall automatically retry if communications have failed.

xxiii. Provide a system scheduler that shall automatically:

1. Call remote locations to retrieve history transactions and update panel information, including time and date.
2. Activate or deactivate cards locally or at remote dial-up sites.
3. Initiate a pre-programmed command event/action.
4. Synchronize system to controller time.

xxiv. A host grant mode of operation shall exist that requires the host computer to grant accesses to ―valid‖ cards. An alternate host grant mode shall allow the card access information to be downloaded along with unlocking the door for ―valid‖ cards.

- **Card Database**

i. Provide a simple card and card holder database import utility. The utility shall be password protected and accessible only to administrators of the access control system. Information that can be imported shall include but not be limited to: First Name, Last Name, card number, activation date, de-activation date, status, up to 40 note fields and photo images. A simple CSV (comma separated value) file shall be used for the importing of data and image file names.

ii. Cardholder information shall include unique card number up to 15 digits and optional Personal Identification Number.

iii. Allow multiple cards per cardholder.

iv. Allow for up to 16 access levels to be assigned to a card, or a single ―precision‖ access level. When using ―precision‖ access levels it shall be possible to create a unique access level per card using an existing access level as a baseline template. This customized card access level shall have both beginning and ending dates.

v. Provide 30 user definable fields.

vi. Each card holder note filed shall allow the option to be entered as free form data or structured data. Structured data shall be by use of a template or drop list. The template and drop list shall be created by the operator. The capacity of the template shall allow for up to 65,000 characters.

vii. Provide special card options that include, but are not limited to:

1. Time zone reference, which defines valid time.
2. Visitor use, which provides a specified activation date and expiration date (spanning years).
3. Trigger control value, which can initiate a predefined procedure at the intelligent control independent from any control function from the system computer.

viii. Provide a card –Trace‖ function. The Trace function shall allow normal access control, but will provide a tracking alarm at the system monitor.

ix. Provide ability to store digital images and written signature of cardholder.

x. Provide the ability to prioritise specific card usage from 1 to 99 with separate priority options for Anti-pass back, Trace, PIN Violation, Normal, Not Found, Expired, Host Grant, Site Code and Time Zone card activities or violations.

xi. Allow the user the ability to assign an operator message per card event state.

xii. Upon editing card information, the updated information shall be sent automatically to the appropriate access control panel, when hardwired, with no other user intervention. If the port is dial-up, the entry will be stored on disk and shall be updated when connection is made to the remote loop. If the scheduler is used, then card updates shall be sent based on scheduling.

xiii. In a traditional (Wiegand) 5-digit card database, the numbers 0 and 65,535 shall not be valid card numbers as some devices transmit these numbers on an improper read.

xiv. In a 15-digit card database, the number 0 shall not be a valid card number as some devices transmit this number on an improper read.

xv. A card shall have the ability to be allowed to access one or selected accounts up to all available accounts.

- **Access Levels**

i. It shall provide the ability to define specific times of access, specific readers for access, provide a template of a defined access level detail, where changes can be made to the template and saved as a new access level detail and provide an access control tree structure that allows groupings of entrances. User shall have the ability to group program all entrances on the branch or make specific changes to individual entrances.

- **Alarm Monitoring – Alarms Only View**

i. Report alarm point activity.

ii. Provide colour for each specific alarm point action of ―Alarm‖, ―Normal‖ and ―Trouble‖, conditions.

iii. Provide the ability to access the default floor plan graphic for any active alarm point by a right click option, to acknowledge any alarm, card, or reader activity based on priority and to bypass alarms in the system

iv. Execute alarm notification in all modes of operation.

v. Provide display of system activity with the higher priorities displayed at the top of the list with identical points stacked with a frequency count of each point‘s change of state.

vi. Provide ability for the operator to acknowledge and clear alarms from display. Prior to acknowledgment, the user shall be allowed to enter a response per alarm. The system shall offer a means to require acknowledgement of an alarm before it can be cleared.

vii. Provide a display of the most current transactions in real time.

viii. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer‘s video display terminal.

ix. Provide an alarm view filter that is structured as a tree allowing the operator to select individual devices or groups of devices to be viewed.

x. Provide a ―Panel Not Responding‖ alarm if communication to a panel is lost.

xi. Provide real time printing of alarms as they occur by line printing with a dot matrix printer or provide printing of alarms, one page at a time, using typical Windows page printing.

- **Alarm Monitoring/System Control – Tree View**

i. Provide the ability for dynamic alarm monitoring of alarm points in real time on the system computer‘s video display terminal

ii. Provide colour and icon shapes for each specific alarm point action of ―Alarm‖, ―Normal‖ and ―Trouble‖, and ―Shunted‖.

iii. Access control panels in the alarm tree, like alarm points, shall also indicate if they are in the buffered mode of operation as well as any –system‖ related alarm such as –Tamper‖ or —Primary Power Loss‖ or Loss of communication.

iv. Devices connected to the communication server shall provide additional popup information as to the communication port or IP connection the device is programmed for.

v. Provide a means to launch a Virtual keypad from an intrusion panel partition to monitor the physical keypad remotely and to administer programming changes via the Virtual keypad.

- **Operator Database**

i. The software shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change or delete.

ii. The ability to view, edit or delete cardholder sensitive information such as note fields, card number and PIN shall be definable by field per operator.

iii. Define the accounts that the operator has access to.

iv. Provide the ability to log operator actions in the history files.

v. Provide default language to be used based on operator‘s login.

vi. Provide specified time periods that the operator can log in.

- **Reports**

i. Provide reporting capability for printing of selected system transactions from the disk files by specific time and date selection, range from time and date to time and date, or from start time to end time each day of the selected date range.

ii. Provide feature to generate a history report for an alarm point(s) state. An alarm point state shall be defined as Normal, Alarm, Trouble, or Ajar.

iii. Provide feature to generate a history report of system alarms. A system alarm state shall be defined by panel and include any of the following information: communication, ground fault, power, panel reset, low voltage, panel tamper, and loop communication.

iv. Provide feature to generate a history report for a card(s) state. A card state shall be defined as Normal, Trace, Not Found, Anti-Pass back Violation, PIN Violation, Time Zone Violation, Site Code Violation, or Expired card. Additional search criteria shall include cardholders that meet up to at least 3-note field restriction and filter the report with defined reader location(s).

v. Provide feature to generate a history report for system operator(s) activities. The report shall include time, date, operator name the device associated with the action and the type of action performed by the operator. Activities shall include but not limited to: acknowledged and cleared transactions, door and relay control such as unlock, lock; door and input control such as shunt, unshunt; login, logout, panel initialisation, panel buffer and panel unbuffer.

vi. Provide complete database reporting of all data programmed into the system data files.

vii. Provide a means to define how long a card holder has been in a defined area. This report shall allow the time to be accumulated representing an attendance report. The definable filters shall include time/date range, reader(s) definition, card number, card holder and note field. The output of the report shall allow sort options to include First Name, Last Name, Event Time, and Card Number. The sorted data shall be selectable as Alpha or Numeric sorting and Ascending or Descending.

viii. Provide feature to generate a report based on the frequency of usage of a card. The report shall allow the operator to define a time/date period, a minimum and maximum usage limit, a means to define which reader or readers should be used to filter the report and the ability to further define the type of card to be reported on based on note field selections. This report shall also provide a disposition function. The cards meeting the filtering criteria shall be acted upon based on the disposition setting. Disposition settings shall include but not be limited to: Report only, De-activate the card or Re-assign to a specified an access level. This report shall be available in the event scheduler. When defining when to run the report an option to select the number of previous days to run the report against shall be provided. As an example a scheduled weekly report for the last 14 days could generate allowing for an overlap of time if desired.

- **Time Zones**

i. Time zone definitions shall include Starting time, Ending time, Days of the week, and Holiday override.

ii. Minimum time zones that can be assigned to a panel shall be 24 and maximum unlimited.

iii. Holidays shall be definable in two different time zones allowing different time schedule to be programmed for each holiday type.

- **Special System Functions**

The manufacturer of the system shall provide in the system software the following unique applications as standard:

i. Guard Tour

- Guard Tour shall allow the operator to program a series of guard check points that must be activated to accomplish the task of a Guard Tour.
- The check point shall be either reader points or alarm contact points or a mixture.
- The Guard Tour can be timed sequential allowing travel time between points with +/- tolerance. This type of tour shall allow alarms to be generated for early, missed or late events.
- The Guard Tour can be un-sequenced with no time parameters.
- The Guard Tour shall be started by two methods, Manual or Scheduled by the access control system scheduler.

ii. ID Badging System/Video Image System

- Allow any card data fields to be assigned to a badge.
- Allow a stored cardholder image to be associated to any background. Each cardholder shall have any one of the background layouts associated to it.
- Provide the ability to create temporary or permanent badges.
- Badges shall be printed without the need to assign an access level or access control card number. Numbers and access levels may be assigned after the print process.
- Provide image export capability. Image shall be exported utilizing the cardholder‘s name as the file name in .jpg format.
- Provide unlimited custom badge layouts (only limited by the hard disk capacity).
- Provide 24-bit (16.7 Million) colour palette for background design or foreground text and all fonts supported by Windows.
- Provide import capabilities of background information by video camera or via BMP, JPG, or TGA files.
- Provide for multiple bitmap images to be imported onto the badge layout.
- Provide video capture capability from a compatible TWAIN device, DirectX device or from a compatible video capture device, such as a high-resolution colour camera.
- Provide ability for multiple card enrollment /badging stations on networked system.
- Provide signature capture or import capability for up to 99 signatures that can be previewed in the cardholders badge or printed on the cardholder‘s card.
- Provide the capability to have a front and back layout selected for a cardholder and the ability to print the card in one step (requires suitable printer) without the need to reinsert the card.
- Provide the capability to encode a magnetic stripe with information from any of the card data fields to include, but not be limited to: First Name, Last Name, Card Number, Activation date, Expiration Date or any data from the card holders note field.

iii. Networking

- Provide networking capabilities (LAN or WAN) as allowed by the computer‘s operating system license.
- The access control software shall support two networking methods. By default, Domain controlled networks shall be the standard configuration providing secure networking communications. The ability to work on less secure peer-to-peer (Workgroup) networks shall be allowed for lower security installations. The functionality shall be one or the other and not run in both modes at the same time.
- Provide the ability for a network system to support concurrent users up to the license limit, i.e., one station adding cards and making badges, another station monitoring alarms, yet

another running data base report, another controlling door openings and alarm shunting, and so on.

- The workstation shall have the same UI (user interface) functionality as the Server, except the workstation shall not be able to perform database maintenance functions.

2.0 SYSTEM PRODUCTS:

- **Communication Ports And Loops**

The computer shall have two serial communication ports. If additional ports are required, they shall be provided by installing additional compatible multi-port cards. Instead of communication ports a LAN/WAN solution is acceptable using standard 10/100/1000 Ethernet connections.

System communication ports shall be expandable up to a maximum of 255 ports.

Each communication port shall support one of the following configurations. Local direct connect loop or multiple remote loops via modem. A local RS485 multi-drop communication loop shall support up to eight intelligent controllers, 128 readers or 1024 output relays or monitor up to 1024 alarm points. Remote configuration shall be supported.

- **Front End Software Specifications**

i. Databases: The software shall provide edit, add, delete, search, sort, and print options for records in selected databases.
ii. Printer Output: The software shall direct user-selected activity to the Windows supported printer.
iii. Monitor Display: The software shall display all system activity on a colour monitor in real time, except for remote locations configured as dial-up. The software shall allow a WAV file to be played upon all alarm conditions. The software shall provide an acknowledge function for all incoming alarm messages that are defined for alarm acknowledgment.
iv. Disk Storage: The software shall store user-selected activity on the hard disk. Report options shall recall selected history information from the hard disk. The user may request report information based on selected cardholders, specific areas and/or specific times. The software shall allow archiving by defined dates.
v. English Descriptions: The software shall support descriptive names for all database entries. The card database shall include name, number, PIN, access level, status, activation, and expiration date or limited usage and 40 user-defined fields.

- **Front End Software Requirements**

i. Password Protection: The software shall provide multi-level password protection, with user-defined operator name/password combinations. Name/password log-on shall restrict operators to selected areas of the program. The software shall allow the assignment of operator levels to define the system components that each operator has access to view, operate, change or delete.

ii. Manual Panel Control: The software shall allow manual control of selected inputs, outputs and groups of outputs. Manual panel control shall include pulse, timed pulse, and energize/de-energize or return to time zone options for output points and shunt/unshunt or return to time zone options for input points. For entrances and readers manual control shall include but be limited to Lock, Un-Lock, Disable, Card only, Card-Pin only, Pin only, exit only and site code only. For partitions monitored by the intrusion panel the control shall include but not be limited to arm away, arm stay, disarm, refresh and provide a virtual keypad for the partition. For zones monitored by the intrusion panel the control shall include but not be limited to bypass, unbypass and refresh. Intrusion panel output control shall include activate, deactivate and refresh.

II. ACCESS CONTROLLER

The security management system shall be equipped with access control field hardware required to receive alarms and administer all access granted/denied decisions. The system shall include the 2-reader intelligent controller.

The IP-enabled controller is an advanced access control panel capable of providing solutions for medium to large applications. The controller provides power and flexibility with its 32-bit CPU architecture, TCP/IP protocol support, flash memory for firmware and large local card holder database.

The controller is designed to operate off-line, making access control decisions independently from a PC or other controlling device. It can also be connected to a host computer for system configuration, alarm monitoring and direct control. Connectivity to the host computer is accomplished via TCP/IP network connection.

The board combines intelligent controller and reader interface into one complete unit. It connects for two readers via Wiegand controlling two doors.

Sr No.	**Technical Specification**	
1	Applications	Access Control System
2	CPU	ARM 32 Bit RISC Processor
3	Memory	Up to 8 MB (Flash)
4	No. of Doors	4
5	No. of Readers	8
6	Events/Transactions	60,000
7	No. Users	30,000
8	Reader Interface	Weigand (Up to 34 bit)

Sr No.	Technical Specification	
9	Input	12 inputs (4- Door Status, 4- Egress, 1- Fire & 1- intrusion and 2 Extra input)
10	Output	8 outputs (4 - DOTL, 4 – Lock)
11	Communications Port	TCP/IP,RS485
12	Door Interlocking/Man Trap	Yes
13	Fire Integration	Yes
14	Intrusion Integration	Yes
15	LCD	16X2 LCD Display
16	Keypad	4X3 Key with soft keypad
17	Baud Rate	9600bps (Default)
18	Controller ID	Up to 10,000
19	Language	English
20	Power Supply	12 V DC/ 5A
21	Enclosure	Industry Standard Metal Enclosure
22	Mounting	Din Rail (Without Metal Enclosure)
23		Wall mount (With Metal Enclosure)
24	Facility Code	Available
25	Time Zone / Access Levels	63 + 1 (Free Time Zone)/Unlimited
26	Time Zone Slots	4 slots per Day
27	Anti-Pass back	Hard, Soft, Escort (Reader Wise)
28	Holiday Settings	42
	General Specification	
29	Access Control panel should support 8 wiegand reader to restrict the entry of unauthorised people at 4 Door as well as restrict the exit of unauthorized person	
30	Controller should have open protocol platform and SDK can be shared if required	

Sr No.	Technical Specification
31	Data download should be automatic or extremely User friendly
32	The controller must support intrusion i/p, Fire Input & Ethernet networking for communicating on Internet, LAN, Intranet and Port Forwarding
33	It should work Temperature Range upto 50 deg C
34	Should support Nested Antipass Back to restrict the unauthorised one who got access by tail getting
35	Facility to set and change the IP address on the device itself. There should be no requirement of PC or laptop to set IP address
36	Reader shall flash the green LED and emit a short beep indicating that a card was read
37	5,8,10 digit card nos should be accepted by the system
38	Indication on unit for Transaction & Users buffer
39	Facility to create 16 different Authority Levels for Supervisor/Administrator/User on the device
40	There should be a provision to trigger 3rd party devices like Siren etc. on critical events
41	There should be a facility to verify card/finger before admin login
42	Device should be highly secured so that it can communicate with the selected IP/Particular PC only
43	Device should not accept continuous swipes, Successive swipes should create a soft alert. This feature should be enabled user wise
44	Employee Name,/Emp code/card no should be displayed on the LCD screen along with Access granted
45	All controller's information should be readable using keypad in offline mode
46	Holidays restrictions should be reader wise settable
47	Bulk card adding facility through device
48	Can be integrated with reader for out entry/exit with Pin + card reader
49	There should be a facility to activate- deactivate of cards automatically without any human intervention

Sr No.	Technical Specification
50	Provision for silent alarms, if any unknown person tries to intrude on gun point.
51	The Access decisions should be based solely on site codes
52	Should support 13.56 MHz or 125KHz cards technology ie; HID, Mifare and EM card Compatible, Should support any standard Wiegand readers
53	The Controller should function and record in same way even in standalone mode when network fails.
54	Provision to integrate with IP cameras, DIS & visitor management software
55	Should support any type of locking devices & remote controlled exit switch
56	Common message display on the LCD should be possible & Should have facility to display company name permanently on the LCD screen
57	Opening and closing of the doors should be possible from PC
58	Access Control panel should have power supply with battery charging facility to smooth operation under diverse power infrastructure conditions
59	The system should be able to keep records in case of Network or Power Failure and once Network or Power is restored, it should be able to communicate with central server without any data loss
60	The machine should have inbuilt RTC. Provision for setting the time of all machines from a single location to maintain uniform time in all locations
61	Real time data downloading should be supported
62	The connectivity of the devices should be detected remotely from remote machine
63	Alarm monitoring provision should be available in case of any emergency
64	There should be a facility to configure the unit in access or attendance mode depending upon the client requirement
65	Device Should be CE Certified
66	Component level servicing should be possible.
67	Total Indian Manufacturing Technology to enable better service and support
68	Should be provision to integrate Analogue Camera and IP Camera and record the short clip/Image for every events

III. SMART CARD READER:

Read Range	4 -9 cms
Data Read	CSN/Sector
Type	Smart Card (Mifare Classic)
Transmit Frequency	13.56 MHz
Card (Transponder)	Mifare® Series (ISO14443-A)
Card Read Time	0.1 sec
Output Interface	Wiegand Format(32 bits)
LED Indicator	Bi colour LED
Power supply	12 V DC @ 100mA
Dimensions	80W X 83 H X 21 D
Material	ABS Plastic
Color	Black
Cable Specs (Recommended)	5 core, 7/36 shielded cable
Cable Distance from Controller:	80m (Wiegand)
Card should be read in1 sec	
A Wiegand output that easily interfaces with most existing Wiegand protocol access control panels.	
Compact and Elegant. Easily installed on walls and doors.	

IV. BIOMETRIC READER:

Sr No.	Technical Specification	
1	Applications	Fingerprint + Card Reader
2	CPU	ARM 32 Bit RISC Processor
3	Memory	Up to 8 MB (Flash)
4	No. Of Finger Template	Up to 19000 (1:N)
5	Operation Mode	Card Only, Card+Finger, Finger Only
6	Sensor	High Quality Scratch Resistance Optical
7	Communications Port	TCP/IP &Wiegand& RS485
8	Baud Rate	9600bps (Default)
9	LED	Tri Color LED Bar
10	Sound	Various Beep Indication
11	Power Supply	12 V DC/ 5A , POE (Optional)
12	Enclosure	ABS Plastic
13	Color	Silver & Black
14	Dimension (H X W X D) in mm	167 X 105 X 45
15	Mounting	Wall Mounting
16	Temperature	0 to 50 Degree Centigrade
17	Humidity	20% to 90%
18	Sensor Specification	
19	Image Resolution	500 DPI
20	Template Size	384 Bytes
21	Image Size (Pixel)	272 X 320
22	Sensing Area (mm)	16 X 19

Sr No.	Technical Specification	
23	EER/FAR/FRR	<0.1% / 0.001% / 0.1%
24	Enrolment time & verification Time	< 1 Sec
	General Specification	
25	Device should be having Matching Mode 1:N as well as 1:1	
26	Device should have facility to integrate with CCTV/IP camera to take the photograph of user when user swipe his card/Finger	
27	26,32,34,35 bit wiegand format supported	
28	Reader shall flash the green LED and emit a short beep indicating that a card was read	
29	Should work with 5,8,10 digit card no	
30	There should be facility to adjust the Finger Rejection ratio as per the client needs/environment.	
31	Bulk card adding through device	
32	Time based Scheduler for automatic activate- deactivate of cards.	
33	If any person is trying to open the device an alarm should be raised	
34	Template size 384 bytes Capacity to store up to 8 template per user to avoid finger rejection	
35	The connectivity of the devices should be detected remotely from remote machine, should have inbuilt capability for online firmware up gradation.	
36	The outer coating should be noncorrosive	
37	Component level servicing should be possible in India	
38	Total Indian Manufacturing Technology to enable better service and support	
39	provision for at least 2 fingers per employee should be accepted on the card memory	
40	The Finger scan scanner shall be of High Protection from Scratch i.e Upper surface shall be scratch resistant and Protection from ESD	
41	Provision for Finger print, expiry date, access mode should be stored on the card.	

Sr No.	Technical Specification
42	Real time auto update of finger impressions

V. ACCESS MANAGEMENT SOFTWARE:

Desktop based Modular Access Management software with SQL Database especially designed to cater small & medium organizations.
Single GUI Platform with complete modular software with provision to integrate with different application ie; Time Attendance, VMS, Canteen, Alarm Management, etc.
It comprises with all masters, basic access control software, and basic attendance software and enrollment module.
Advance access control management software module with all the access control features i.e.; Time Zone, Access Level, Anti passback, Holiday restrictions, employee black list, etc.
User Enrolment interface module for finger/card enrollment of users. BIO mini& smart PERSONALIZER can be connected to this module for user enrollment.
Comprehensive Email and SMS module for smart ACCESS to send various SMS & Email on the base of different events in Access Control system.
Role wise module ie; Employee Self service - for View Attendances, for applying Leave, Manual Punch, outdoor entry, tour entry, Condone entry, compensation off & Overtime
Admin/Location Admin/ Company Login for all the configuration/ settings of attendance rules, leave management, shift management and others parameters
It should support Multi company, multi location, multi department, multi login with different rights, muti hierarchy of employee
Configurable Employee Hierarchy with Multiple employee categories ,multiple Employee Type, different Employee Status and Employee Photograph with other details
Should support maker & checker facility - the local administrator should able to add the users but he should not able to authenticate/approve the User, Approval right of the added user should be with main Administrator
Different type of Anti passback - Hard,Soft, user wise & controller wise
Holiday restriction (Reader Wise)
Blacklist of employee

Duress Authentications
Dual Authentications
Configurable delay time for two successive punch from same
Controller communication status display with indication of Green/Red button denotes device is online or, offline
Displaying Short Messages setting to display on device
Centralize fingerprint Template Management
Bulk upload of cards
Support Maximum 9,999 controller
Configurable Auto/Manual/Scheduled Data Downloading
Controller Reset command
Block Admin/User of controller
Device Configuration – Push/Pull
Door Open Time Configuration
Door Auto Relock configuration
Reader open Time can be define
Facility Code supported
Audit Log
Event Wise mail And SMS can be sent
Central Date & time Synchronization
User wise/Controller wise Latest swipe display
20+ Useful different type of MIS reports
Master data import facility & data export facility
Dedicated output reports for Payroll integration
Format reports should be PDF & Excel

VI. ELECTROMAGNETIC LOCK:

1.0 Single Leaf doors

1.1 Surface Mount Electromagnetic Lock with built in magnetic read switch contractor shall consider the U, L, Z brackets based on the site conditions accordingly.

1.2 The EM Lock shall have minimum with following specifications

a. Suitable for surface mount on single leaf doors

b. Current Draw: 500mA / 12V, 250mA / 24V

c. Dual Voltage: 12V / 24 V

d. Holding Force: About 600 lbs

e. Built-in magnetic read switch and Voltage Spike Suppressor

2.0 Double Leaf doors

2.1 Surface Mount Electromagnetic Lock with built in magnetic read switch contractor shall consider the U , L , Z brackets based on the site conditions accordingly

2.2 The EM Lock shall have minimum with following specifications

a. Suitable for surface mount on double leaf doors

b. Current Draw: 1A / 12V, 500 mA / 24V

c. Dual Voltage: 12V / 24 V

d. Holding Force: About 600 lbs

e. Built-in magnetic read switch and Voltage Spike Suppressor

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART E-13

WaterSupply Pump Sets

Scope:-

Supplying, installation, testing and commissioning of hydro pneumatic water supply system consisting of pumps, pneumatic tank, microprocessor based control panel, VFD, inter connecting pipes, valves cabling etc.

TECHNICAL SPECIFICATIONS

1. PUMPS

1.1 CONSTRUCTION

Pumps shall be as per IS:1520-1660, IS:9079, IS:325 and shall be of the following construction:

	Pump Description	Vertical type / Monobloc
1.	Casing	Cast Iron/Cast Steel
2.	Impeller	Bronze
3.	Shaft	High Tensile steel
4.	Bearings	Heavy duty Ball/Roller Bearings.
5.	Base Plate	Cast Iron/Fabricated M.S
6.	Flanges	Conforming to I.S.S. 1536/1960
7.	Packing	Mechanical seals
8.	Max. Speed	2900 RPM
9.	Driver	For Monobloc Pumps T.E.F.C. upto 3.7 KW and S.P.D.P. motors above 5.0 KW. All other type pumps TEFC motors
10.	Starter	See Schedule of Equipment

1.2 Tenderer shall select their drivers at least 15% in excess of the maximum B.H.P of the pump plus transmission losses if any. Drivers shall be supplied with starters unless otherwise stated.

Pump and driver shall be mounted on a single bed-plate and directly driven through flexible coupling in case of horizontal split casing pumps.

1.3 ACCESSORIES AND FITTINGS

The following accessories shall be provided with each pump among other standard accessories required:

a) Coupling guard for horizontal split casing pumps.
b) Lubrication fittings and seal piping.
c) Test and/or air vent cocks.
d) Set of Ball valves for isolation of the pump.
e) Non return valve at the discharge of the pump.

1.4 Following fittings shall be provided with each pump among other standard fittings required:

a) Suction and discharge shut off valves (Ball type)
b) Suction and discharge pressure gauges not less than 100mm dia and of the appropriate rating with gauge cocks etc. Suction gauge shall be of compound type.
c) 25mm GI gland drain as shown on drawings.

1.5 INSTALLATION

Pump shall be installed as per manufacturer's recommendations. Pump sets shall be mounted on machinery isolation pads or any other equivalent vibration isolation fitting. Concrete floating

foundation shall also be provided by the contractor as per approved shop drawings and specifications. The vibration isolation pads, foundation bolts etc. shall be supplied by the Contractor. Contractor shall however ensure that the foundation bolts are correctly embedded.

Pump-sets shall preferably be factory aligned, wherever necessary, site alignment shall be done by competent persons. Before the foundation bolts are grouted and the couplings are bolted, the bed plate levels and alignment results shall be submitted to the Engineer.

1.6 TESTING

Contractor shall submit the performance curves of the pumps supplied by them. They shall also check the capacity and total head requirements of each pump to match his own piping and equipment layout. On completion of the entire installation, pumps shall be tested, wherever possible, for their discharge, head, flow rate, B.H.P. Where it is not possible at least the discharge, head and B.H.P. (as measured on the input side) shall be field tested. Test results shall correspond to the performance curves.

1.7 PAINTING

After complete installation and testing, pumps accessories and fittings shall be given two coats, three mils each of approved finishing paint.

2. PIPING

2.1 SCOPE

The scope of this section comprises the supply, laying, erection, testing and commissioning of pipes required for this project. All piping laid shall be as follows:

Pipe Size	Material Fittings	Joints & Material	Sealing
Upto 65mm	G.I.tube	(i) Screwed fittings	(i) Non-hardening
	Medium Class	(ii) Unions	(ii) Lubricant
	I.S.	(iii) Screwed flanges	(iii) 3mm, 3-ply Rubber insertion.
75mm to 150mm	G.I.tube	(i) Screwed flanges	
	Medium Class	(ii) Screwed flanges	
	I.S.	(iii) Screwed flanges (for G.I. Pipes)	(iii) 3mm, 3-ply Rubber insertion.

Pipe threads shall be to IS:554/1955 and flanges to IS:1536/1960

2.2 All piping shall be galvanised steel unless otherwise stated. Pipes shall be given one primary coat of red-oxide paint before being installed. Pipes shall be sloping towards drain points.

2.3 Fittings shall be new and from reputed and approved manufacturers, Fittings shall be of malleable casting of pressure ratings suitable for the piping system. Flanges shall be new and from standard manufacturers. Supply of flanges shall include bolts, washers gaskets, etc., as required.

2.4 Tee-off connection shall be through reducing tees, wherever possible. Drilling and tapping of the walls of the main pipe shall not be resorted to.

2.5 All equipment and valve connections shall be through flanges.

2.6 All piping is subject to the approval of the Engineer-in-Charge and sufficient number of flanges and unions shall be provided.

2.7 Gate / Ball valves shall be provided as required or as shown in the applicable shop drawings conforming to the following specifications:

Gate valves

Size	Construction	Ends
12mm to 65mm	Gun Metal	Screwed Female
75mm and Over	Body-cast iron	Flanged
(Spindle valve seat wedge nut etc.)	- Bronze or Gun Metal	

B*all valves*

Size	Construction	Ends
upto 40 mm dia	Brass	Screwed Female
50mm and above	Brass	Flanged

Ball : Stainless steel to AISI 316
Seat : Teflon/ PTFE
Gland packing : Teflon
Lever : Steel (Rust proof)
Handle lock nut : Stainless steel

Valves shall conform to IS:780/1969, flanges to IS:1536 or as required. Gate valves shall have non-rising spindles unless otherwise specified and shall be suitable for 21 Kg./Sq.cm test pressure. Tail pieces shall be used where required. The samples of valves shall be got approved before procurement and installation at site.

2.8 Check valves shall be provided as required or as shown on the drawings and conform to the following specifications:

Size	Construction	Ends
12mm to 65mm	Gun Metal	(i) Screwed Female
75mm and Over	Gun Metal/ C.I	(ii) Flanged

Swing / dual plate check valves shall normally be used in all water services. Lift type valves may be used in horizontal runs. Air release and clean out plugs shall be provided and valves shall be suitable for 21 Kg./Sq.cm test pressure.

2.9 Strainers shall be preferably of the approved _Y' type with Bronze or C.I bodies designed to the test pressure specified for gate / ball valves. Strainers shall have removable bronze screen with 3mm perforations. Strainers shall be provided with flanges or threaded sockets as required. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of screen without disconnection of the main pipe. All strainers shall be provided with equal size isolating gate valves with rising spindles so that the strainer may be cleaned without draining the system. Strainers shall be provided on the suction side of each pump and inlet side of equipment wherever shown in the drawings.

2.10 PIPING INSTALLATION

The drawings indicate schematically the size and location of pipes. Pipes runs and sizes may, however, be changed to meet the site conditions. The Contractor on the award of the work, shall prepare detailed working drawings showing the cross section, longitudinal section, detail of fittings, locations of isolating drain and air valves etc. They must keep in view the specific openings in buildings and other structures through which the pipes are designed to pass.

2.10.1 Piping shall be properly supported on or suspended from stands, clamps, hangers etc, as specified and as required. The contractor shall adequately design all the brackets, saddles, clamps, hangers etc. and be responsible for their structural integrity.

2.10.2 Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated black. Where pipe and clamp are of dis-similar material, a gasket shall be provided in between.

Spacing of pipe supports shall not exceed the following :

Pipe Size (mm)	Spacing (M)
19 to 25	2.0
32 to 150	2.5

Pipe hangers shall be fixed on walls and ceilings by means of metallic rawl plugs of Hilti/Fischer make.

2.10.3 Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 12mm thick ribbed rubber pad or any other approved resilient material.

2.10.4 Pipe sleeves of 50mm on larger diameter shall be provided wherever pipes pass through well and the annular space filled with mineral wool and finished with retaining rings.

2.10.5 Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 1.80mm metal sheet shall be provided between insulation and the clamp saddle or roller extending at least 150mm on both sides of the clamp, saddle or roller.

2.10.6 Piping work shall be carried out with minimum disturbance to the other works being done at the site. A programme of work shall be chalked out in consultation with the Engineer.

2.10.7 Piping layout shall take due care for expansion and contraction in pipes.

2.10.8 All pipes using screwed fittings shall be accurately cut to the required sizes and threaded in accordance with IS:554/1955 and burrs removed before laying. Open ends of the piping shall be locked as the pipe is installed to avoid entrance of foreign matter. Wherever reducers are to be provided in horizontal runs, eccentric reducers shall be used if the piping is to drain freely, in other locations, concentric reducers may be used.

2.10.9 Air valves shall be provided at all high points in the piping system for venting. Valves shall be of the double float type, with G.M./C.I. body, vulcanite balls, rubber seating, etc. Air valves shall be of the sizes specified and shall be associated with an equal size gate valve with rising spindle.

Mains	Air Valves
Upto 100mm dia	25mm dia
100mm to 300mm dia	28mm dia

Discharge from the air valves shall be piped through an equal sized G.S. pipe to the nearest drain or floor waste or as shown.

2.10.10 All buried pipes shall be cleaned and coated with zinc chromate primer and bitumenous paint, than wrapped with two layers of fibreglass felt each layer laid in bitumen.

2.10.11 Drain shall be provided at all low points in the piping system and shall be of the following sizes :

Mains	Drains
Upto 300mm dia	25mm dia

Drains shall be provided with ball valves of equal size. Drains shall be piped through equal size G.I. pipe to the nearest drain or floor waste or as shown on the drawings. Piping shall be pitched towards drain points.

2.11 PRESSURE GAUGES

2.11.1 Pressure gauge shall be not less than 100 mm dia dial and of appropriate range and be complete with shut off gauge cocks etc. duly calibrated before installation.

2.11.2 Pressure gauge shall be provided at the suction and discharge of pumps and as indicated on the drawings. Care shall be taken to protect pressure gauges during pressure testing.

2.12 VIBRATION ELIMINATION

Piping installation shall be carried out with vibration elimination fittings wherever required.

2.13 TESTING

2.13.1 All piping shall be tested to hydrostatic test pressure of at least one and a half times the maximum operating pressure, but not less than 11 Kg/Sq.cm for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Engineer.

2.13.2 Piping repaired subsequent to the above pressure test shall be re-tested in the manner described above.

2.13.3 Systems may be tested in sections and such sections shall be securely capped.

2.13.4 The Engineer shall be notified well in advance by the contractor of his intention to test a section of piping and all testing shall be witnessed by the Engineer or his authorised representative.

2.13.5 The Contractor shall make sure that proper noiseless circulation of fluid is achieved through all branches and other equipment in the system concerned. If proper circulation is not achieved due to air bound connections, the Contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification including the tarring-up and re-finishing of floors, walls, ceiling etc. as required.

2.13.6 The Contractor shall provide all materials, tools, equipment, instruments, services and labour required to perform the test, and shall ensure that the plant room and other areas are cleaned up and spill over water is removed.

2.13.7 Painting

After the piping has been installed, tested and run for at least ten days the piping shall be given two finish coats, 3 mils each of approved colour.

The direction of flow of fluid in the pipes shall be visibly marked in white arrows or as directed by the Engineer.

3. HYDRO PNEUMATIC SYSTEM

Multistage type centrifugal pumps with SS casing, mechanical shaft seals directly couple to TEFC induction motor suitable for 415±10 V, 50 Hz AC power supply, IP 54 enclosure, class F insulation. The motor shall be provided thermal overload. The skid mounted, factory assembled hydro-pneumatic system

shall be provided with pressure transmitters, individual frequency convertor for noiseless operation of the pump at varying duty point. The convertor shall be provided with short circuit safety, earthing, over current, under voltage protection. The system shall comprise of multiple pumps, with one stand-by to meet the system discharge requirements.

The control panel shall have terminals for :
Remote start stop
Motor temperature protection
Pump fault
Analogue output signal for frequency convertor
Pressure sensors
Motor connection
Power supply

The control panel shall alternate the lead lag pump, taking over in case of failure. The system shall be provided by a diaphragm type pressure vessel suitable for a back-up of min. one minute.

The system shall be complete with GS base frame with adjustable vibration isolators, GS manifold with NRVs and isolation ball valves complete with all accessories should be as per specification. The hydro pneumatic system shall be capable of maintaining a constant pressure at varied consumption. The hydro pneumatic system shall be complete with pressure sensor and microprocessor based controller for pressure control by means of frequency variation. The controller should have time control switch to adapt pump operation to actual requirement in peak load situation. The control panel should also have manual operation.

The pump shall have stainless steel impeller with self-lubricating bearing. The shaft seal shall be mechanical type tungsten carbide sealing rings.

The pumping system shall perform the following functions:

a. Shut off the pump at zero demand.
b. Shut off the pump at zero suction.
c. Protect the pump from overvoltage, under voltage, overload, earth fault.
d. Vary the time of pump speed acceleration and deceleration.
e. Compensate for higher friction losses at high flow rates.
f. Send out a signal for remote monitoring of flow as well as pressure.
g. Conduct automatic test run of pumps at set times.
h. Keep track of run time for pumps.
i. Perform run time equalization of all pumps in system.

	Pump Description	**Vertical multistage in line pumps**
1.	Casing	Stainless Steel
2.	Impeller	Stainless steel
3.	Shaft	High Tensile steel
4.	Shaft seal	Tungsten carbide seal
5.	Packing	Mechanical seals

The motor shall be with following parameters

Type	:	Totally enclosed fan cooled
Insulation	:	class - F
Enclosure	:	IP -54
Ambient temperature	:	50 deg. C
Power input	:	3 Phase, 415 V, 50 Hz. power supply.

4. ELECTRICAL INSTALLATION

4.1 SCOPE

The scope of this section comprises of the fabrication, supply, erection, testing and commissioning of electrical control panels, wiring and earthing for all components of the water supply and distribution system.

4.2 GENERAL

Work shall be carried out in accordance with the Specifications, local rules, Indian Electricity Act 1910 as amended upto date and rules issued thereunder, regulations of the Local Fire Insurance Association and Indian Standard code of practice No.IS:732-1963 (revised) including Indian Electricity Rules 1956.

4.3 WIRING SYSTEM

All power wiring shall be carried out with 650/1100 Volts grade PVC insulated, copper conductor wires in M.S. Conduits. Sized for starting current and continuous running current carrying capacity and by applying proper derating factor. Termination of copper conductors shall be by means of crimping. No joints shall be permitted.

4.4 CONSTRUCTION FEATURES

The control panels shall be metal enclosed sheet steel cubicles, indoor type, dead front, floor mounting/wall mounting type. The control panel shall be totally enclosed, completely dust and

vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and/or rubber strips and shall be lockable. All mild steel sheets used in the construction of control panels shall be 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded all welding slag grounded off and welding pits wiped smooth with plumber metal. All panels and covers shall be properly fitted square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal or provided with hank nuts. Self-threading screws shall not be used in the construction of control panels. A base channel of 75mm x 75mm x 5mm thick shall be provided at the bottom.

A maximum of 200mm space between the floor and bottom most panel of unit shall be provided. The control panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switch gear.

Knockout holes of appropriate size and member shall be provided in the control panels in conformity with the location of incoming and outgoing conduits/cables.

Facility shall be provided for the entry of all types of conduits/cables from bottom or top of control panel as per site requirements.

The following capacity contactors and overload relays shall be provided for different capacity motors.

	Type of Starter	Contactor Current Capacity	Overload Relay range
1. 5 HP motor	DOL	16 Amps	6-12 Amps
2. 7.5 HP motor	Star Delta	16 Amps	6-12 Amps
3. 10 HP motor	Star Delta	32 Amps	6-12 Amps
4. 15 HP motor	Star Delta	32 Amps	10-16 Amps

Single phase preventers shall be provided for all 3 phase motors. Single phase preventer shall be in conformity with relevant ISI standards. Single phase preventers shall act when the supply voltage drops down to 90% of the rated voltage or failure of one or more phases. Single phase preventer shall be voltage operated and of Larsen and Toubro make or other approved equal make.

Control panel shall contain starters and safety fuses for water distribution system pumps motors. It shall also house the main switch for incoming supply, voltmeter with selector switch for measuring the current drawn by each motor and indicating lights for incoming phases as well as status indication of each equipment.

The control panel shall be provided with a control module having connecting strips and all the wiring for on-off and status indication of all the equipment shall be brought to this point. All control panels shall be provided with detailed control circuit diagram indicating the terminal numbers and colour coding of the wires used in the panels. This diagram shall be pasted on the inner side of the cover and protected with PVC transparent lamination.

ON-OFF switches for each motor/equipment should not be provided on the cover of the control panel, but at the same time interlocking shall be provided between switch and the door in such a way that the door of the panel cannot be opened when the supply is ON.

4.5 WIRING OF EQUIPMENT

Wires

PVC insulated copper conductor wires (1100 Volts grade) shall be used for connecting motors up to 25 HP. The wires shall be drawn through M.S. conduits (14 SWG) of suitable size.

Cables:

PVC insulated aluminium conductor Armoured cables shall be used for connecting motors.

Laying of M.S. conduits and wires shall be done as approved by the Engineer-In-Charge. Cables shall be laid as per standard practice conforming to relevant Indian Standards by providing proper cable supports and clamps as required. Cables and wires in conduits inside the plant room shall be laid on the metallic trays made out of slotted angles (40mm x 40mm x 2mm) and perforated M.S. sheets (2mm thick) duly painted.

4.6 WIRE SIZES

Final connection to the equipment shall be through flexible wiring enclosed in galvanised flexible conduit rigidly clamped at both ends. An isolator shall be provided near each motor/equipment wherever the motor/equipment is separated from the supply panel through a partition barrier or through ceiling construction. P.V.C. insulated single strand hard drawn copper conductor wires shall be used inside the control panel for connecting different components and all the wires inside the control panel shall be neatly dressed and plastic beads shall be provided at both the ends for easy identification.

4.7 EARTHING

Main power upto the Electrical panel in plant room along with earthing shall be provided by other agency. Each panel shall be earthed to the main earthing.

All the motors etc. shall be double earthed to the panel. The earthing shall be done with wires as under.

Cross sectional area of current carrying conductor(Sq.mm)	Size of earth copper conductor SWG
1. 4/6/10	10
2. 16/25/35	08

Where the current of Motor/equipment is more than 150 Amps 25mm x 3mm copper strips shall be used. All three phase motors/equipment shall be connected to earth with two independent earth conductors as per the requirement of Indian Electricity Rules and Regulation - 1956.

5. DRAWINGS

Shop drawing for control panel and wiring of equipment showing the route of conduit/cables shall be got approved by the Engineer-In-Charge before starting the fabrication of panel and starting the work. On completion two sets of completion/"As installed" drawings incorporating all details like conduit routes, number of wires in conduit, location of panels, switches, junction/pull boxes and cable route etc. shall be furnished by the Contractor.

6. TESTING

Before commissioning of the equipment the entire Electrical Installation shall be tested in accordance with code of Practice IS:732-1963 (Revised) and test report furnished by a qualified and authorised person. The entire electrical installation shall be got approved by the Electrical Inspector and

certificate from Electrical Inspector shall be submitted. All tests shall be carried out in presence of Engineer-In-Charge.

7. PAINTING

All sheet steel work shall undergo a process of degreasing, pickling in acid, cold rinsing, phosphatising passivating and then sprayed with a high corrosion resistant primer. It shall then be baked in an oven. The finishing treatment shall be by application of synthetic enamel paint of approved shade.

Preference to PPP-M – II Policy (Make in India):

i. The Government has issued public procurement policy (Preference to Make in India) vide Ministry of Commerce and Industry Development of industrial policy and promotion (PPS) vide order No. P-45021/2/2017-PP BE-II dated 28.05.2018, to ―Encourage Make in India‖ and to promote manufacturing and production of Goods and services in India with a view to enhancing income and employment.

ii. The agency shall submit list of makes of materials proposed to be used on the work from local suppliers (as defined in the above order dated 28.05.2018) along with minimum local content as specified below for approval of the department out of the approved makes kept in the tender.

iii. The department will be approving only makes of the materials having a minimum local content of 50% for use on this work, out of the preferred makes list.

iv. The minimum local content of 50% is considered for the complete item including labour component.

v. The agency shall obtain the certificate for all items except for sundry items.

PART-E-14
AV & PA SYSTEM

AUDIO VIDEO WORKS OF 150 & 80 PAX Classroom & Conference room.

Subject: Design Basis Report and Technical Specification of Audio-Visual Works

1. General

The Scope of work consists of Planning, designing & Preparation of drawings, obtaining approvals from the department, Supply, Installation, testing and Commissioning of Audio-Visual system and video recording & live streaming /Smart Classroom with all necessary equipment in the following locations as per the technical specifications.

- Areas to be covered –
    a) 1500-Seater Auditorium – 1 Nos.
    b) 400-Seater Lecture Hall – 3 Nos.
    c) 200-Seater Lecture Hall – 6 Nos.

2. Scope of Work

2.1 General Scope of Work:

The scope of work shall include supply, installation, testing and commissioning of all Audio-Visual system services, equipment, components, accessories, and fittings required for the operation of the facility to the extent specified and detailed on the Specification.

Supply and installation of Audio/Visual equipment in Ceiling, Walls and Floors with all cables as required for proper functioning of system.

Supply and installation of all cables, cables, outlets, etc. associated with audio visual systems. Anything that has been omitted in any item of works and materials usually furnished with are necessary for the completion of A/V works as outlined here in before, then such items shall be and are hereby included in the section of work. The Area of Audio-Visual works will be in Auditorium, 400 PAX & 200 PAX, Lecture Hall. The scope of work covers an Audio-Visual and Lighting system in accordance with the specifications, drawings and relevant tender documents regardless of whether they are explicitly mentioned or not for proper functioning of AV System.

2.2 1500-Seater Auditorium

Audio Visual and Stage Light System in Auditorium shall be designed for Presentation and Teaching. The Control rack shall be located at one place in the room. Bidders should provide 1 nos of WUXGA projector with 23600 lumens or more brightness as required along with motorized screen as required as per the dimension. Bidders should provide Line Array Loudspeakers, amplifier, audio mixer with handheld, lapel, gooseneck microphones, AVOIP and required encoder & decoders and control system as per requirement. Line array loudspeakers with the Class D power amplifiers for maximum coverage and SPL level of + /- 3 dB variation throughout the hall. The sound system should have a SPL level of 95 dB or above with variation of + / - 3db. STI should be .5 and above.

Items to consider:

- Projector with 23600 lumens or more.
- Motorized projection screen with IR remote and low Voltage Control Module.
- 4K60 Encoder and Decoder.
- Control System and Touch Panel
- FOH Line Array Loudspeakers
- Class D multichannel power amplifier.
- Microphones - Wireless handheld, lapel mics.
- Audio Mixer to control audio & microphone
- Digital Mixing Console & Stage Box, DSP.
- 42 RU Rack

Note: Bidders must ensure that their AV solution is comprehensive in every way. Please refer to the tender specification for more specific information.

2.3 400-Seater Lecture Hall

Audio Visual System in Lecture Hall 400 PAX shall be designed for Presentation and Teaching. The Control rack shall be located at one place in the room. Bidders should provide WUXGA projector with 9600 lumens or more brightness as required along with motorized screen as required as per the dimension. Bidders should provide speakers, amplifier, audio mixer with handheld, lapel, gooseneck microphones, HDMI Wall plate & Switcher and required transmitters & receivers as per requirement. Column Line array loudspeakers with the Class D power amplifiers for maximum coverage and SPL level of + /- 3 dB variation throughout the hall. The sound system should have a SPL level of 85 dB or above with variation of + / - 3Db.

Items to consider:

- Projector with 9600 lumens.
- Motorized projection screen with IR remote and low Voltage Control Module.
- Lapel, Gooseneck & Handheld Microphone
- Audio Mixer to control audio & microphone
- 4K60 HDMI Auto Switcher cum transmitter with mirrored HDMI output
- 4K60 Transmitters & Receivers
- HDMI Wall plates.
- FOH Column Line Array Loudspeakers
- Class D multichannel power amplifier.
- Mixing Console
- 24 – 30 RU Rack

Note: Bidders must ensure that their AV solution is comprehensive in every way. Please refer to the tender specification for more specific information.

2.3 200-Seater Lecture Hall

Audio Visual System in Lecture Hall 200 PAX shall be designed for Presentation and Teaching. The Control rack shall be located at one place in the room. Bidders should provide WUXGA projector with 9600 lumens or more brightness as required along with motorized screen as required as per the dimension. Bidders should provide speakers, amplifier, audio mixer with handheld, lapel, gooseneck microphones, HDMI Wall plate & Switcher and required transmitters & receivers as per requirement. Column Line array loudspeakers with the Class D power amplifiers for maximum coverage and SPL level of + /- 3 dB variation throughout the hall. The sound system should have a SPL level of 85 dB or above with variation of + / - 3Db.

Items to consider:

- Projector with 8500 lumens.
- Motorized projection screen with IR remote and low Voltage Control Module.
- Lapel, Gooseneck & Handheld Microphone
- Audio Mixer to control audio & microphone
- 4K60 HDMI Auto Switcher cum transmitter with mirrored HDMI output
- 4K60 Transmitters & Receivers
- HDMI Wall plates.
- FOH Column Line Array Loudspeakers
- Class D multichannel power amplifier.
- Mixing Console
- 24 – 30 RU Rack

Note: Bidders must ensure that their AV solution is comprehensive in every way. Please refer to the tender specification for more specific information.

2.3 PA System for Centenary Building

PA System in cemetery building shall be designed for announcement. The Control rack shall be located at one place in the room. Bidders should provide speakers, amplifier, DSP, and Paging Mic. maximum coverage and SPL level of + /- 3 dB variation throughout the hall. The sound system should have a SPL level of 85 dB or above with variation of + / - 3Db.

Items to consider:

- Ceiling Loudspeaker.
- Class D multichannel power amplifier.
- Paging Microphone
- DSP and Zone & Volume Controller
- Mixing Console
- 24 – 30 RU Rack

Note: Bidders must ensure that their PA-System solution is comprehensive in every way. Please refer to the tender specification for more specific information.

3. Tentative amenity of audio-visual facility in the various parts of the buildings with technical specifications are as under:

AUDIO-VIDEO EQUIPMENT TECHNICAL SPECIFICATION FOR 1500-PAX AUDITORIUM AT CENETARY BUILDING, IITISM DHANBAD		
AUDIO SOLUTION FOR 1500-PAX AUDITORIUM		
S.NO.	**MATERIAL BRIEF**	**TECHNICAL SPECIFICATION**
1	Dual 8-inch Compact Line Array Loudspeaker with 110º Dispersion	Dual 8-inch Compact Line Array Loudspeaker with 110º Dispersion ,Frequency Range (-10 dB): 49 Hz - 19 kHz, Coverage Pattern (-6dB) Horizontal: 110 degrees nominal (300 Hz - 18 kHz), System Input Power Rating LF :600W Continuous , MF/HF :390W Continuous (IEC/100 hour) ,Maximum Peak Output: 139 dB , System Impedance LF :8 ohm , MF/HF : 8 Ohm , Low Frequency : 2x 8" diameter with dual 2.5 in diameter voice coil, Mid Frequency : 4x 3" diameter with 1.5 in diameter voice coil, High Frequency : 2x2" diameter.
2	Array Frame for Line array Loudspeaker	Lightweight Array Frame for Line array Loudspeaker; should support minimum 9 pick points for single point suspension; Should be Flexible front-to-back or side-by-side various pick point options for mounting / suspension; Should support up to 24 cabinets; etc.

3	Amplifier for FOH Line Array Loudspeaker - Four-channel x 4000W @ 4Ω Power Amplifier	Four-channel x4000W @ 4Ω Power Amplifier, True Ethernet backbone – fast, reliable and scalable, Color LCD provides users with diagnostics and presets for easy setup, Sweep Load Monitoring, one USB port, Damping Factor :(10Hz to 100Hz) >5000, Signal to Noise Ratio (20Hz to 20kHz, A Weighted) :> -108dB, (THD) (full rated power, 20Hz to 20kHz) :0.35%, Intermodulation Distortion (from 9dB down to -40dB): 0.06%, Frequency Response (20Hz to 20kHz at 1W into 4/8Ω) :+/- 0.25dB, Crosstalk (below rated power 20Hz to 1kHz): >80dB.
5	Dual 18" Arrayable Subwoofer	Dual 18”-21" Arrayable high Power Subwoofer Unit; should support Coverage Pattern Omni-directional and/or cardioid; Frequency Range (-10dB) :26Hz - 80Hz or better, Power Rating (100 hrs): 2600W Continuous orbetter, Max SPL :141dB ormore, IP Rating: IP55; Material (Grille): Powder coated 1.8 mm (14-guage) hex-perforated stainless steel with acoustically transparent black cloth backing; etc.
4	Array Frame for Arrayable Subwoofer	Versatile suspension bar accessory for subwoofer, Single-point, and dual-point support, Secondary safety attachment points included Support for (16) enclosures, Lightweight, fully symmetric design
6	Subwoofer Amplifier - Multichannel Digital Power Amplifier	Two-channel, 4500W @ 4Ω Power Amplifier, Sensitivity:1.28Vrms to 8Vrms, Signal to Noise Ratio :>112dB, Total Harmonic Distortion :>0.1%, Intermodulation Distortion :<0.2%, Frequency Response: ±0.25dB ,Crosstalk :>80dB ,Common Mode Rejection :>70dB typical , Shall have DSP with 24-bit, 192kHz A/D and D/A converters ,Shall have RJ 45 port for digital audio inputs
7	Front Fill Loudspeaker - Dual 8"; 2-Way Bi-amplified Loudspeaker	Compact 2-way Loudspeaker with 2 x 8” LF, 2-way loudspeaker system with 1500W Peak, 2x8" LF driver; Coverage Pattern = 120° x 60°, Frequency Range = 54 Hz - 20 kHz, SPL =120 dB, System Sensitivity1: 94 dB SPL/1W/1m, Crossover: 2.1 kHz
9	Amplifier for Front Fill Loudspeaker - Multichannel Digital Power Amplifier	Multichannel Digital Network Based Power Amplifier with Power output 8 x 600W @ 4 Ohms / 8 Ohms; Eight-channel Audio amplifier , 8x 600W at 4 and 8 Ohm, 70Vrms and 100Vrms output on all Eight channels, THD (at full rated power, 20Hz - 20kHz) =0.35%, Cooling Continuously variable speed forced air, Voltage Gain Max level= 34dB, Audio Digital channel bus compatibility up to 8 channel, bridgeable channels - even in 100Vrms mode, 2 digital audio bus RJ 45 port, 1 Ethernet R 45 port for monitoring and configuration , Should have Limiters, Input/output EQ, Delay, Matrix Mixer, Speaker Line Monitoring, Damping Factor (20 Hz to 100 Hz) : >1000
10	Active Stage Monitor - Single 15" 2-Way Speaker	15” Two-Way Full-Range Main System/Floor Monitor with Wi-Fi, Built-in Wi-Fi for wireless control of your system from anywhere in the venue ,Shall have Connect mobile app for iOS and Android provides wireless control over volume levels, 8-band parametric EQ and up to 50ms of speaker delay to fine-tune your sound, Class-leading 1500-watt amplifier delivers ample power to fill your venue ,Including XLR, 1/4” and RCA inputs plus XLR loop-through , Intelligent variable-speed fan activates only when needed to reduce noise, Updated tuning delivers flat frequency response and smooth off-axis behavior ,Universal power supply for worldwide compatibility ,Maximum SPL Output: Normal: 137dB peak, Frequency Range (-10 dB): Main: 42.9 Hz - 19.5 kHz Monitor: 43.6 Hz - 19.3 kHz ,Frequency Response (±3 dB): Main: 58.1 Hz - 17.2 kHz Monitor: 60.7 Hz - 16.7 kHz ,Input Connectors: 2 x Balanced XLR / 1/4 inch input, 2 x unbalanced RCA input, Input Impedance: 20K Ohms (balanced), 10K Ohms (unbalanced), Design: Highly efficient Class-D amplifier Power Rating: 1500W (750W x 2)
11	Wireless Handheld Dynamic Microphone	Wireless Handheld Microphone System, Wireless Microphone system with MHZ carrier frequency band; Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz; THD at 1 kHz: <0.3% (Receiver) , Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation, Up to 48 Simultaneous channels , Upto 14 hours operation with one single AA battery or better, Pilot Tone, transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status ; Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D.: 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW.

12	Wireless Presenter Microphone	Wireless Lavalier Microphone System, Wireless Microphone system with MHZ carrier frequency band; Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz; THD at 1 kHz: <0.3% (Receiver), Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation; Up to 48 Simultaneous channels, Upto 14 hours operation with one single AA battery or better, Pilot Tone transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status, Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D. 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW.
13	Antenna Power Splitter	Antenna power splitter, Active Antenna Power Splitter for up to 4 receivers, Antenna power splitter with an extended frequency range from 470 to 952 MHZ, Cable length adjustment with available, Support up to 4 receivers
14	Active Antenna	Active Omnidirectional wide-band UHF receiving antenna, switching bandwidth (from/to) :470 to 952 MHz, Antenna gain17 dBi Cable length can be up to 300M, Covering angle :360 Grad, Recommended load impedance :50 Ohms
15	Active Antenna Booster	Antenna Booster for Switching bandwidth (from/to)470 to 952 MHz or more; Switching bandwidth (from/to)470 to 952 MHz or more; RF input 50 Ohms or better; Recommended load impedance: 50 Ohms or better; Can compensate 3.5 to 17.5 dB of cable attenuation; etc.
16	2-in, 1-Out Power and Antenna RF Combiner	2-in, 1-Out Power and Antenna RF Combiner
17	Professional wired dynamic Vocal microphone	Wired Vocal microphone, Professional Dynamic Mic, Polar Pattern: super cardioid ,Audio Frequency bandwidth : 70 to 20000 Hz ,Sensitivity : 2.6 mV/Pa ,Electrical Impedance : 600 Ohms ,Recommended Load Impedance : 2000 Ohms ,Type : Balanced XLR ,Gender : Male ,Contacts : 3-pin ,Body : Metal
18	Professional wired dynamic instrument microphone	Wired Dynamic Instrument Microphone, Cardioid Dynamic Instrument Microphone, Audio frequency bandwidth =40 - 20000 Hz, Sensitivity at 1000 Hz 2.5 mV/Pa (–52 dBV re 1 V/Pa), Max. SPL for 1 % THD = 47 dB SPL
19	Wired tabletop gooseneck condenser microphone	Wired Gooseneck Microphone with Desktop base unit and on/off switch for Podium, Desktop gooseneck Mic, Audio frequency bandwidth =70 - 18000 Hz, Signal to Noise:64 dB-A, Length =500 mm, Voltage =9 to 52 V Power Interface
20	Direct Box	Professional direct injection box; should support features like Premium Performance; Rugged Design; Stackable Chassis with Durable Rubber Foot; Gold-plated Neutrik XLR Connector; 3-Way 0/20/40 dB Pad Switch; +48V Phantom Powered Operation; Green LED Phantom Power Indicator; Low-Noise Active Circuitry; etc.
21	Digital Signal Processor	12 x 8 Networked Digital Signal Processor with 12 inputs and 8 outputs or more; 12 ormore Control Inputs and 6 or more Logic Outputs for GPIO Integration; 48V phantom power on all analog inputs; THD: <0.01% 20Hz to 20KHz; Crosstalk: <-75dB orbetter; Open architecture software configurable; logic processing power; 2 digital audio bus RJ45 Port; 1Ethernet RJ45 port for Monitoring and configuration; Capable to handle +5V unloaded logic output voltage; Should have speech sense engine; Capable to control 3rd party devices with TCP IP and RS232; Should have 1nos of RS 232 port for integration with control System; Should have Bi-Directional Locate Functionality; Should have 48 or more digital audio Channel Bus; Should have monitoring LED for COM, STAT, ERR and PWR; etc.
22	40-input Digital Mixing Console	32 Channel Digital mixing console, 32-in/32-out USB Interface, iPad Control, 40-input Mic/Line, 31 Output busses, 8 VCAs + 8 Mute groups, 26 motorized faders (24 input + LR/Mono), 5" touchscreen display, Should Support MADI/Dante/cobranet Cards, 20 sub-group / aux busses, Multi-Color LCD Channel Displays on each input fader, 4 studio-grade Effects engines and dedicated FX busses, 4 mono/stereo matrix busses Up to 80 channels to mix

23	32 analog inputs, 12 analog outputs Stage Box	Digital Stage box, it should support 32 ormore analogue inputs and 12 or more outputs; Should also have MADI compatible with main digital mixer to route the required audio signal configuration over a CAT5; the digital stagebox should be supplied by same OEM of digital Mixer for better performace and avoid any compatibility issues during / post installation; should be available in height up to 3U or less; etc.
24	Advanced Feedback Suppression	Advanced Feedback Suppression; should support Stereo or Dual Independent Channel Processing; Inputs / Outputs 2In / 2 Out; Max input line level +20dBu or more; A/D Conversion 24bit orbetter; THD+Noise 0.003% or better; Should have Wizard Setup Function; Should have Full LCD Display; 24 or more Programmable Filters per Channel; Live and Fixed Filter Modes; 24 or more LED per Channel Filter Metering; Input Impedance: Balanced 50kΩ, Unbalanced 25kΩ; Frequency Response: 20Hz – 20kHz, +/- 0.5dB orbetter; Crosstalk input to output >80dB ormore; etc.
25	Reference Monitor	8" Bi-Amplified Master Reference Monitor ,LF DRIVER SIZE: 203mm (8") ,HF DRIVER SIZE: 25mm (1") ,POWER CONFIGURATION: Bi-Amplified, Built-In AMP: 2x 250W Class D ,FREQUENCY RESPONSE +/-3 dB: 41Hz-25kHz , Peak SPL: 114 dB , 0.1%THD @ 1kHz/2.83VRMS , SIGNAL TO NOISE RATION, HF: 92dBA (A-Weighted), 83dBr (unweighted), ANALOG INPUT TYPE: 1 x XLR, Female Balanced , Digital Input : AES3 , A/D, D/A CONVERTER: 24 bit / 192 kHz A/D, 32 bit / 192 kHz D/A
26	Wall Speaker	Two-way 5" speaker with wide 100° x 100° coverage, Frequency Response (+/-3 dB): 85Hz - 17 kHz, Power Rating :200W, Maximum SPL:116dB, Sensitivity 90 dB, 1W/1m, Transformer Taps : 100V/70V, High Frequency Driver:.75 In
27	Analog Power Amplifier	Dual Channel Power Amplifier 120W @ 4 ohm/ 8 ohm per channel, "Audio Amplifier with Power Output: 2x120W at 100V/70V and 8/4 ohm", Input Sensitivity: 1.4Vrms for 8-ohms, Input Impedance 20K ohms, Should have one RJ45 port

PROJECTION & VIDEO CONTROL SOLUTION FOR 1500-PAX AUDITORIUM

S.NO.	MATERIAL BRIEF	TECHNICAL SPECIFICATION
1	Projector	1DLP Laser Projector, 23600 Lumens, WUXGA (1920 x 1200) Resolution, 3000000:1, Contrast Ratio, High-efficiency blue laser phosphor, Standard inputs: HDMI (1.4a), HDMI 2.0, HDBaseT, 3D Sync In (BNC), VGA, Audio In (3.5mm phone jack), USB-A, Signal outputs: 3D SYNC Out (BNC), HDMI, Audio Out, 1.25-2.0:1 (1.6x throw ratio) motorized lens - powered zoom, focus and offset, IP5X dust-resistant, 24/7 performance etc all complete.
2	Projector Mounting Kit	Custom made Projector mounting kit as per site.
3	Projection Screen	Projection Screen of 360" Fixex Projection Screen, Aspect Ratio: 16:10, Tubular Motor, Fiber Glass Fabric, Gain 1.0, Viewing angle : 160 °, Built-in RF/IR remote control, RS485 & dry contact etc all complete.
4	Audio over IP Encoder	4K60 4:4:4 & H.264 1080p Multi-Codec, Dual-Stream Encoder, Shall have Video Preview viewable from the built-in web interface or from a touch panel , USB 2.0 Transport , Shall have Switchable Dual HDMI Inputs , High security network support and features, including multicast, VLAN tagging and QoS,PoE+ powered with low-power mode for energy savings.Open Direct-Control API ,Digital Video Input HDMI 2.0 ,Digital Video Output Network video over Ethernet via RJ45 port or HDMI,Color Space 4:4:4, YUV ,Streaming Protocols RTP, RTSP, RTMP, RTMP/S, MPEG2-TS, HTTP Live ,Input Signal Types Embedded audio on HDMI or Analog Stereo (Balanced or Unbalanced), Output Signal Types Ethernet, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.
5	Audio over IP Decoder	4K60 4:4:4 & H.264 1080p Multi-Codec Decoder, High-Quality, Low-Latency 4K60 Decoding and H.264 Decoding, Shall have Video Preview viewable from the built-in web interface or from a touch panel ,2x USB 2.0 Transport, High security network support and features, including multicast, VLAN tagging and QoS. PoE+ powered with low-power mode for energy savings. Open Direct-Control API. Digital Video Input Network video over Ethernet via RJ45 port, Digital Video Output HDMI 2.0, Formats HDMI 2.0, HDCP 2.2 content protection support, Color Space 4:4:4, YUV, Embedded audio on HDMI, HDMI Audio Formats 8ch PCM , Shall have on board IR In and out , RS232 ,2x HDMI Input and 1x HDMI monitor output.

6	Audio over IP Transceiver	Audio over IP Transceiver, Input: 2-channel user selectable balanced or unbalanced audio.Output: 2-channel balanced audio ,2-channel unbalanced audio (headphone jack)m Analog-To-Digital Conversation : 16-bit 32 kHz, 44.1 kHz and 48 kHz, LATENCY : Audio 20ms, Ethernet: Multi-cast, unicast, IGMP v3, IPv6, layer-2 and layer-3 switch compatible.Network port -8-wire RJ45 female. 10/100/1000 Mbps 10/100/1000Base-T auto-sensing gigabit Ethernet switch port.
7	Integrated Controller	Integrated Controller, Dual Network Interface card, Should support IPv6 , Shall Supports IEEE Standard for Port-based Network Access Control with the ability to grant or deny network access to devices wishing to attach to a LAN based on credentials tied to the device rather than to a user, Should have High Performance Architecture, Flexible Programming Platform Java, Should have ability to manage secure port TLS and SSH communications with a remote device or server, Enhanced Diagnostics On Serial and IR Ports , Hardware / Software should be Built for 24/7/365 Operation, Should have Ultra-Fast 1600 MIPS processor , 512 MB Onboard RAM , 1 M Non-Volatile Memory, 8 GB SDHC FLASH Memory ,1 RU Rack Space ,10/100 LAN Interface ,4 Digital I/O Ports , 1 RS-232/422/485 Port , 3 RS-232-Only Ports , 4 IR/Serial Output Ports , 4 Relay Ports,Shall be supplied with OEM recommended power supply , Regulatory Compliance :RoHS ,WEEE
8	7” Touch Panel	7” Tabletop Touch Panel , fully configurable , Capacitive Touch Screen ,Built-in Web Browser and document Viewers ,Adjustable Security Modes, Resolution (WH) Landscape: 1280x800, Aspect Ratio (WH) Landscape: 16:9, Brightness 330 cd/m2, Contrast Ratio 800:1, SDRAM 2 GB, Flash 16 GB, Ethernet 10/100 Auto MDI-X port, RJ-45 connector, USB (1) USB host 2.0, Type A ports, Speakers 4 ohm, 2 Watt, 300 Hz cutoff frequency , Supported Video Codecs :MPEG ,MPEG-2-TS: H.264 , Shall be able to decode two Active Video Streams , Viewer Applications -PDF, JPEG, BMP, PNG, TIFF, GIF, PowerPoint, .doc, .docx, .xls, .xlsx, .ppt, .pptx along with POE enabled network switch.
STAGE LIGHTING SOLUTION - 1500-PAX AUDITORIUM		
S.NO.	**MATERIAL BRIEF**	**TECHNICAL SPECIFICATION**
FOH Lighting Bar		
1	Moving Head RGBW LED Wash Fixture with Zoom	High Ouput LED wash light with RGBW color mixing and 19 x 15 Watt LED , With 6,000 lumen output, shall have Aura Light Source: 30 x 0.3 W RGB LED , Minimum LED lifetime: 50,000 hours (to >70% luminous output), Zoom range from 10° - 59° ,Pan: 540°,Tilt: 232°,Variable CTC: 2.5K - 10K , Control option: DMX,RDM,Total power consumption: 400 W,DMX channels: 25/14 and IP20 rated.
2	Warm White LED ELLIPSOIDAL Profile	High Ouput LED Static Ellipsoidal Profile with 91 x 3 Warm white LED With 7000 lumen output and CRI >97; Minimum LED lifetime: 30,000 hours (to >70% luminous output); shall be supplied with lens Tube : 19°; Variable CTC: 3000k; Control option: DMX,RDM; Total power consumption: 250 W; DMX channels: 1/2/4 and IP20 rated
3	LED Moving Head Profile with CMY Color Mixing	High Ouput LED Moving head Profile with CMY color mixing and 260 Watt LED engine with 95,000 lumen output and CRI >70; Minimum LED lifetime: 20,000 hours (to >70% luminous output); Zoom range from 13° -28°; Pan: 540°,Tilt: 260° and 4, 6 Facet prism with Focus,Iris option; Color wheel: 9 + open; Rotating gobo wheel includes 7 gobos + open; Fixed Gobo : 9 + open; Color temperature: 6.5k; Control option: DMX,RDM; Total power consumption: 362 W; DMX channels: 21 and IP20 rated
MIDDLE Lighting Bar - 1		
4	Static RGBW LED PAR Fixture with Zoom fixture with Zoom	Static LED Par Light engine: 7 x 40W RGBW Full-gamut color-calibration system; CTC control: 1,800–12,850 K; Lumen output: 3,500 lm; Intensity: 390,000 cd; Zoom: 4.2 - 58°; Low-noise 33 dB Theatre mode operation; Color mixing: RGBW; Color presets: 48 color presets, virtual color wheel effects; Control options: DMX, RDM; IP20 rating
5	Warm White LED ELLIPSOIDAL Profile	High Ouput LED Static Ellipsoidal Profile with 91 x 3 Warm white LED With 7000 lumen output and CRI >97; Minimum LED lifetime: 30,000 hours (to >70% luminous output); shall be supplied with lens Tube : 19°; Variable CTC: 3000k; Control option: DMX,RDM; Total power consumption: 250 W; DMX channels: 1/2/4 and IP20 rated

MIDDLE Lighting Bar - 2		
6	Static RGBW LED PAR Fixture with Zoom fixture with Zoom	Static LED Par Light engine: 7 x 40W RGBW Full-gamut color-calibration system; CTC control: 1,800–12,850 K; Lumen output: 3,500 lm; Intensity: 390,000 cd; Zoom: 4.2 - 58°; Low-noise 33 dB Theatre mode operation; Color mixing: RGBW; Color presets: 48 color presets, virtual color wheel effects; Control options: DMX, RDM; IP20 rating
7	Warm White LED ELLIPSOIDAL Profile	High Output LED Static Ellipsoidal Profile with 91 x 3 Warm white LED With 7000 lumen output and CRI >97; Minimum LED lifetime: 30,000 hours (to >70% luminous output); shall be supplied with lens Tube : 19°; Variable CTC: 3000k; Control option: DMX,RDM; Total power consumption: 250 W; DMX channels: 1/2/4 and IP20 rated
LAST Lighting Bar		
8	Static RGBW LED PAR Fixture with Zoom fixture with Zoom	Static LED Par Light engine: 7 x 40W RGBW Full-gamut color-calibration system; CTC control: 1,800–12,850 K; Lumen output: 3,500 lm; Intensity: 390,000 cd; Zoom: 4.2 - 58°; Low-noise 33 dB Theatre mode operation; Color mixing: RGBW; Color presets: 48 color presets, virtual color wheel effects; Control options: DMX, RDM; IP20 rating
9	LED Moving Head Profile with CMY Color Mixing	High Ouput LED Moving head Profile with CMY color mixing and 260 Watt LED engine with 95,000 lumen output and CRI >70; Minimum LED lifetime: 20,000 hours (to >70% luminous output); Zoom range from 13° -28°; Pan: 540°,Tilt: 260° and 4, 6 Facet prism with Focus,Iris option; Color wheel: 9 + open; Rotating gobo wheel includes 7 gobos + open; Fixed Gobo : 9 + open; Color temperature: 6.5k; Control option: DMX,RDM; Total power consumption: 362 W; DMX channels: 21 and IP20 rated
Atmospheric Effect on Stage		
10	Compact Sized Water-Based Haze Machine	Finest and densest haze particles in its class, Water-based fluid provides dense particles and even haze; 2.5 l fluid reservoir - up to 20 hours on full output; Independent variable haze and fan control. Shall be supplied with OEM approved Fluid System

AUDIO-VIDEO TECHNICAL SPECFICIATION FOR 400-PAX LECTURE HALL AT CENETARY BUILDING, IITISM DHANBAD

AUDIO SOLUTION FOR 400-PAX LECTURE HALL

S.NO.	MATERIAL BRIEF	TECHNICAL SPECIFICATION
1	Two-Way Column Line Array Loudspeaker	Constant Beamwidth Technology Two-Way Line Array Column with Asymmetrical Vertical Cove Four 130 mm (5 in) LF drivers Sixteen 25 mm (1 in) HF drive, Frequency Response (-10dB): 60 Hz – 20 kHz, Power Rating: 350 W (1400 W peak), 100 hrs, senstivity : 98dB, Nominal Impedance 8 ohms or better, Max SPL:131 peak, Outdoor Capability IP-55 rated, Enclosure Fiberglass reinforced ABS cabinet.
2	18" High Power Subwoofer	18" High Power Subwoofer System Frequency Range (-10 dB) : 32 Hz - 250 Hz , Frequency Response (±3 dB) : 40 Hz - 250 Hz , System Sensitivity (1w @ 1m) : 95 dB ,Nominal Impedance 8 ohms , Maximum SPL(1m) : 128 dB peak , Power Rating (Peak) : 1800 W , Low Frequency Driver 1 x 18” woofer , 457.2 mm (18 in) driver with 75 mm (3 in) voice-coil , Input Connector Dual Neutrik NL4MP connectors plus covered barrier trip terminals , Enclosure Material 18 mm multi-ply hardwood plywood.

3	Four Channel Digital Power Amplifier, 600W@4 Ohms	Four Channel Digital Power Amplifier, 600W@4 Ohms, On-board Digital Signal Processor and includes these integrated features: Input Router , Input Delay – Up to 1000ms , Input Parametric EQ – 8 band , Crossover , Output Parametric EQ – 8 band ,Output Delay – Up to 100ms , Limiter, Should be controllable, configurable and monitorabe through standard TCP/IQ network. ,Each output channel should be capable of providing either 70V or 100V for high impedance applications ,Completely configure the amplifier using an intuitive front-panel interface, Should have GPIO/AUX Port to Recall presets, mute channels, monitor faults, power on/off the amplifier, and more through a combined , Digital Signal Processing :96kHz, 32-bit floating point, Voltage Gain (at maximum level setting) 4/8Ω, 70Vrms and 100Vrms Operation : 34dB, Frequency Response (8Ω, 20Hz - 20kHz): +/-0.25dB, Total Harmonic Distortion (at full rated power, from 20Hz - 20kHz) : 0.35% ,Analog Input Signal to Noise Ratio (ref. rated power, 100V,20Hz - 20kHz): >104dB, Damping Factor (20Hz to 100Hz) : >1000, Crosstalk (below rated power, 20Hz to 1kHz) : >80dB, 4x600 W at 4 Ohm ,8 Ohm 70V and 100 V
4	Dual Channel Digital Power Amplifier, 1200W@4 Ohms	Dual Channel Digital Power Amplifier, 1200W@4 Ohms, On-board Digital Signal Processor and includes these integrated features: Input Router , Input Delay – Up to 1000ms , Input Parametric EQ – 8 band , Crossover , Output Parametric EQ – 8 band ,Output Delay – Up to 100ms , Limiter, Should be controllable, configurable and monitorabe through standard TCP/IQ network.Each output channel should be capable of providing either 70V or 100V for high impedance applications.Completely configure the amplifier using an intuitive front-panel interface, Should have GPIO/AUX Port to Recall presets, mute channels, monitor faults, power on/off the amplifier, and more through a combined , Digital Signal Processing :96kHz, 32-bit floating point Voltage Gain (at maximum level setting) 4/8Ω, 70Vrms and 100Vrms Operation : 34dB, Frequency Response (8Ω, 20Hz - 20kHz): +/-0.25dB, Total Harmonic Distortion (at full rated power, from 20Hz - 20kHz) : 0.35% Analog Input Signal to Noise Ratio (ref. rated power, 100V,20Hz - 20kHz): >104dB, Damping Factor (20Hz to 100Hz) : >1000, Crosstalk (below rated power, 20Hz to 1kHz) : >80dB, 2x1200 W at 4 Ohm ,8 Ohm 70V , and 100 V
5	Wireless Handheld Dynamic Microphone	Wireless Handheld Microphone System, Wireless Microphone system with MHZ carrier frequency band, Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz, THD at 1 kHz: <0.3% (Receiver) , Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation, Up to 48 Simultaneous channels , Upto 14 hours operation with one single AA battery or better, Pilot Tone, transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status, Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D.: 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW.
6	Wireless Presenter Microphone	Wireless Lavalier Microphone System, Wireless Microphone system with MHZ carrier frequency band, Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz, THD at 1 kHz: <0.3% (Receiver), Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation, Up to 48 Simultaneous channels, Upto 14 hours operation with one single AA battery or better, Pilot Tone transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status, Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D. 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW.
7	Antenna Power Splitter	Antenna power splitter, Active Antenna Power Splitter for upto 4 receivers, Antenna power splitter with an extended frequency range from 470 to 952 MHZ, Cable length adjustment with available, Support up to 4 receivers
8	Active Antenna	Active Omnidirectional wide-band UHF receiving antenna, switching bandwidth (from/to) :470 to 952 MHz, Antenna gain17 dB Cable length can be up to 300M, Covering angle :360 Grad, Recommended load impedance :50 Ohms
9	Active Antenna Booster	Antenna Booster for Switching bandwidth (from/to)470 to 952 MHz or more; Switching bandwidth (from/to)470 to 952 MHz or more; RF input 50 Ohms or better; Recommended load impedance: 50 Ohms or better; Can compensate 3.5 to 17.5 dB of cable attenuation; etc.

10	Wired tabletop gooseneck condenser microphone	Wired Gooseneck Microphone with Desktop base unit and on/off switch for Podium, Desktop gooseneck Mic, Audio frequency bandwidth =70 - 18000 Hz, Signal to Noise:64 dB-A, Length =500 mm, Voltage =9 to 52 V Power Interface
11	12 x 8 Networked Digital Signal Processor with AEC	12 x 8 Networked Digital Signal Processor With AEC , Should have 12 floating AEC in group of 4 Ch - DSP with 12 inputs and 8 outputs, 12 Control Inputs and 6 Logic Outputs for GPIO Integration, 48V phantom power on all analog inputs, THD: <0.01% 20Hz to 20KHz, +10dBu output, Crosstalk: <-75dB, Open architecture software configurable, Separate logic processing power ,2 digital audio bus RJ 45 Port , 1 Ethernet port for Monitoring and configuration , Capable to handle +5V unloaded logic output voltage ,Should have speech filter engine , Capable to control 3rd party devices with TCP IP and RS 232 , Should have 1nos of RS 232 port for integration with control System, Should have Bi-Directional Locate Functionality ,Should have 48 or more digital audio Channel Bus, Should have monitoring LED for COM, STAT, ERR and PWR , Shall have 8x8 USB interface to the PC.

PROJECTION & VIDEO CONTROL SOLUTION FOR 400-PAX LECTURE HALL

S.NO.	MATERIAL BRIEF	TECHNICAL SPECIFICATION
1	Projector	1DLP Laser Projector, 9600 Lumens, WUXGA (1920 x 1200) Resolution, 3000000:1 Contrast Ratio, High-efficiency blue laser phosphor, Standard inputs: HDMI (1.4a), HDMI 2.0, HBase, 3D Sync In (BNC), VGA, Audio In (3.5mm phone jack), USB-A, Signal outputs: 3D SYNC Out (BNC), HDMI, Audio Out, 1.25-2.0:1 (1.6x throw ratio) motorized lens - powered zoom, focus and offset, IP5X dust-resistant, 24/7 performance etc. all complete.
2	Projector Mounting Kit	Supply of custom-made projector mounting kit.
3	Projection Screen	226" Recessed Ceiling Motorized Projection Screen, Aspect Ratio: 16:10, Tubular Motor, Fiber Glass Fabric, Gain 1.0, Viewing angle: 160 °, Built-in RF/IR remote control, RS485 & dry contact etc all complete.
4	Multi-Format Decor Style Wall plate	Multi-Format Decor Style Wall plate, Multi-Format Analog Port and HDMI Port, Send HDMI signals up to 100 meters, Standard Twisted Pair Cable, HDMI Input HDMI Type A Female, Analog Video Input HD-15, Analog Stereo Input 3.5mm Mini-Stereo Jack, USB (HID) Keyboard & Mouse USB Mini-B Connector, Advanced Configuration Interface USB Mini-B Connector, HDBT Output RJ-45, Compatible Formats HDMI, HDCP , DVI, Data Rate (Max) 4.95 Gbps / 6.75 Gbps, Video Pixel Clock (Max) 165 MHz / 225 MHz, Progressive Resolution Support 480p up to 1920x1200 @ 60 Hz, Color Space Support RGB 4:4:4, YCbCr 4:4:4 and 4:2:2, Audio Format Support Dolby TrueHD, Dolby Digital, DTS-HD Master, Audio, DTS, 2 CH through 8 CH L-PCM, Dolby Digital and DTS support up to 48kHz, 5.1, channels, Audio Resolution 16 bit to 24 bit, Audio Sample Rate 32 kHz, 44.1 kHz, 48 kHz, 96 kHz, 192kHz, DDC/EDID Support, Regulatory Compliance: FCC, CE, UL, RoSH/WEEE
5	HDBT Transmitter with RS-232 / IP ports, USB2.0	4K60 Twisted Pair Transmitter, Shall have 4K60 4:4:4 transmitter which supports up to four sources via traditional HDBaseT , Shall have onboard USB 2.0 available on the HDBT allows for easy distribution of USB signals between the transmitter and receiver. A USB device, such as conferencing soundbar, can be mounted at the display and connected to a receiver. A laptop can then connect to the transmitter at the table, with USB and video distributed over category cable. 4K60 4:4:4 and HDCP 2.2 Support over HDBaseT with Display Stream Compression (DSC)– Visually lossless compression and future-proof support , Power over HDBaseT – Can be powered from HDBaseT inputs which means there is no need for an additional power source at the table ,Twisted Pair Cable Type Shielded Cat6, Cat6A and Cat7 / Shielded Cat6A and Cat7, Twisted Pair Cable Length Up to 328 ft. (100 m) ,HDBaseT Layer Throughput (Max) 10.2 Gbps, Shall have 1xHDMI , 1x HDBT Output , Shall serial port , Shall have IR TX and RX ports , Input Signal Type HDMI, HDCP DVI , Data Rate (Max) :18 Gbp ,Pixel Clock (Max) Up to 600 MHz, Regulatory Compliance CE, FCC, NRTL, RoHS, WEEE

6	Twisted Pair 4K HDMI Receiver Module	4K twisted pair receiver , shall be capable to receive Ultra High Definition (UHD) and 4K60 4:4:4 signal without modifying the color space or reducing the frame rate ,HDMI 2.0 and HDCP 2.2 Support , USB 2.0 – Utilize for a convenient way to connect USB 2.0 devices such as HID compliant , keyboard and mouse, monitors, and projectors, as well as web cameras, microphones and storage devices, shall support Standard Twisted Pair Cable ,Transport Layer Throughput (Max) :10.2 Gbps ,Twisted Pair Cable Length:Up to 262 ft. (80 m) for full 4K format support and Up to 328 ft. (100 m) for 1080p and below format support , shall have Bidirectional RS-232 serial port to control the devices , Compatible Formats : HDMI , HDCP, DVI. Output Re-clocking: Yes , Propagation Delay (Typical) : 5 microseconds , Video Data Rate (max) : 18 Gbps (Max) , Video Pixel Clock (max): Up to 600 Mhz , Output Format Matched to incoming video resolution up to 4K60 4:4:4 HDMI 2.0, HDCP 2.2 ,HDCP Support: Yes, including HDCP 1.x and HDCP 2.2
7	6x2 4K60 HDMI Switcher	6x2 4K60 HDMI Switcher, HDMI 2.0 4K60 4:4:4 Video, High Dynamic Range (HDR) and Deep Color Support, HDCP 2.2. EDID Management, Audio De-Embedding, firmware re-writing via USB, Open API Control over IP and Serial, full Web GUI console, and front panel buttons, Video Inputs (6) HDMI; supports HDMI/HDCP, Video Outputs: (2) HDMI; supports HDMI/HDCP, Video Resolution Support Various up to 4096 x 2160@ 60 Hz, Audio Inputs: Embedded audio on HDMI; support 2 CH L-PCM, Audio Outputs: (2) 3 Position 3.5mm pluggable Phoenix Terminal Block; supports Unbalanced Analog Stereo, 12V Power: (1) Screw Down Locking Power Connector, Ethernet: (1) RJ45 Connector, Analog Stereo Output: (2) 3 Position 3.5mm pluggable Phoenix Terminal Block, RS-232: (1) 3 Position 3.5 mm pluggable Phoenix Terminal Block Regulatory Compliance FCC, EN, UL, RoHS
8	Integrated Controller with 8 Button and Knob	Keypad with programmable 8 Buttons and 1 knob, 2x RS-232 Port, 2xIR Serial Port (2) 2x I/O Channels ,1x Relay Connection ,Program Port (1) USB Mini-B, USB , ID Pushbutton Reset factory settings, reset factory image, toggle between DHCP or static IP addressing mode, Shall have Memory Card of 4 GB SD ,DDRAM 256 MB

AUDIO-VIDEO TECHNICAL SPECFICIATION FOR 200-PAX LECTURE HALL AT CENETARY BUILDING, IITISM DHANBAD

AUDIO SOLUTION FOR 200-PAX LECTURE HALL

S.NO.	MATERIAL BRIEF	TECHNICAL SPECIFICATION
1	Constant Beamwidth Technology Two-Way Line Array Column with Asymmetrical Vertical Cove	Constant Beamwidth Technology Two-Way Line Array Column with Asymmetrical Vertical Cove Four 130 mm (5 in) LF drivers Sixteen 25 mm (1 in) HF drive, Frequency Response (-10dB): 60 Hz – 20 kHz, Power Rating: 350 W (1400 W peak), 100 hrs, sensitivity : 98dB, Nominal Impedance 8 ohms or better, Max SPL:131 peak, Outdoor Capability IP-55 rated, Enclosure Fiberglass reinforced ABS cabinet
2	15" High Power Subwoofer System	15" High Power Subwoofer System Frequency Range (-10 dB) : 32 Hz - 250 Hz , Frequency Response (±3 dB) : 40 Hz - 250 Hz , System Sensitivity (1w @ 1m) : 94 dB ,Nominal Impedance 8 ohms , Maximum SPL(1m) : 126 dB peak , Power Rating (Peak) : 1600 W , Low Frequency Driver 1 x 15” woofer , 385 mm (15 in) driver with 75 mm (3 in) voice-coil , Input Connector Dual Neutrik NL4MP connectors plus covered barrier trip terminals , Enclosure Material 18 mm multi-ply hardwood plywood

3	Four Channel Digital Power Amplifier, 600W@4 Ohms	Four Channel Digital Power Amplifier, 600W@4 Ohms, On-board Digital Signal Processor and includes these integrated features: Input Router, Input Delay – Up to 1000ms , Input Parametric EQ – 8 band , Crossover , Output Parametric EQ – 8 band ,Output Delay – Up to 100ms , Limiter, Should be controllable, configurable and monitorabe through standard TCP/IQ network. ,Each output channel should be capable of providing either 70V or 100V for high impedance applications ,Completely configure the amplifier using an intuitive front-panel interface, Should have GPIO/AUX Port to Recall presets, mute channels, monitor faults, power on/off the amplifier, and more through a combined , Digital Signal Processing :96kHz, 32-bit floating point, Voltage Gain (at maximum level setting) 4/8Ω, 70Vrms and 100Vrms Operation : 34dB, Frequency Response (8Ω, 20Hz - 20kHz): +/-0.25dB, Total Harmonic Distortion (at full rated power, from 20Hz - 20kHz) : 0.35% ,Analog Input Signal to Noise Ratio (ref. rated power, 100V,20Hz - 20kHz): >104dB, Damping Factor (20Hz to 100Hz) : >1000, Crosstalk (below rated power, 20Hz to 1kHz) : >80dB, 4x600 W at 4 Ohm ,8 Ohm 70V and 100 V
4	Wireless Handheld Dynamic Microphone	Wireless Handheld Microphone System, Wireless Microphone system with MHZ carrier frequency band, Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz, THD at 1 kHz: <0.3% (Receiver) , Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation, Up to 48 Simultaneous channels , Upto 14 hours operation with one single AA battery or better, Pilot Tone, transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status, Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D.: 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW
5	Wireless Presenter Microphone	Wireless Lavalier Microphone System, Wireless Microphone system with MHZ carrier frequency band, Up to 16 pre-programmed frequencies within the same frequency band, Audio bandwidth 35 - 20,000 Hz, THD at 1 kHz: <0.3% (Receiver), Signal-to-noise: 120 dB(A) (Receiver), Wideband FM Modulation, Up to 48 Simultaneous channels, Upto 14 hours operation with one single AA battery or better, Pilot Tone transmission to know the transmitter battery status, Receiver should have microphone level and line level output, Transmitter should have display to show the battery and LED to show the Muted /Unmuted status, Sensitivity 6.3 dB V / -100 dBm, Should have Microprocessor-controlled diversity, T.H.D. 0.7 % (Transmitter), Infrared programmable, RF output power: 10 or 50 mW
6	Wired tabletop gooseneck condenser microphone	Wired Gooseneck Microphone with Desktop base unit and on/off switch for Podium, Desktop gooseneck Mic, Audio frequency bandwidth =70 - 18000 Hz, Signal to Noise:64 dB-A, Length =500 mm, Voltage =9 to 52 V Power Interface
7	12 x 8 Networked Digital Signal Processor with AEC	12 x 8 Networked Digital Signal Processor With AEC , Should have 12 floating AEC in group of 4 Ch - DSP with 12 inputs and 8 outputs, 12 Control Inputs and 6 Logic Outputs for GPIO Integration, 48V phantom power on all analog inputs, THD: <0.01% 20Hz to 20KHz, +10dBu output, Crosstalk: <-75dB, Open architecture software configurable, Separate logic processing power ,2 digital audio bus RJ 45 Port , 1 Ethernet port for Monitoring and configuration , Capable to handle +5V unloaded logic output voltage ,Should have speech filter engine , Capable to control 3rd party devices with TCP IP and RS 232 , Should have 1nos of RS 232 port for integration with control System, Should have Bi-Directional Locate Functionality ,Should have 48 or more digital audio Channel Bus, Should have monitoring LED for COM, STAT, ERR and PWR , Shall have 8x8 USB interface to the PC.

PROJECTION & VIDEO CONTROL SOLUTION FOR 200-PAX LECTURE HALL		
S.NO.	**MATERIAL BRIEF**	**TECHNICAL SPECIFICATION**
1	Projector	SITC of 1DLP Laser Projector, 8500 Lumens, WUXGA (1920 x 1200) Resolution, 3000000:1, Contrast Ratio, High-efficiency blue laser phosphor, Standard inputs: HDMI (1.4a), HDMI 2.0, HDBaseT, 3D Sync In (BNC), VGA, Audio In (3.5mm phone jack), USB-A, Signal outputs: 3D SYNC Out (BNC), HDMI, Audio Out, 1.25-2.0:1 (1.6x throw ratio) motorized lens - powered zoom, focus and offset, IP5X dust-resistant, 24/7 performance etc all complete
2	Projector Mounting Kit	Supply of custom-made projector mounting kit.

3	Projection Screen	SITC of 164" Recessed Ceiling Motorized Projection Screen, Aspect Ratio: 16:10, Tubular Motor, Fiber Glass Fabric, gain 1.0, Viewing angle: 160 °, Built-in RF/IR remote control, RS485 & dry contact etc. all complete.
4	Multi-Format Decor Style Wall plate	Multi-Format Decor Style Wall plate, Multi-Format Analog Port and HDMI Port, Send HDMI signals up to 100 meters, Standard Twisted Pair Cable, HDMI Input HDMI Type A Female, Analog Video Input HD-15, Analog Stereo Input 3.5mm Mini-Stereo Jack, USB (HID) Keyboard & Mouse USB Mini-B Connector, Advanced Configuration Interface USB Mini-B Connector, HDBT Output RJ-45, Compatible Formats HDMI, HDCP , DVI, Data Rate (Max) 4.95 Gbps / 6.75 Gbps, Video Pixel Clock (Max) 165 MHz / 225 MHz, Progressive Resolution Support 480p up to 1920x1200 @ 60 Hz, Color Space Support RGB 4:4:4, YCbCr 4:4:4 and 4:2:2, Audio Format Support Dolby TrueHD, Dolby Digital, DTS-HD Master, Audio, DTS, 2 CH through 8 CH L-PCM, Dolby Digital and DTS support up to 48kHz, 5.1, channels, Audio Resolution 16 bit to 24 bit, Audio Sample Rate 32 kHz, 44.1 kHz, 48 kHz, 96 kHz, 192kHz, DDC/EDID Support, Regulatory Compliance: FCC, CE, UL, RoSH/WEEE
5	HDBT Transmitter with RS-232 / IP ports, USB2.0	4K60 Twisted Pair Transmitter, Shall have 4K60 4:4:4 transmitter which supports up to four sources via traditional HDBaseT , Shall have onboard USB 2.0 available on the HDBT allows for easy distribution of USB signals between the transmitter and receiver. A USB device, such as conferencing soundbar, can be mounted at the display and connected to a receiver. A laptop can then connect to the transmitter at the table, with USB and video distributed over category cable. 4K60 4:4:4 and HDCP 2.2 Support over HDBaseT with Display Stream Compression (DSC)– Visually lossless compression and future-proof support , Power over HDBaseT – Can be powered from HDBaseT inputs which means there is no need for an additional power source at the table ,Twisted Pair Cable Type Shielded Cat6, Cat6A and Cat7 / Shielded Cat6A and Cat7, Twisted Pair Cable Length Up to 328 ft. (100 m) ,HDBaseT Layer Throughput (Max) 10.2 Gbps, Shall have 1xHDMI , 1x HDBT Output , Shall serial port , Shall have IR TX and RX ports , Input Signal Type HDMI, HDCP DVI , Data Rate (Max) :18 Gbp ,Pixel Clock (Max) Up to 600 MHz, Regulatory Compliance CE, FCC, NRTL, RoHS, WEEE
6	Twisted Pair 4K HDMI Receiver Module	4K twisted pair receiver , shall be capable to receive Ultra High Definition (UHD) and 4K60 4:4:4 signal without modifying the color space or reducing the frame rate ,HDMI 2.0 and HDCP 2.2 Support , USB 2.0 – Utilize for a convenient way to connect USB 2.0 devices such as HID compliant , keyboard and mouse, monitors, and projectors, as well as web cameras, microphones and storage devices, shall support Standard Twisted Pair Cable ,Transport Layer Throughput (Max) :10.2 Gbps ,Twisted Pair Cable Length:Up to 262 ft. (80 m) for full 4K format support and Up to 328 ft. (100 m) for 1080p and below format support , shall have Bidirectional RS-232 serial port to control the devices , Compatible Formats : HDMI , HDCP, DVI Output Re-clocking : Yes , Propagation Delay (Typical) : 5 microseconds , Video Data Rate (max) : 18 Gbps (Max) , Video Pixel Clock (max): Up to 600 Mhz , Output Format Matched to incoming video resolution up to 4K60 4:4:4 HDMI 2.0, HDCP 2.2 ,HDCP Support: Yes, including HDCP 1.x and HDCP 2.2
7	6x2 4K60 HDMI Switcher	6x2 4K60 HDMI Switcher, HDMI 2.0 4K60 4:4:4 Video, High Dynamic Range (HDR) and Deep Color Support, HDCP 2.2 EDID Management, Audio De-Embedding, firmware re-writing via USB, Open API Control over IP and Serial, full Web GUI console, and front panel buttons, Video Inputs (6) HDMI; supports HDMI/HDCP, Video Outputs: (2) HDMI; supports HDMI/HDCP, Video Resolution Support Various up to 4096 x 2160@ 60 Hz, Audio Inputs: Embedded audio on HDMI; support 2 CH L-PCM, Audio Outputs: (2) 3 Position 3.5mm pluggable Phoenix Terminal Block; supports Unbalanced Analog Stereo, 12V Power: (1) Screw Down Locking Power Connector, Ethernet: (1) RJ45 Connector, Analog Stereo Output: (2) 3 Position 3.5mm pluggable Phoenix Terminal Block, RS-232: (1) 3 Position 3.5 mm pluggable Phoenix Terminal Block Regulatory Compliance FCC, EN, UL, RoHS

8	Integrated Controller with 8 Button and Knob	Keypad with programmable 8 Buttons and 1 knob, 2x RS-232 Port, 2xIR Serial Port (2) 2x I/O Channels ,1x Relay Connection ,Program Port (1) USB Mini-B, USB , ID Pushbutton Reset factory settings, reset factory image, toggle between DHCP or static IP addressing mode, Shall have Memory Card of 4 GB SD ,DDRAM 256 MB

PA SYSTEM TECHNICAL SPECFICATION FOR PA-SYSTEM AT CENETARY BUILDING, IITISM DHANBAD

PA SYSTEM FOR CENTENARY BUILDING

S.NO.	MATERIAL BRIEF	TECHNICAL SPECIFICATION
1	3"Compact Full Range Ceiling Loudspeaker	3"Compact Full Range Ceiling Loudspeaker, Full-range loudspeaker with a single 3” driver or better, Power Handling @ Low Z: 40W Peak or better, Transformer Taps: 15 W ,7.5W @ 70V and 100V, Frequency Range (-10 dB) : 80 Hz - 17 kHz, Nominal Dispersion :130° conical, Maximum SPL @ 1 m : 102 dB SPL peak
2	Four-channel 300W @ 4Ω Power Amplifier	Four Channel Digital Power Amplifier, 300W@4 Ohms On-board Digital Signal Processor and includes these integrated features: Input Router, Input Delay – Up to 1000ms, Input Parametric EQ – 8 band, Crossover, Output Parametric EQ – 8 band, Output Delay – Up to 100ms, Limiter, should be controllable, configurable and monitorable through standard TCP/IQ network. Each output channel should be capable of providing either 70V or 100V for high impedance applications. Completely configure the amplifier using an intuitive front-panel interface. Should have GPIO/AUX Port to Recall presets, mute channels, monitor faults, power on/off the amplifier, and more through a combined ,Digital Signal Processing :96kHz, 32-bit floating point, Voltage Gain (at maximum level setting) 4/8Ω, 70Vrms and 100Vrms Operation : 34dB, Frequency Response (8Ω, 20Hz - 20kHz): +/-0.25dB, Total Harmonic Distortion (at full rated power, from 20Hz - 20kHz) : 0.35%, Analog Input Signal to Noise Ratio (ref. rated power, 100V,20Hz - 20kHz): >104dB, Damping Factor (20Hz to 100Hz) : >1000, Crosstalk (below rated power, 20Hz to 1kHz) : >80dB
3	Desktop paging station	Desktop paging station with ON/OFF button, Frequency bandwidth 150 - 15000 Hz, Polar Pattern: Cardioid, Sensitivity 2.2 mV/Pa, Electrical impedance: 530 Ohms, Recommended load impedance 2000 Ohms,
4	12 x 8 Networked Digital Signal Processor	12 x 8 Networked Digital Signal Processor ,DSP with 12 inputs and 8 outputs, 12 Control Inputs and 6 Logic Outputs for GPIO Integration, 48V phantom power on all analog inputs, THD: <0.01% 20Hz to 20KHz, +10dBu output, Crosstalk: <-75dB, Open architecture software configurable, Separate logic Processing power, 2 digital audio bus RJ 45 Port ,1 Ethernet port for Monitoring and configuration, Capable to handle +5V unloaded logic output voltage , at-least 6 ,Should have speech sense engine ,Capable to control 3rd party devices with TCP IP and RS 232 ,Should have 1nos of RS 232 port for integration with control System, Should have Bi-Directional Locate Functionality, Should have 48 or more digital audio Channel Bus, Should have monitoring LED for COM, STAT, ERR and PWR
5	USB Audio to Digital link Interface	USB Audio to Digital link Interface, Low-Latency Operation, Audio Bus Supports 48kHz or 96kHz/24-Bit High-Resolution Audio, Sample Rate is Automatically Configured, should be capable to transfer 8 Input and 8 output channels to DSP from PC or Mac
6	8 Buttons Ethernet Controller and Volume Control	8 Buttons Ethernet Controller and Volume Control, should be Compatible with supplied DSP, should support PoE (Power Over Ethernet), 8 Programmable Buttons (Multicolored), Capable to trigger any DSP logic, Multicolored 2 Programmable 64x128 Pixel LCDs, Sleep Function, Security: Remote Lock/Unlock and Local Unlock via PIN Entry, Should have knob and capable to control 8 zones separate

Annexure-A

List of Preferred Makes For Civil & Plumbing Works

Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of preferred make attached in the tender, shall be used in the work. In case of non-availability of the brand specified in the contract the contractor shall be allowed to use alternate equivalent brand of the material subject to submission of documentary evidence of non availability of the specified brand.

Sample of all the materials will be used only after approval of Addl. Chief Engineer, WAPCOS Limited.

S. No.	Items	Preferred Makes / Brands
1	Cement (PPC/OPC43)	Ultra Tech / J.K. Cement / ACC / Birla / Lafarge / Wonder
2	White Cement	J.K. White / Birla White / Ultratech / Wonder
3	Reinforcement Steel	Tata Steel / SAIL / RINL /JSPL / JSW / Shyam
4	Structural Steel	Tata Steel / SAIL / RINL /JSPL / JSW / Shyam
5	Stainless Structural Steel	Jindal Hissar / Sail / Tata Steel / Shyam
6	Welding Rods	ESAB / Bohler / Advani Oerilikam / D&H
7	Steel Nut & Bolts	Hilti / Bosch / Fischer
8	Admixtures, Plasticizers	Fosroc/ Sika/ BASF/ MBT/ Bulwark Conchem / Kunal Conchem
9	Water Proofing Compound	Fosroc/ Sika/ Pidilite/ Basf/Kunal Conchem/ Bulwark Conchem
10	Crystalline Water Proofing Compound	Fosroc / Sika / Penetron /Xypex / Vendex / Asian Paints/Bulwark Conchem
11	Polysuphide Sealant	Fosroc / Sika / Pidilite / BASF/ Sika/ Kunal Conchem
12	Weather Silicon Sealant	Dow Corning / Wacker / GE Silicones/ Kunal Conchem
13	Modular Expansion Joint	Herculas / Vexcolt /Devin / Sainfield
14	Autoclaved Aerated Cement Blocks	Aerocon (Hil Ltd.) / Ultratech / Siporex / Magicrete / Biltech / J.K Laxmi
15	Polymer Modified Adhesive For AAC Blocks	MYK Laticrete / J.K. Laxmi / Ultratech / Aerocon /Ardex Endura/ Kunal Conchem
16	Tile and Stone Adhesive & Grouting Compound	Fosroc / Sika / Ardex Endura / Laticrete / Pidilite/ Kunal Conchem
17	Laminate	Greenlam / Durian / Merino / Century/Skydecor
18	Flush Doors / Plywood /Veneers	Green / Merino / Century
19	Block Board	Green / Merino / Century
20	uPVC Window	Fenasta / JELD-WEN / EGGER / VELUX /Prominance / REHAU / Deceuninck
21	Frameless Glass Doors With SS Patch Fittings	Dorma / Hafele / Geze /Becker FS
22	Stainless Steel Mortice Lock, Ball Bearing Hinges, Hanging Floor Door Stopper, Magic Eye) For Doors(Non-Fire Rated)	Dorma / Hafele / Geze / Becker-FS
23	Stainless Steel Sliding Door Bolts, Tower Bolts, Handles For Doors (Non- Fire Rated)	Hafele / Geze / Becker-FS
24	Hydraulic Door Closer	Dorma / Hafele / Geze / Becker-FS / Hettich / Blum
25	Modular Kitchen Accessories	Dorma / Hafele / Geze / Becker-FS / Hettich / Blum

26	Auto Sensys Hinges (Stainless Steel)	Dorma / Hafele / Geze / Becker-FS / Hettich / Blum
27	False Ceiling (Metal)	Lindner / Rockfon / USG Boral (KNAUF) / Gyproc (Saint Gobain) / Anakon / Hunter Douglus / Armstrong
28	False Ceiling (Mineral Fiber)	Lindner / Rockfon / USG Boral (KNAUF) / Gyproc (Saint Gobain) / Anakon / Hunter Douglus / Armstrong
29	U Baffle Aluminum Panel Ceiling	Lindner / Rockfon / USG Boral (KNAUF) / Gyproc (Saint Gobain) / Anakon / Hunter Douglus / Armstrong
30	Dash Fasteners / Anchors	Hilti / Bosch / Fischer / Wurth
31	Clamp System For Stone Cladding	Hilti / Bosch / Fischer / Wurth
32	Float/ Frosted Glass, Mirror Glass	Saint Gobain/ Modiguard /Asahi
33	Structural Glazing, Skylight	Saint Gobain/ Modiguard /Asahi
34	Fire-Rated Glass	Saint Gobain / Schott/ Asahi / Pyroguard
35	Hermetically Sealed Performance Glass, Toughened Glass	Saint Gobain/ Modiguard /Asahi
36	Fire Door Shutter (Wooden / Metallic / Glass)	I Clean /Shakti Hormann / TATA Pravesh / Mikasa (Greenlam) / Vetrotech (Saint-Gobain) / Navair
37	Fire Rated Door Hardware Fitting	Dorma / Hafele / Geze / Becker-FS / Hettich
38	FRP Door Frames And Shutter	Fiberways Technology / Jayna / Simba
39	SS Drapery Rod	Vista / Hunter Douglus / Mac
40	Blinds (including Roller Blinds) For Windows	Hunter Douglus / Mac / Aerolux / D Décor / Marvel
41	Stainless Steel Railings (Knock Down)	Q Railing / D-Line / Ozone
42	Vitrified Tiles	Kajaria / Varmora / Somany / Simpolo / Johnson / Nitco / Nitco / RAK / Cera
43	Glazed / Ceramic Tiles	Kajaria / Varmora / Somany / Simpolo / Johnson / Nitco / Nitco / RAK / Cera
44	Aluminum Sections	Jindal / Hindalco / Indal / Nalco
45	Gypsum Plaster	Saint Gobain (Gyproc) / Boral / Ultratech / Asian Paints
46	Wall Putty (White Cement Based)	Birla Wall Care Putty / JK Wall / Asian Paints Professional Wall Putty / Dulux Wall Putty
47	P.O.P. Putty	Sakarni / Adhar Shree / JK / Ashirwad
48	Epoxy Primer And Paints / Wood Primer/ Steel Primer	Akzonobel India (ICI Dulux) / Kansai Nerolac / Asian Paints
49	Acrylic Distemper	ICI Dulux (Maxilite)/Kansai Nerolac (Narolac Acrylic)/ Asian Paints (Tractor Acrylic) / Berger (Bison)
50	Plastic Emulsion Paint	ICI Dulux (Super Cover 3 In 1) / Kansai Narolac (Beauty Gold) / Asian Paints (Premium Emulsion) / Berger (Easy Clean)
51	Synthetic Enamel Paint	ICI Dulux (Dulux Hi Gloss) / Kansai Narolac (Narolac Hi Gloss) / Asian Paints (Apcolite Premium Gloss) / Berger (Luxol)

52	Exterior Emulsion Paint	ICI Dulux (Weather Shield) / Kansai Narolac (Excel) / Asian Paints (Apex) / Berger (Weather Coat)
53	Melamine Polish	ICI Dulux / Kansai Nerolac / Asian Paints
54	Fire Paint	Akzonobel India (Ici Dulux) / Berger / Asian Paints/Promat
55	Polyester Powder Coating	ICI Dulux / Kansai Nerolac / Asian Paints
56	Centrifugally Cast (Spun) Iron Pipes & Fittings	Neco / Saint Gobain / BIC /Hepco / Kapilansh
57	Centrifugally Cast (Spun) Iron Pipes Class (La) Pipe	Neco / Electro Steel / Tata / Kesoram
58	UPVC Pipes & Fittings	Supreme / Finolex / Jain Irrigation /Astral / Signet
59	G. I. Pipes	Tata/ Jindal (Hisar) / Sail
60	G. I. Pipe Fittings	Unik / Zoloto / Jindal
61	SS Water Supply Pipes And Fittings	Rampart / Jindal / J-Press
62	Stainless Steel Sinks	Neelkanth / Nirali / Jayna
63	CP Brass Fittings	Grohe / Roca / American Standard / Neycer / Duravit / Toto / Kohler / Kerovit
64	Vitreous China Sanitary ware fittings	Grohe / Roca / American Standard / Neycer / Duravit / Toto / Kohler / Kerovit
65	HDPE Pipes	Jain Irrigation / Oriplast / Dutron / Reliance/Signet
66	Ball Valves	Zoloto / Leader / Audco / Schell/ Signet
67	Non Return Valves	Zoloto / Leader / Audco / Kirloskar / IVC/ Signet
68	Butterfly Valves	Audco / Advance / Schell / Kirloskar
69	Water Meter	Zoloto / Leader / Audco
70	SS Floor Grating	Jayna / Chilly / Nirali / Camry
71	Interlocking Precast C.C. Paver Blocks / Kerb Stone / Grass Paver	Dalal / Nitco / Unistone / Ntc / Ultra Tiles / ACC
72	Factory Made Wooden Frames And Wire Gauge Shutters	D.S. Doors / Jain Wood Industries / Jain Doors Pvt. Ltd.
73	Polycarbonate Sheet	Danpalon / Coxwell / Sunpal / Gallina
74	GRC Jali	Unistone / Birla White / Nav Nirman
75	Insulation	Up Twiga / Lloyd / Rock Wool
76	Acoustic Treatment For Walls, Ceiling	Knauf Amf / Saint Gobain / Top Akustik / Hunter Douglus / Armstrong / Anutone
77	Toilet Cubicles	Green Laminate / Marino / Century/ Skydecor
78	Soap Dispenser	Euronics/ Kohler / Jaquar / Grohe
79	Extruded Polystyrene Board Insulation (XPS Board)	Dow Building Solutions / Owens Corning / Isofoam
80	Reinforced Soil Walls	Maccaferri / Terre Armee / Freyssinet
81	Hubless Centrifugally Cast Iron Pipes & Fittings	Neco / Saint Gobain / Bic
82	CGI Sheet	Tata / Jindal / JSW
83	Ball Valves (15 To 50mm)	Arco (Sena)/Sant/L&T/ Signet
84	Non Return Valve	Audco / Advance / L&T/ Signet
85	Monoblock Pumps	Grundfoss/Xylem/Wilo-Mather & Platt
86	Vessels	Global Composite/ Aquanomics / Ion Exchange
87	Multiport Valve	CWG / Astral/Aquanomics
88	Chlorinator/Dozer	CWG / Astral/Aquanomics
89	Metering Pump	Lotus Alpha / Asia LMI/Aquanomics

90	Constant Pressure Variable Volume	Grundfos/Armstrong / ITT
91	Air Blower	Swan/Everest / Stanley
92	Resin	Thermax / Ion Exchange
93	Control Valves	Rapid Control / Anergy / L&T/ Signet
94	Pressure Reducing Valve	Honeywell/ Watts/ Utam
95	Solenoid Valve	Danfos/ Honeywell /L&T
96	GM /Forged Brass Ball Valves	Danfos/Kitz/ Utam
97	Sluice Valve	Audco/Advance/L&T
98	Check Valve-Wafer Type	Audco/Advance/L&T
99	Check Valve-Dual Plate	Audco/Advance/L&T
100	Check Valve-Forged Screwed	Audco/Advance/L&T
101	Air Release Valve	Audco/Advance/L&T/ Signet
102	Ball Float Valve	Audco/Advance/L&T
103	NRV Ball Type-Sewage Application	Danfos/Silverspark/Normex/Utam
104	Y Strainer CI	Audco/Kitz/VTM
105	Hydro pneumatic System	Grundfos/Xylem/Wilo-Mather & Platt
106	Storm Water Drainage & Sewage Sump Pumps	Grundfos/Xylem/Wilo-Mather & Platt
107	Transfer Pumps	Grundfos/Xylem/Wilo-Mather & Platt
108	Self-Priming Pump	Johnson/Kirloskar
109	Mechanical Seal	Burgmann/Sealol
110	Ant vibration Mounting & Flexible Connection	Dunlop/Kanwal Industries/Resistoflex
111	Pressure Gauge	H Guru/Fiebig/Emerald
112	Water Meter	Kranti/Actaris/Kent/Capstan
113	Electronic Flow Meter	Krohne/Rockwin / Honeywell / Omega
115	MH/Water Tank Plastic	KGM/Patel/Pranali Industries
116	Three Way Motorised	Danfoss/Honeywell/Siemens/AIP
117	Fire Sealant	Birla 3m/Hilti / Dowsil
118	Manhole(Prefabricate)	Ok Plat/Crescent Foundary
119	Temperature	Forbes Marshall/Wika
120	Dosing Pumps	LMI/Pulser/Feeder/Toschon
121	U.V Steriliser	Eureka Forbes / Ion- Exchange/ Kent / LG
122	Flow Control Devices	Aquaplus/Jaquar/RST
123	SS Pipe	Jindal/Viega/Prime Gold
124	Auditorium Chairs	Godrej / Durian / Featherlite / SR Seating Pvt. Ltd. / Methodex /
125	Conference Room furniture	Godrej / Durian / Featherlite / Methodex /
126	System Aluminium doors/windows	Fenesta / Dorma / Assa Abloy / Boon Edam / Hafele / Hettich / Doorset
127	Fire Curtain	Window techs /CLAUSS / MARKISEN / MHZ
128	Modular Kitchen	Sleek / Hafele / Hettich/Godrej Interio/Kutchina/Fab India/ Johnson Kitchen/Anchor/Livspace/Hacker/Wurfel/ Space wood
129	Fly Ash Cement bricks	***Must be got approved from Engineer-in-charge before use***
130	Stamp Concrete	***Must be got approved from Engineer-in-charge before use***

Annexure-B

List of Preferred Makes for Electrical & Mechanical Works

Unless otherwise specified, the brand / make of the material as specified in the item nomenclature, in the particular specifications and in the list of preferred make attached in the tender, shall be used in the work. In case of non-availability of the brand specified in the contract the contractor shall be allowed to use alternate equivalent brand of the material subject to submission of documentary evidence of non availability of the specified brand.

Sample of all the materials will be used only after approval of Addl. Chief Engineer, WAPCOS Limited.

Internal Electrical Installation, Street Lighting &Fixtures

S. No.	Material	Manufacturer
1	LT panels/ boards, Feeder panels.	STERLING GENERATOR, MARINEELECTRICALS, PRECISION SYSTEM CONTROL
2	MCCBS	SIEMENS-3VL, L&T- D-SINE, SCHNEIDER- NSX, ABB-T-MAX
3	ACB's	ABB (E-MAX) / SCHNEIDER (MASTERPACT NW) / L&T (U-Power Omega) / SIEMENS (3WL)
4	MCB, ELCB, RCCB, DB and RCBO. Distribution board shall be of the same make of MCB, ELCB, RCCB, DB and RCBO.	SIEMENS (BETAGUARD), L&T (AU), SCHNEIDER (ACTI-9)
5	LT cables, 1.1 KV grade	KEI, HAVELLS, POLYCAB, RR KABEL, EMPIRE
6	FRLS copper wires and cables, 1.1 KV grade	KEI, HAVELLS, POLYCAB, RR KABEL, L&T, EMPIRE
7	Switch Socket accessories.	LEGRAND (ARTEOR), SCHNEIDER (ZENCELO), MK (ELEMENTS), CRABTREE (MURANO), L&T (Englaze)
8	Lugs and Ferrules	DOWELLS, JAINSON, GRIPWELL, RAYCHEM
9	Brass Compression Gland (Heavy duty)	COMMEX, GRIPWELL, HENSEL, DOWELLS
10	Telephone Cables	FINOLEX, HAVELLS, ANCHOR, POLYCAB, RR KABEL, EMPIRE

S. No.	Material	Manufacturer
11	Telephone Tag Blocks with boxes	KRONE,POUYET
12	PVC Conduits and Accessories (ISI Marked, Heavy duty)	BEC, PRECISION, POLY-PACK
13	MS Conduit and Pipes	BEC, AKG, VIMCO, RMCON
14	MS Conduit Accessories (Heavy duty) (ISI MARKED)	BEC, AKG, VIMCO, RMCON
15	Pipes and Accessories (ISI)	TATA, JINDAL, SAIL
16	Indoor Light Fixtures	PHILIPS, TRILUX, ENDO, REGENT, LIGHTING TECHNOLOGIES, WIPRO
17	Water cooler with UV+UF	BLUE STAR, VOLTAS, KENT, ION EXCHANGE
17	Hand Dryer	EURONICS, MITSUBISHI, DOLPHY
18	Street /landscape LED Light Fixtures	PHILIPS, KESLEC, SHREDDER, TRILUX, LIGHTING TECHNOLOGIES
19	LED Chip for Street /landscape LED Light Fixtures	CREE, PHILIPS, OSRAM, NICHIA
20	Street Light Poles	KESLEC, PHILIPS, VALMONT
21	Decorative Street / Compound Light Poles	KESLEC, PHILIPS, VALMONT
22	4 Way Junction Box with fuse / MCB with heavy duty loop connector in poles	LEGRAND, SCHNEIDER, ABB, L& T
23	Emergency Exit Light	LEGRAND, PHILIPS, WIPRO
24	Selector Switch	RISHAB –L&T, KAYCEE, SIEMENS, C&S
25	CT/PT	AE, GILBERT, PRECISE, KAPPA, ANANT POWERTECH
26	Aviation Light	BAJAJ, WIPRO, PHILIPS
27	Photo Chromatic Switch	BAJAJ, WIPRO, PHILIPS
28	Annunciation Panel	CROMPTON, AREVA, SIEMENS, KIRLOSKAR
29	Terminal Blocks	BCH, INDUSTRIAL CONTROL, JAINSON
29	Change Over Switch	L&T, SOCOMEC, SIEMENS, HAGER
30	Bus bar	JINDAL, HINDALCO, CENTURY
31	Sandwich type bus trunking (Risingmain)	LEGRAND / SCHNEIDER / L&T / C&S
32	ATS	ABB / SIEMENS / SOCOMEC / ASCO
33	Chemical Earthing	JEFECOSAFE, ERICO, TERECPLUS
34	GI pipes	JINDAL, TATA, SAIL
35	Copper conductor PVC insulated Wires	KEI, HAVELLS, POLYCAB, RR KABEL, EMPIRE
36	Timers &Contactors to be mounted in DB's	L&T, SIEMENS, SCHNEIDER, HAGER,LEGRAND
37	MV Contactors/Timer/Starters	L&T, SIEMENS, SCHNEIDER, LEGRAND
38	Protective Relays	AREVA, SIEMENS, L&T, ALSTOM, SCHNEIDER

S. No.	Material	Manufacturer
39	kWh Meters (Electronic Digital type)/Multifunction Meter/ Ammeter/ Voltmeter)	CONZERV, SECURE, CAPITAL, L&T
40	Indication Lamps/Push Button	L&T, BCH, GE
41	Ceiling/Exhaust Fans	CROMPTON GREAVES, ORIENT, HAVELLS
42	G.I. Cable Tray	SLOTTCO/ LEGRAND/ OBO / PROFAB/Precision System Control
43	Raceway	LEGRAND, MK, SCHNEIDER, OBO
44	PVC MODULAR DLP TRUNKING	LEGRAND, MK, SCHNEIDER, OBO
45	TV outlet	LEGRAND (ARTEOR), SCHNEIDER (ZENCELO), MK (ELEMENTS), CRABTREE (MURANO) L&T (Englaze)
46	DWC HDPE PIPE	SUPREME, JAIN, KISSAN, GEMINI, SIGNET
47	Poly carbonate Junction Boxes	HENSEL, CLIPSAL, MENEKKES
48	Fasteners	HILTI, FISCHER, BOSCH, WUNH
49	Kitchen Chimney	FABER / BOSCH / KAFF

HV**AC**

S. No.	Material	Manufacturer
	HVAC (HighSide)	
1	Water Cooled Screw Chilling Machine with VSD (AHRI Certified)	TRANE/CARRIER/McQuay/YORK/DUNHAMBUSH
2	Cooling Tower	EVAPCO/ADVANCE/BELL/DELTA
3	Variable Speed Chilled Water Secondary & Tertiary / Hot Water Variable Pumping System, Air Separator & Pressurized Expansion Tank	ITT-XYLEM/ ARMSTRONG / GRUNDFOS
5	Suction Guide	ANERGY/ EMERALD/RAPID COOL
6.	VFD (for chiller, pumps cooling tower and AHU's)	DANFOSS / ABB /SIEMENS / FUJI
	MECHANICAL INSTALLATION	
7	Pipes (M.S & G.I) upto 150mm dia.	TATA / JINDAL (HISSAR) / SAIL
8	200mm dia. onwards (wall thickness 6-10 mm)	TATA/JINDAL (HISSAR) / SAIL
9	Resin bonded Fibre glass	UP-TWIGA / OWENS CORNING / KIMMCO
10	Cold sticking compound / Bonding	CPRX COMPOUND OF SHALIMAR TAR
11	Globe valve	AUDCO / L&T / ADVANCE
12	Ball Valves / Gate Valves	AUDCO / L&T / ADVANCE
13	Pressure gauges & Thermometers	ANERGY /H.GURU / FIEBIG
14	Test points	ANERGY
15	Y-strainers/Pot strainer	RAPID CONTROL / EMERALD / ADVANCE
16	Butterfly valves/NRV	AUDCO / L&T / ADVANCE
17	Balancing valves	AUDCO / L&T / ADVANCE
18	Steel fasteners	FISCHER / HILTI
19	Spring Isolator	RESISTOFLEX / DUNLOP / GERB
20	Belt	FENNER (INDIA) LIMITED
21	Neoprene in shear isolators	RESISTOFLEX/ DUNLOP
22	Air vents	ANERGY /FLAMCO / AIRTECH /COMFORT
23	Flexible connections Pipes	RESISTOFLEX/KANWAL
24	Pressure Independent Balancing Cum 2-Way Modulating Control Valve (Single Body)	SIEMENS/HONEYWELL / JOHNSON/ Danfoss / Advance-Pettinaroli
25	Thermostat	SIEMENS/HONEYWELL / JOHNSON
26	Actuator	BELIMO / DANFOS / SIEMENS
27	Supporting Steel	TATA/SAIL/JINDAL
28	Motorized Butterfly Valve	BELIMO /AUDCO / ADVANCE
	Louvers	CARYAIRE / AIRFLOW / CON AIRE

S. No.	Material	Manufacturer
29	**ELECTRICALINSTALLATION**	
30	Power cables	RR KABEL/ KEI/ POLYCAB/BONTON/EMPIRE
31	Motor Control Centre /LT Switch boards / Panels	STERLING GENERATOR, MARINE ELECTRICALS, PRECISION SYSTEM CONTROL
32	HRC fuses & fittings	L&T / SIEMENS / GEC ALSTHOM
33	MCCB	SCHNEIDER / SIEMENS / ABB
34	Starters / Relays	L&T / SIEMENS / GE/SCHNEIDER
35	Meters	AUTOMATIC ELECRTIC / KAPPA / CONZERV, SECURE, CAPITAL, L&T,TOHSNIWAL
36	C.T's / P.T's	As per OEM authorised make
37	Protective relays	SIEMENS / ALSTOM/SCHNEIDER/ L&T
38	Glands	COMET / HMI
39	Selector switches	SALZER / KAYCEE /L & T
40	Indication lamps & Push Buttons	BCH / SIEMENS / CONCORD/ L&T
41	G. I. Cable Trays	BEC / SLOTCO/ VENUS / PROFAB
42	Time delay device	SIEMENS / L & T / LK / CONCORD
43	Changeover Switch	HAVELLS /SOCOMAC / L&T
44	Controls cable	LAPP KABEL /SKYTONE / POLYCAB
45	Cable lugs	DOWELL / COMET
46	Selector switches	SIEMENS / ALSTOM
47	Motors	SIEMENS/ CROMPTON/ ABB
48	Air Circuit Breakers	SCHNEIDER /SIEMENS/LEGRAND /L&T/ABB
49	Inline Exhaust Fan	VENTS/GEC/BLOWTECH/ AIRFLOW
50	Single phase preventer	MINILEC
51	Variable frequency drive	DANFOSS/ ABB/SCHNEIDER
52	Propeller Fan	MARATHON/HAVELLS/OSTBERG
	HVAC PIPING	
1	Pipes (M.S & G.I) upto 150mm dia.	TATA / JINDAL (HISSAR) / SAIL
2	200mm dia. onwards (wall	TATA/JINDAL (HISSAR) / SAIL
3	Polyurethene Foam(PUF)	LLOYD/ MALANPUR/ BEARDSELL
4	Resin bonded fibre glass	UP-TWIGA / OWENS CORNING
6	Cold sticking compound / Bonding	CPRX COMPOUND OF SHALIMAR TAR
7	Globe valve	AUDCO / ADVANCE / L&T
8	Ball Valves / Gate Valves	AUDCO / ADVANCE / L&T
9	Butterfly valves/NRV	AUDCO / ADVANCE / L&T
10	Balancing valves	AUDCO / ADVANCE / L&T
11	Steel fasteners	FISCHER / HILTI
12	Spring Isolator	RESISTOFLEX / DUNLOP / GERB
13	Neoprene in shear isolators	RESISTOFLEX/ DUNLOP
14	Supporting Steel	TATA/SAIL / JINDAL
	HVAC (Lowside)	
1	AHU, TFA units with blowers of NICOTRA, KRUGER, COMEFRI	EDGETECH / ZECO/WAVES

S. No.	Material	Manufacturer
2	AHU fan	KRUGER, NICOTRA, COMFRI, GREENHECK
3	AHU Coils	COMFERI / KRUGER / GREENHECK / WOLTER
4	Globe valve	ADVANCE / L&T / AUDCO
5	Hydronic Hi Wall units	YORK, TRANE, CARRIER, EDGETECH
6.	Automatic balancing valve	DANFOS / SIEMENS / ADVANCE
7.	Dual plate Check Valve	ADVANCE / L&T / AUDCO
8	Inline Fan	AIRFLOW, CARYAIRE, GREENHECK, KRUGER NICOTRA, PINE AIR OSTBERG
9	Axial, Vane Axial Fans	KRUGER, NICOTRA, COMFRI, AIRFLOW, GREEN HECK.
10	Propeller Fan	GE, KRUGER, CARYAIRE, ALOMONARD
11	PAC Units	STULZ, EMERSON, SCHENEIDER, BLUEBOX, GEA
12	G.I. Sheet for Ducting	TATA, SAIL, JINDAL
13	Prefabricated Ducts	ZECO, ROLASTAR, DUCTOFAB
14	Grills, Diffuser, Dampers, Louvers, Motorized Fire Dampers	Caryaire, Mapro, Ruskin, Dynacraft, Titus, Servex, Pineair, airflow
15	Actuator	SIEMENS, BELIMO, JOHNSON, HONEYWELL
16	Hot Water Generator	KEPL, RAPID COOL, EMERALD
17	Chilled Water Cassettes:	YORK, EDGETECH, TRANE
18	Cooling Coils	EDGETECH, WAVES,ZECO
19	Fan Coil Units	EDGETECH, WAVES, ZECO
20	FDV Unit (Forced Draft Ventilation)	EDGETECH, RCS, ZECO, HUMIDIN
21	Motors	SIEMENS, ABB, KIRLOSKAR, ALSTOM, CROMPTON
22	Balancing Valves	ADVANCE, AUDCO, L&T
23	Butterfly Valves	AUDCO, ADVANCE, L&T VALVES
24	Pre-Insulated Valves	VALTREE, KRISHVT
25	P.I.D. Valves	DANFOSS, OVENTROP, ADVANCE, AUDCO,
26	Ball Valves	ADVANCE, AUDCO, L&T
27	POT, Y-Strainer, Suction Strainer, Airvent	EMERALD, RAPID CONTROL
28	Pipes(MS/GI)	JINDAL HISSAR, TATA, SAIL
29	TDR'S	L&T, BCH
30	Duct &Refrigerant Piping Thermal Insulation (Closed Cell, Cross Linked Elastomeric, Polyethylene Foam)	ARMAFLEX, AEROFLEX, TROCELLEN, K-FLEX
31	Duct Acoustic Lining	UPTWIGA, OWENS CORNING
32	Aluminium Sheets	INDALCO, HINDALCO, BALCO
33	Stem Thermometers (V Grooved)	EMRALD, H. GURU, JAPSIN
34	Duct Hangers	GRIPPLE, MUPRO
35	Digital Thermometer	STAEFA, JOHNSON, SEIMENS, HONEYWELL
36	Pressure Gauges	H. GURU, FIEBEG, MARSH, EMERALD

S. No.	Material	Manufacturer
37	Fire Dampers	RUSKIN, GREENHECK, AIRFLOW, DYNACRAFT
38	Actuator for Fire Damper	SIEMENS, BELIMO
39	Analog Measuring Meters	AE, RISHAB
40	P.U.F. Pipe supports	MALANPURENTECH, MULTIPRODUCTS, BESTPLASTRONICS
41	Bituminous products, Mastics	S.T.P., TIKKI TAR
42	CPRX Compound	SHALIMARPAINTS, ASIAN PAINTS
43	Gate Vales and Globe Valve (Gun Metal, Drain Valve)	ADVANCE, AUDCO, L&T
44	Auto Air Vent With Stop Valve	ANERGY, RAPID CONTROL, EMERALD
45	Fire Resistant Hessian, Canvas	ARCHNACHEMICALS, NAVAIR
46	Rubber Pads, Vibration Isolators	RESISTOFLEX, EMERALD, KANWAL
47	Modulating Valves (3 Way,2 Way)	HONEYWELL, JOHNSON, ANERGY RAPID CONTROL
48	Thermostat and Actuator (2 Way,3 Way Valve)	ANERGY, HONEYWELL, SIEMENS, RAPID CONTROL
49	Energy Meters	SEIMENS, HONEYWELL, ANERGY, SECURE, L&T
50	Flow Switch (Bellow Type)	RAPID CONTROL, ANERGY
51	Air Curtains	MITZVAH, BEACON, SAM, EURONICS
52	Flexible Duct	PINEAIR, CARRYAIR, GPSPIRA
53	Flexible Couplings	KANWAL, RESISTOFLEX, CORI
54	Electrical Starters, Contactors	SIEMENS, L&T, BCH
55	Control Cables Copper Conductor	KEI, HAVELLS, POLYCAB, RR KABEL, EMPIRE
56	L.T. Power Aluminium /Copper Cables (FRLS)	KEI, HAVELLS, POLYCAB, RR KABEL, EMPIRE
57	Panel Boards (Powder Coated) and Control Console	STERLING GENERATOR, MARINE ELECTRICALS, PRECISION SYSTEM CONTROL
58	Filters	THERMODYNE / KLENZOID / PUROLATOR /SPECTRUM
59	ACB Microprocessor	L&T, SIEMENS, SCHNEIDER,ABB,LEGRAND
60	M.C.C.B. with Rotary Handle	L&T, SIEMENS, LEGRAND, SCHNEIDER, ABB
61	Selector Switch	L&T, SIEMENS, G.E, HAVELLS
62	Current Transformer (Cast Resin)	AE, KAPPA, PRECISE
63	Indicating Lamps (LED Type)	SIEMENS, L&T, TELEMECANIQUE
65	Cable Glands	COMMET, GRIPWEL
66	Solder less Lugs	DOWELLS, COMMET

S. No.	Material	Manufacturer
67	Duct Silencers	System air / Caryaire / Zeco
68	CAV / VAV Unit	Cynor / Airflow / Caryaire / Bluebox
69.	UL Listed and Certified AHU Mounted UVGI System	Ruks / Trimed / Aeropure
70	Push Button	SIEMENS, L&T, TELEMECANIQUE
71	Capacitors (APP Type)	SIEMENS, L&T, ASIAN, GE
72	Controls	HONEYWELL, STAEFA, RAPIDCONTROL, JOHNSON
73	Motor Protection Circuit Breakers	SIEMENS, L&T, LEGRAND, SCHNEIDER, ABB
74	Copper Wires	KEI, HAVELLS, POLYCAB, RR KABEL, L&T
75	Digital Voltmeter and Ammeter With Selector Switch	ENERCON, L&T, DUCAT
76	Contactors RELAY	L&T, SIEMENS, G.E, SCHNEIDER
77	Thermal OverLoad Relay	L&T, SIEMENS, G.E
78	Single Phasing Preventer	MINILEC, BCH
79	Miniature Circuit Breaker	SIEMENS (BETAGUARD), L&T (AU), SCHNEIDER (ACTI-9)
80	Electrical	
(a)	Electrical Motor, Motor Starter, Contactor, Switches	SIEMENS, ABB, CROMPTON, NGEF
81	Double skinned AWS / scrubber	WAVE / ZECO / EDGETECH
82	MS DUCT(16 GUAGE)	MODERN ENGG INDUSTRIES, VENTAIR
83	uPVC/PPR drain pipe	Astral, Kisan
84	Drain Pump	Aspen / Blue Diamond/Sauremann
85	Magnehaulic gauge	Dwyer/ Aerosense /Omicron
86	Air Cooled VRV / VRF System	O GENERAL / TOSHIBA / MITSUBISHI
87	Air Cooled Hi Wall Split Unit	O GENERAL / TOSHIBA / MITSUBISHI
88	Fan Coil Unit Copper Connection Set / FCU Link	ATS / OVENTROP / CSI
89	Electrochemical Water Treatment & Disinfection System (For Condenser Water Circuit)	Elgressy / Terragon / ENPAR Technologies
90	Copper Refrigerant Piping	Rajco / Mandev / Shree Shyam
91	Any other item	***Must be got approved from Engineer-in-charge before use / procurement***

MRLLIFT

S. No.	Material	Manufacturer
1	MRL LIFTS	MITSUBISHI, SCHINDLER, HYUNDAI ELEVATOR, FUJITEC, HITACHI, TOSHIBA,
2	Housing Motor	***AS PERMANUFACTURER'S STANDARDS; AND MUST BE GOT APPROVED FROM ENGINEER-IN-CHARGE BEFORE USE/ PROCUREMENT***
3	Rope	***AS PERMANUFACTURER'S STANDARDS; AND MUST BE GOT APPROVED FROM ENGINEER-IN-CHARGE BEFORE USE/ PROCUREMENT***

ELECTRICAL SUBSTATION EQUIPMENT

S. No.	Material	Manufacturer
1	ACB	SCHNEIDER (NW) / SIEMENS (3WL) / ABB (E-MAX)/ L&T (U POWER OMEGA)
2	MCCB	SIEMENS-3VL, L&T- D-SINE, SCHNEIDER- NSX, ABB- T-MAX
3	Main LT Panel, APFC / Main Outdoor Feeder Pillar (TTA Type)	ABB (ArTuK) / Schneider electric (PRISMA SET)/ Siemens (SIVACON) /L&T (ENERSIS) or their authorized licensee channel partner from: STERLING GENERATOR, MARINE ELECTRICALS, PRECISION SYSTEM CONTROL
4	Sub distribution boards	STERLING GENERATOR, MARINE ELECTRICALS, PRECISION SYSTEM CONTROL
5	Capacitor	ABB/Schneider/L&T/EPCOS
6	Batteries	EXIDE / PANASONIC/ AMRON
7	Measuring Meters	SCHNEIDER (CONZERV) / C&S / NEPTUNE / L&T
8	Indicating Lamps and Push Buttons	SCHNEIDER / L&T/ / SIEMENS / C&S
9	Control Relays, Contactors, Starters	SCHNEIDER / L&T/ / SIEMENS / C&S
10	CT and PT	SCHNEIDER / GILBERTS & MAXWELL / EPCOS/AE/KAPPA
11	Energy Meters	SCHNEIDER (CONZERV) / C&S/ L&T/SIEMENS
12	Sandwich type Bus duct	SCHNEIDER /L&T/C&S/LEGRAND
13	MCB, RCCB, RCBO, DB	SCHNEIDER / SIEMENS / L&T/ LEGRAND
14	Glands	COMET / HMI / RAYCHEM
15	Selector switches	SALZER / KAYCEE /L & T
16	Cable Trays	PROFAB / SLOTCO /MK / OBO
17	Cable	KEI, HAVELLS, POLYCAB, RR KABEL, EMPIRE
18	Earthing	JMV/ JEF TECHNO SOLUTIONS PVT. LTD. /ERICO/OBO
19	TRANSFORMER (Oil Type)-	SCHNEIDER / CROMPTON GREAVES / ABB/ GE / BHEL
20	HT Panel/VCB	SCHNEIDER / SIEMENS / ABB/PRESISON SYSTEM CONTROL

BIDDER IS REQUESTED TO FOLLOW THE PREFERRED MAKE LIST PACKAGE WISE AS GIVEN BELOW:-

A. FOR PACKAGE C-5 (DG Sets and HSD Fuel Storage tank)

S. No.	Material	Manufacturer
1	11 KV DG Sets with Acoustic Enclosures	Engine: Cummins/Cater Piller /Volvo penta Brushless Alternator: Stamford /AVK /Leroy Somer
2	Synchronization Panel / AMF Panel	ABB / Siemens / Schneider, OEM of DG Set/STERLING GENERATOR/ MARINE ELECTRICALS/PRECISION SYSTEM CONTROL
3	M.S. Pipe	Tata / Jindal Hissar / SAIL
4	D.G. Acoustic Enclosure	Cummins / Caterpillar / Sterling / Perkins
5	Exhaust Silencer	Rusk Power / Nelson / Acoustic India
6	Exhaust Flexible Bellow	Alfa Flexitube / Kanwal / Precise
7	Exhaust Pipe Insulation	Lloyd Insulation / Rockwool India / UP Twiga
8	M.S. Angle / Channel	TATA / SAIL / JINDAL
9	Sandwich type Bus duct	SCHNEIDER / SIEMENS /L&T
10	Anti Vibration Mountings	Gerb/ Resistoflex/ Kanwar
11	Butterfly Valve/Sluice Valve/Check Valve/Pot/Y Strainer/Butterflyvalve	C&R/Intervalve/Advance/Audco/Univas/Kirlosar
12	Level Controls	Levcon/Minilec/Femack
13	Fuel Oil Pump	Reactor /Keshco/ Tushaco
14	Oil Flow Meter	Kent
16	Motors	SIEMENS / GREAVES / ABB / KIRLOSKER
17	MS Pipes	TATA/JINDAL(HISSAR)/SAIL
18	Cooling Tower	Advance/ Mihir/ Paharpur
19	Pumps	Wilo/ Xylem/ Grundfos
20	Synchronizing Relay	Wood word / Dief
21	PLC	Allen Bradley / Siemens / Schneider
22	Any Other Items	***Must be got approved from Engineer-in-charge before use / procurement***

BIDDER IS REQUESTED TO FOLLOW THE PREFERRED MAKE LIST PACKAGE WISE AS GIVEN BELOW:-

B. FOR PACKAGE C-6 (BMS & SCADA System)

S. No.	BMS System	Manufacturer
a)	Software	Honeywell Trend / Schneider / Siemens/Azbil
b)	Network Area Controller	Honeywell Trend / Schneider / Siemens/Azbil
c)	Third Party Integrator	Honeywell Trend / Schneider / Siemens/Azbil
d)	Central and DDC Controllers	Honeywell Trend / Schneider / Siemens/Azbil
e)	Ultrasonic BTU Meters	Forbes Marshall/ Landis &Gyr / Siemens/Azbil
f)	Immersion Temperature Sensor	Honeywell / Schneider / Siemens/Azbil
g)	Return Air Temperature Sensor	Honeywell /Azbil/ Schneider / Siemens
h)	Network / Remote Operator Terminal	Honeywell / Schneider/Azbil / Siemens
i)	Smoke Sensor (VEFSA)	Honeywell / MSR / MSA/Azbil
j)	Motorized Butterfly Valve	Advance / Audco/Azbil
k)	Temperature plus RH Sensor	Honeywell / Carrier Race / Siemens/Azbil
l)	Differential Pressure Switch-Air	Honeywell /Azbil/ Siemens / Beck
m)	Differential Pressure Switch-Water	Honeywell /Azbil/ Carrier Race / Siemens
n)	Computer	IBM / HP / Dell
o)	Communication & Signal Cable	Delton / Fusion Polymer / Skytone
p)	CO2 Sensor	MSR /Azbil/ Gas Alarm / Honeywell
q)	CO Sensor (Electro Chemical Gel Based)	MSR /Azbil/ Gas Alarm / MSA / Honeywell
r)	Level Switch	Dwyer /Azbil/ Radix / Weksler
s)	Current Relay	ABB /Azbil/ Minilac / Seto
t)	DC Voltage Transducer	ABB / Siemens //AzbilSeto
u)	Multifunction Meter with Communication Port	Conzerve / L&T/Azbil
v)	Lux Level Sensor	Honeywell / Schneider/Azbil / Siemens
w)	BMS Integrator / Automated Parking Ventilation System	Koncept Engineer / DS Fire / Pushkar & Company/Azbil

BIDDER IS REQUESTED TO FOLLOW THE PREFERRED MAKE LIST PACKAGE WISE AS GIVEN BELOW:-

C. For Package C-7 (FIREFIGHTING)

S. No.	Material	Manufacturer
1	M.S Pipes	TATA, JINDAL(HISSAR), SAIL
2	Forged Steel Fittings	SS, MEC(JAINSONS), VS
3	ERW, Butt welded Fittings	MEC (JAINSONS)
4	D.I. Grooved Coupling Fittings	MEC(JAINSONS), VICTAULIC, UNIQ
5	Ball valve	RAPID CONTROL, CIM, SKS, L&T VALVES
6	Butterfly Valve(up to PN16)	AUDCO, ADVANCE, L&T VALVES
7	Butterfly Valve(PN20)	AUDCO, ADVANCE, L&T VALVES
8	Air Release Valve	CASTLE, LEADER, ANERGY
9	C.I Double flanged sluice valves	KIRLOSKAR, AUDCO, ADVANCE, L&T VALVES
10	C.I Double Flanged Non-return Valve	KIRLOSKAR, AUDCO, ADVANCE, L&T VALVES
11	Dual Plate / Wafer Type Non ReturnValves(up toPN16)	AUDCO, ADVANCE, L&T VALVES
12	Dual Plate / Wafer Type Non ReturnValves(PN20)	AUDCO, ADVANCE, L&T VALVES
13	Fire Extinguishers	GUARDS, LIFEGUARD, MINIMAX, NEWAGE
14	First-aid Hose Reel Drum	GUARDS, LIFEGUARD, MINIMAX, NEWAGE
15	Rubber Hose Reels for Drums	GUARDS, MINIMAX, EVERSAFE, LIFEGUARD
16	Thermo Plastic Hose Reels for Drums	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
17	R.R.L. Hose and C.P. Hose	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
18	Branch Pipe, Nozzle, Coupling etc.	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
19	Landing Valves	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
20	Fire Brigade Connections	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
21	Fire Fighting Equipment not covered elsewhere	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
22	Hose Box	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
23	Sprinklers and Rosette Plates (All Types)	GUARDS, LIFEGUARD, NEWAGE, EVERSAFE
24	Motors for Fire Pumps	KIRLOSKAR /ABB/CROMPTON GREAVES / SIEMENS / GRUNDFOS
25	Fire Pumps	KIRLOSKAR, MATHERPLATT, WILO, GRUNDFOS
26	Diesel Engine	KIRLOSKAR / GREAVES COTTON / GRUNDFOS /CUMMINS
27	Electrical Switch Gear	SEIMENS, L&T, SCHNEIDER, LEGRAND
28	Cables	KEI, POLYCAB, EMPIRE, HAVELLS, RR KABEL

S. No.	Material	Manufacturer
29	Main Control panel (Power coated)	STERLING GENERATOR, MARINE ELECTRICALS, PRESISON SYSTEM CONTROL
30	Voltmeter &Ammeter	SCHNEIDER, RISHABH, MECCO, CONZERV, SECURE, CAPITAL, L&T
31	Y-Type, Pot, Suction Strainer	KIRLOSKAR, LEADER, FIVALCO TYCO
32	Foot valve with Strainer	KIRLOSKAR, LEADER
33	Pressure Reducing Valves (For Fire Fighting)	WILKINS, OCV
34	Pre-Fabricated Structural supports and clamps	CHILLY, EASYFLEX, CAMRY
35	Pressure Gauge	FIEBIG, H.GURU, DANFOSS
36	Pipe Coat Material (Pipe Protection)	PYPKOTE, POLYCHEM,CHILLER
37	Dash fasteners	HILTI, FISHER
38	Paint and Primers	ASIAN,JOHNSON NICHOLSON, BERGER
39	Weld. Electrodes	ADVANI, ESSAB, MANGALAM
40	Anti-vibration Pads &suction & delivery flexibleconnectors	EASYFLEX, RESISTOFLEX
41	Nut and Bolt	LAKSHMI,UNBRAKO
42	Gas based Fire suppression system	FIRETRACE / KIDDE / TYCO

D. FOR PACKAGE C-8 (Fire Alarm & PA System)

S. No.	Material	Manufacturer
1	Addressable Fire Alarm Control Panel	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
2	Repeater Panel	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
3	Addressable Smoke Detector	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
4	Short Circuit Isolator	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
5	Addressable Control Module	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
6	Addressable Input Module	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
7	Addressable Manual Call Point	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH
8	Sounder with relay Module	NOTIFIER /EDWARDS / SIEMENS / COOPER / BOSCH

LIST OF APPROVED / PREFERRED MAKES FOR PA SYSTEM

Sl. No.	Item Description	Approved Brand/Manufacturers
1	Speakers	ASL/ BOSCH /BOSE
2	Amplifier	ASL/ BOSCH / BOSE
3	Music & FM radio player	PHILIPS/ SONY / LG
4	FRLS PVC insulated Multi strand flexible copper wires	POLYCAB / RR KABEL / L&T / HAVELLS / EMPIRE

I. FOR PACKAGE C-9 (DATA NETWORKINGSYSTEM)

S. No.	Material	Manufacturer
1	Fiber Optics Components (Data & Voice/Telecom, Single Mode and/or Multimode) – Cables, LIUs, Shelves, Pigtails, Patch-cords, Connectors, Couplers, Splices.	COMMSCOPE, MOLEX, PANDUIT
2	Outdoor mounted enclosure	COMMSCOPE, MOLEX, PANDUIT
3	IP66 rated 96 core External Splicing Kit for outdoor fiber optics cable	COMMSCOPE, MOLEX, PANDUIT, TYCO
4	Networking Racks, Data Centre racks, Distribution Racks – from sizes 15U to 42U	MOLEX, APW-VERO PRESIDENT, RITTAL, PANDUIT-PANNET, SCHNEIDER, VALRACK
5	CAT6 / CAT 6A / CAT 6E Cable, I/Os for CAT6A, Patch panel, Face plate, modular box, and panel rack.	COMMSCOPE, MOLEX, PANDUIT

J. FOR PACKAGE C-10 (AUDIO / VISUALSYSTEM)

S. No.	Material	Manufacturer
1	PROJECTORS	NEC / Barco / Christie / DPI
2	MOTORISED SCREENS	Suvira / Dalite / Drapper
3	SWITCHING AND CONTROL SYSTEM WITH TRANSMISSION AND REVIEVERS	AMX / Extron / Lightware / Kramer
4	Full HD Display	Christie / Samsung / LG / Sony / Panasonic
5	Document Camera	Lumens / Sony /Panasonic
6	High Definition Video Conferencing	Cisco, Polycom , Sony
7	Audio Conference system, MICROPHONES	AKG / Shure / Beyerdynamic
8	DIGITAL SIGNAL PROCESSOR,	BSS / Symmetrix / Bi-amp / Xillica / Bose
9	Loudspeakers - Colum array Speakers / Line array Speakers / Wall mount / Ceiling Speakers	JBL / Meyer Sound / L-acoustic / d&b audiotechnik / Martin Audio / Bose/ Nexo
10	Audio Mixer	Behringer /Soundcraft / Digico / Midas / Allen heath
11	Network Switch and router	Netgear / HPE / Juniper/ Nutir ARISTA, CISCO
12	VGA, HDMI cables	Crestron / Extron / Kramer
13	Microphone and speaker Cable	Crestron / Extron / BELDEN / Kramer / Krystal
14	Shielded Cat 5 / 6 Cable	Belden / Crestron / Kramer / Krystals
15	Equipment Rack	Valrack / Netrack / Rittal
16	Lighting controller	Lutron / Crestron / Leviton
17	Smart Podium	It has to be custom based as per site finish with 21‖ interactive monitor of WACOM/ELOTOUCH
18	Digital Interactive Board	Christie/Samsung/LG/PANASONIC/BENQ
19	DMX Amplifier unit	Obsidian NX1 / Martin / Studer
20	12 channel (12chx4KW) Dimmer pack	Liteputer / ADB / ETC
21	Streaming and recording Device	LUMENS/ MEDIASITE/ MEDIAPOINT
22	POWER AMPLIFIER	Crown / Meyer Sound / Martin Audio / L-acoustic / d&b audiotechnik / Bose
23	Stage Lighting	Elation / Martin / Chauvet
24	Stage Lighting Controller	Obsidian / Martin

K. FOR PACKAGE C-11 (UPS SYSTEM)

S. No.	Material	Manufacturer
1	UPS	EMERSION, NUMERIC, SCHNEIDER, HITACHI
2	BATTERIES	EXIDE, AMRON, PANASONIC
3	INVERTER	LUMINOUS, MICROTEK, SU-KAM, SERVOTECH POWER SYSTEMS, UTL SOLAR

L. FOR PACKAGE C-12 (CCTVSYSTEM)

S. No.	Material	Manufacturer
1	Cameras – Dome / Bullet / PTZ	SONY, BOSCH, AXIS COMMUNICATION, AVIGILON, MOBOTIX
2	Video Management, Recording, Analytics and Failover Server	Dell, HP, Cisco
3	CCTV Client Workstation	Dell, HP, IBM
4	Video Storage – 900 TB usable	Dell, HP, Cisco
5	FRP Junction boxes	MK, HENSEL, MENEKKES
6	CAT6 / CAT 6A / CAT 6E / Cable, I/Os for CAT6	COMMSCOPE, MOLEX, PANDUIT

M. FOR PACKAGE C-13 (ACCESS CONTROLSYSTEM)

S. No.	Material	Manufacturer
1	Access Control System	
(a)	Access Controllers	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(b)	Access Control Management Software	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(c)	Door Interlock Controller	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(d)	Biometric Fingerprint Reader	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(e)	Smart Card Reader	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(f)	Smart cards	LENEL,CASSIRUSCO, SMART –I, MOTOROLA
(g)	Electromagnetic Locks	TRIMEC, BEL, ALGATECH
(h)	Computer	IBM, HP, DELL, LENOVO

N. FOR PACKAGE C-14 (STP & ETP)

S. No.	Material	Manufacturer
1	G.I. Pipes IS 1239/3589	JINDAL HISSAR/TATA / SAIL
2	Butterfly Valve	ADVANCE / AUDCO/L&T
3	Ball valves (15 to 50mm)	ADVANCE / AUDCO/L&T
4	Non return valve	AUDCO / ADVANCE / L&T
5	Monoblock Pumps	GRUNDFOSS/XYLEM/WILLO-MATHER & PLATT
6	Vessels	GLOBAL COMPOSITE/ AQUANOMICS / ION EXCHANGE
7	Multiport Valve	CWG / ASTRAL/AQUANOMICS
8	Chlorinator/Doser	CWG / ASTRAL/AQUANOMICS
9	Metering pump	LOTUS ALPHA / ASIA LMI/AQUANOMICS
10	Constant Pressure variable volume	GRUNDFOS/ARMSTRONG / ITT
11	Air Blower	SWAN/EVEREST
12	Resin	THERMAX / ION EXCHANGE
13	Control valves	RAPID CONTROL / ANERGY
	ELECTRICAL FOR WATER TREATMENT	
16	XLPE Insulated Al Armoured	HAVELLS / KEI / POLYCAB / RR KABEL
17	PVC Insulated Copper ConductorFlexible Wire	HAVELLS / FINOLEX / KEI / POLYCAB
18	Steel Conduits	BEC / AKG / VIMCO / RMCON
19	M V Switch Gears/ Air Circuit Breaker	As per part C-4
20	Motor Control Centre	As per part C-4
22	Moulded Case Circuit Breakers	As per part C-4
23	Starters, Overload Relays And Push Buttons	L&T / SIEMENS / SCHNEIDER
24	Meters And Metering Equipment (Digital)	ENERCON/ AUTOMATIC ELECTRIC/ NIPPON/ KAPPA/ L&T/ SECURE
25	Toggle Switches	KAYCEE / L&T / SALZER
26	C T's & P T's	KAPPA / L&T / AE
27	Protective Relays	L & T/ SIEMENS/ ALSTOM
28	Chromium Plated Brass Cable	COMET
29	Cable Lugs	DOWEL / SNEC
30	Time Delay Relay	SIEMENS / BCH / L&T
31	Battery	EXIDE/ STANDARD / AMRON

S. No.	Material	Manufacturer
32	G.I. Cable Tray	SLOTCO / PILCO / STEELWAYS
	ETP	
33	AIR BLOWER	EVEREST/USHA/AIRVAC
34	SS PIPE	JINDAL/VIEGA / PRIME GOLD
35	COARSE BUBBLE MEMBRANE	MM AQUA/AIRFIN
36	FILTER PRESS	PHARMATECH/NM PATEL/AURO
37	SCREW SLLURY PUMPS	UT/ROTO/TECHNOFLOW
38	SUBMERSIBLE MIXTURE	AQA ITELY/ABS
39	UV SYSTEM	ALFA/EUREKA
40	GI / MS PIPE (IS : 1239 and IS :	TATA STEEL/JINDAL/ SAIL
42	GI PIPE SEALENT	HENKEL- LOCTITE 55
43	PIPE CLAMP & SUPPORT	CHILLY EURO CLAMP/KANWAL
44	UPVC PIPE	SUPREME/PRINCE/ASTRAL
45	CPVC PIPES	AJAY/ASHIRWAD/ASTRAL/SUPREME
46	GI / MS PIPE (IS : 1239 and IS :	TATA STEEL/JINDAL/ SAIL
47	GI PIPE FITTINGS	ZOLOTO M/UNIK
48	BUTTERFLY VALVE	ADVANCE / AUDCO/L&T
49	CHECK VALVE-WAFER TYPE	AD ADVANCE / AUDCO/L&T
50	CHECK VALVE-DUAL PLATE	ADVANCE / AUDCO/L&T
51	CHECK VALVE-FORGED	ADVANCE / AUDCO/L&T
52	PRESSURE REDUCING VALVE	HONEYWELL/ WATTS/ AUDCO/L&T
53	SOLENOID VALVE	DANFOS/ HONEYWELL
54	DOSING PUMPS	LMI/PULSER FEEDER/TOSCHON
55	DRAINAGE & SEWAGE SUMP PUMPS	GRUNDFOS/XYLEM/WILLO-MATHER & PLATT
56	TRANSFER PUMPS	GRUNDFOS/XYLEM/WILLO-MATHER & PLATT
57	SELF PRIMING PUMP	JOHNSON/KIRLOSKAR
58	MECHANICAL SEAL	BURGMANN/SEALOL
59	COUPLINGS	LOVE JOY
60	ANTYVIBRATION MOUNTING &	DUNLOP/KANWAL
61	PRESSURE GAUGE	H GURU/FIEBIG/EMERALD
62	WATER METER (MECHANICAL)	KRANTI/ACTARIS/KENT/CAPSTAN

O. FOR PACKAGE C-15 (SOLAR HOT WATER GENERATIONSYSTEM)

S. No.	Material	Manufacturer
1	Solar hot water generation system	
(a)	Solar Water Heating System	BOSCH/RACOLD/HONEYWELL / BHEL
(b)	Material for Structure	TATA/JINDAL/SAIL
(c)	G.I. Pipe	TATA/JINDAL/SAIL
(d)	Hot Water Re circulation OR other Pumps	DP – Holland/Grundfos /Xylem -ITT/ Wilo – Mather Platt
(e)	Heat Pump	Blue Box / AO Smith / HONEYWELL
(f)	Heat Exchanger	GEA Eco flex/Alfa Level or equivalent
(g)	GM / Forged Brass Ball Valves	DANFOSS / HONEYWELL / ZOLOTO
(h)	Check Valve – Wafer Type & Dual Plate	ADVANCE / DANFOSS / AUDCO
(I)	Butterfly Valve	ADVANCE / DANFOSS / AUDCO
2.	Any other item	***Must be got approved from Engineer-in-charge before use / procurement***

P. FOR PACKAGE C-16 (Water Treatment plant & Water supply pump set)

S. No.	Material	Manufacturer
1	G.I. Pipes IS 1239/3589	JINDAL (HISSAR)/TATA / SAIL
2	Butterfly Valve	ADVANCE / AUDCO/L&T
3	Ball valves (15 to 50mm)	ARCO (SENA)/SANT/L&T
4	Non return valve	AUDCO / ADVANCE / L&T
5	Monoblock Pumps	GRUNDFOSS/XYLEM/WILO-MATHER & PLATT
6	Vessels	GLOBAL COMPOSITE/ AQUANOMICS / ION EXCHANGE
7	Multiport Valve	CWG / ASTRAL/AQUANOMICS
8	Chlorinator/Doser	CWG / ASTRAL/AQUANOMICS
9	Metering pump	LOTUS ALPHA / ASIA LMI/AQUANOMICS
10	Constant Pressure variable volume	GRUNDFOS/ARMSTRONG / ITT
11	Air Blower	SWAN/EVEREST
12	Resin	THERMAX / ION EXCHANGE
13	Control valves	RAPID CONTROL / ANERGY
14	PRESSURE REDUCING VALVE	HONEYWELL/ WATTS/ UTAM
15	SOLENOID VALVE	DANFOS/ HONEYWELL
16	GM /FORGED BRASS BALL VALVES	DANFOS/KITZ/ UTAM
17	SLUICE VALVE	AUDCO/ADVANCE/L&T
18	BUTTERFLY VALVE	AUDCO/ADVANCE/L&T
19	CHECK VALVE-WAFER TYPE	AUDCO/ADVANCE/L&T
20	CHECK VALVE-DUAL PLATE	AUDCO/ADVANCE/L&T
21	CHECK VALVE-FORGED SCREWED	AUDCO/ADVANCE/L&T
22	PRESSURE REDUCING VALVE	HONEYWELL/ WATTS/ UTAM
23	SOLENOID VALVE	DANFOS/ HONEYWELL
24	THERMOSTATIC VALVE	OVENTROP
25	AIR RELEASE VALVE	AUDCO/ADVANCE/L&T
26	BALL FLOAT VALVE	AUDCO/ADVANCE/L&T
27	NRV-BALL TYPE-SEWAGE APPLICATION	DANFOS/SILVERSPARK/NORMEX/UTAM
28	Y STRAINER CI	AUDCO/KITZ/VTM

S. No.	Material	Manufacturer
29	HYDROPNEUMATIC SYSTEM	GRUNDFOS/XYLEM/WILO-MATHER & PLATT
30	STORM WATER DRAINAGE & SEWAGE SUMP PUMPS	GRUNDFOS/XYLEM/WILO-MATHER & PLATT
31	TRANSFER PUMPS	GRUNDFOS/XYLEM/WILO-MATHER & PLATT
32	SELF PRIMING PUMP	JOHNSON/KIRLOSKAR
33	MECHANICAL SEAL	BURGMANN/SEALOL
34	COUPLINGS	LOVE JOY
35	ANTYVIBRATION MOUNTING & FLEXIBLE CONNECTION	DUNLOP / KANWAL INDUSTRIES/RESISTOFLEX
36	PRESSURE GAUGE	H GURU/FIEBIG/EMERALD
37	WATER METER (	KRANTI/ACTARIS/KENT/CAPSTAN
38	ELECTRONIC FLOW METER	KROHNE/ROCKWIN
39	LEVEL CONTROLLER &	ELEGGENT
40	PAINTS	ASIAN PAINTS/BERGER
41	MH/WATER TANK PLASTIC	KGM/PATEL/PRANALI INDUSTRIES
42	INSULATION FOR HOT WATER	ARMACELL/ARMAFLEX/
43	THREE WAY MOTORISED	DANFOSS/HONEYWELL/SIEMENS/AIP
44	WELDING RODS	ADOR/ESSAB
45	FASTENER	FISHER/HILTI
46	FIRE SEALANT	BIRLA 3M/HILTI
47	MANHOLE(PREFABRICATED)	OK PLAT/CRESCENT FOUNDARY
48	TEMPERATURE	FORBES MARSHALL/WIKA
49	DOSING PUMPS	LMI/PULSER FEEDER/TOSCHON
50	FLANGES	CLASS 150 TABLE H
51	U.V STERLIZER	ALFA/EUREKA
52	FLOW CONTROL DEVICES	AQUAPLUS/JAQUAR/RST
53	SS PIPE	JINDAL/VIEGA/PRIME GOLD
54	M V Switch Gears/ Air Circuit Breaker	As per part C-4
55	Motor Control Centre	As per part C-4
56	Moulded Case Circuit Breakers	As per part C-4
57	Starters, Overload Relays And Push Buttons	L&T / SIEMENS / SCHNEIDER
58	Meters And Metering Equipment (Digital)	ENERCON/ AUTOMATIC ELECTRIC/ NIPPON/ KAPPA
59	Toggle Switches	KAYCEE / L&T / SALZER
60	C T‘s & P T‘s	KAPPA / L&T / AE
61	Protective Relays	L & T/ SIEMENS/ ALSTOM
62	Chromium Plated Brass Cable	COMET
63	Cable Lugs	DOWEL / SNEC
64	Time Delay Relay	SIEMENS / BCH / L&T
65	Battery	EXIDE/ STANDARD / AMRON

S. No.	Material	Manufacturer
66	G.I. Cable Tray	SLOTCO / PILCO / STEELWAYS

Q. FOR PACKAGE C-17 (SOLID WASTE MANAGEMENTSYSTEM)

S. No.	Material	Manufacturer
1.	Organic Waste Converter	ENVIcare Soln. Pvt. Ltd / Excel Industries Ltd / Greenvironindia
2.	Any other item	Must be got approved from Engineer-in-charge before use / procurement

R. FOR PACKAGE C-18 (HVLSFANS)

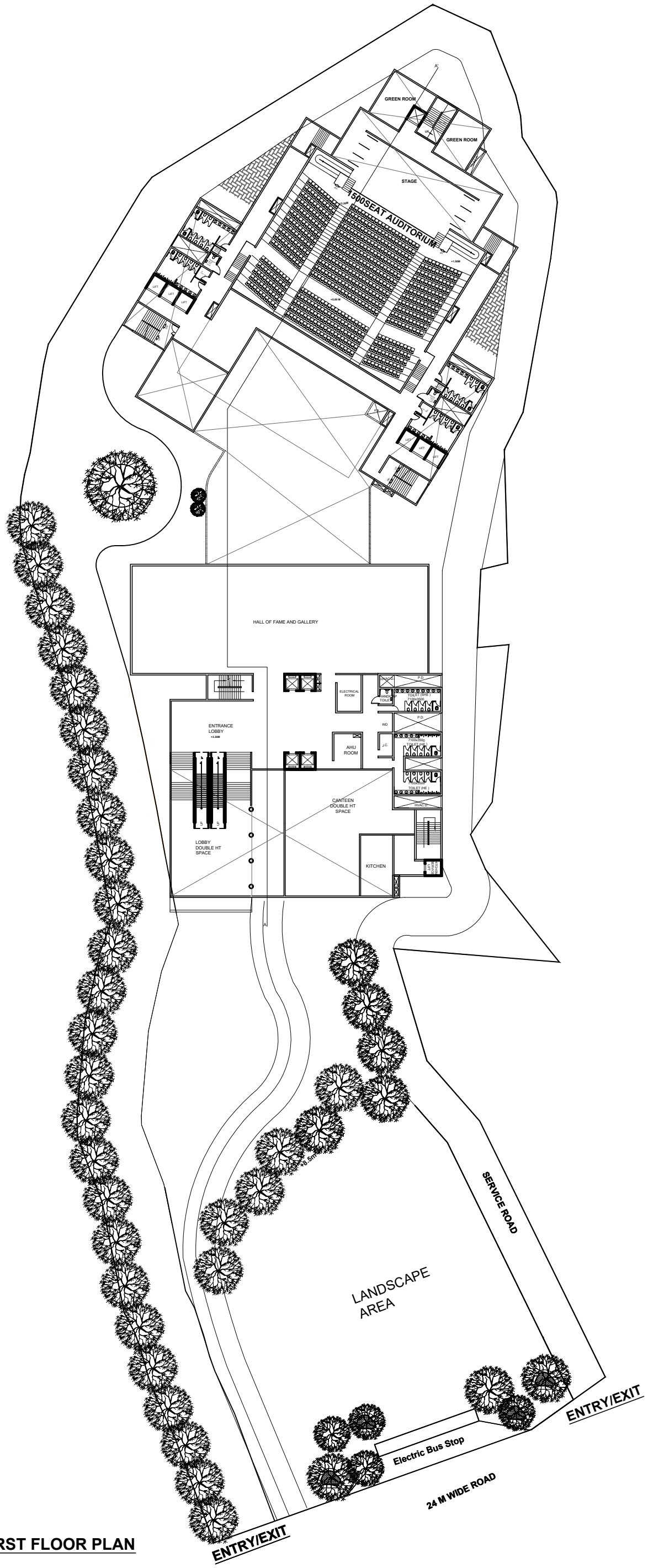
S. No.	Material	Manufacturer
1.	HVLS fans	KALE BRAYAN (EURUS II)/ BIG ASS/ MACROAIR/ ECOAIR COOLING SYSTEM
2.	Motor	LENZE / NORD
3.	VFD controller	LENZE / YASKAWA /MITSHUBISHI
4.	Any other item	***Must be got approved from Engineer-in-charge before use/ procurement***

S. FOR PACKAGE C-19 (FACADELIGHTING)

S. No.	Material	Manufacturer
1.	Special multi colour (RGBW) LED Facade lights & equipment	PHILIPS / IGUZZINI / DISANO / SHREDDER
2.	Aluminum / Copper Power Cable& Wires	FINOLEX / RR Kabel / KEI / HAVELLS / POLYCAB
3.	MCB DB/ MCB	SCHNEIDER / LEGRAND / L&T/ ABB (Elegance)/ SIEMENS
4.	GI Pipe	TATA / JINDAL (HISSAR) / PRAKASH SURYA
5.	SMC Pole Box	MK/ HENSEL / HAVELLS
6.	CAT 6/ CAT 6A / CAT 6E / TV Cable	MOLEX / COMMSCOPE/ PANDUIT
7.	Any other item	***Must be got approved from Engineer-in-charge before use/ procurement***

SECTION - XI

TENDER DRAWINGS



FIRST FLOOR PLAN

PROJECT :
Comprehensive Architectural Concept & Design Services for Development of Centenary Building at
IIT Dhanbad.

CLIENT :
INDIAN INSTITUTE OF TECHNOLOGY,
INDIAN SCHOOL OF MINES,
DHANBAD, JHARKHAND.

ARCHITECT :

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WANKHEDE STADIUM, BLOCK A2 AND B1, NORTH STAND, 'D' ROAD, CHURCHGATE, MUMBAI - 400 020.
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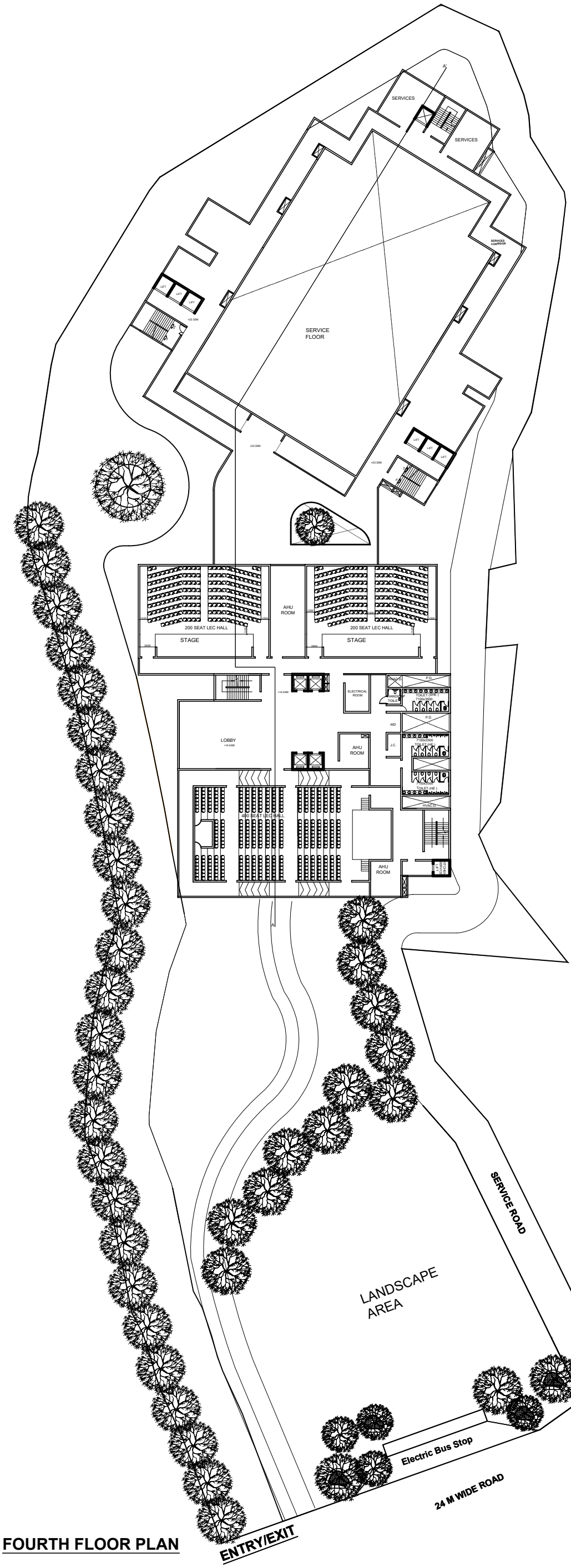

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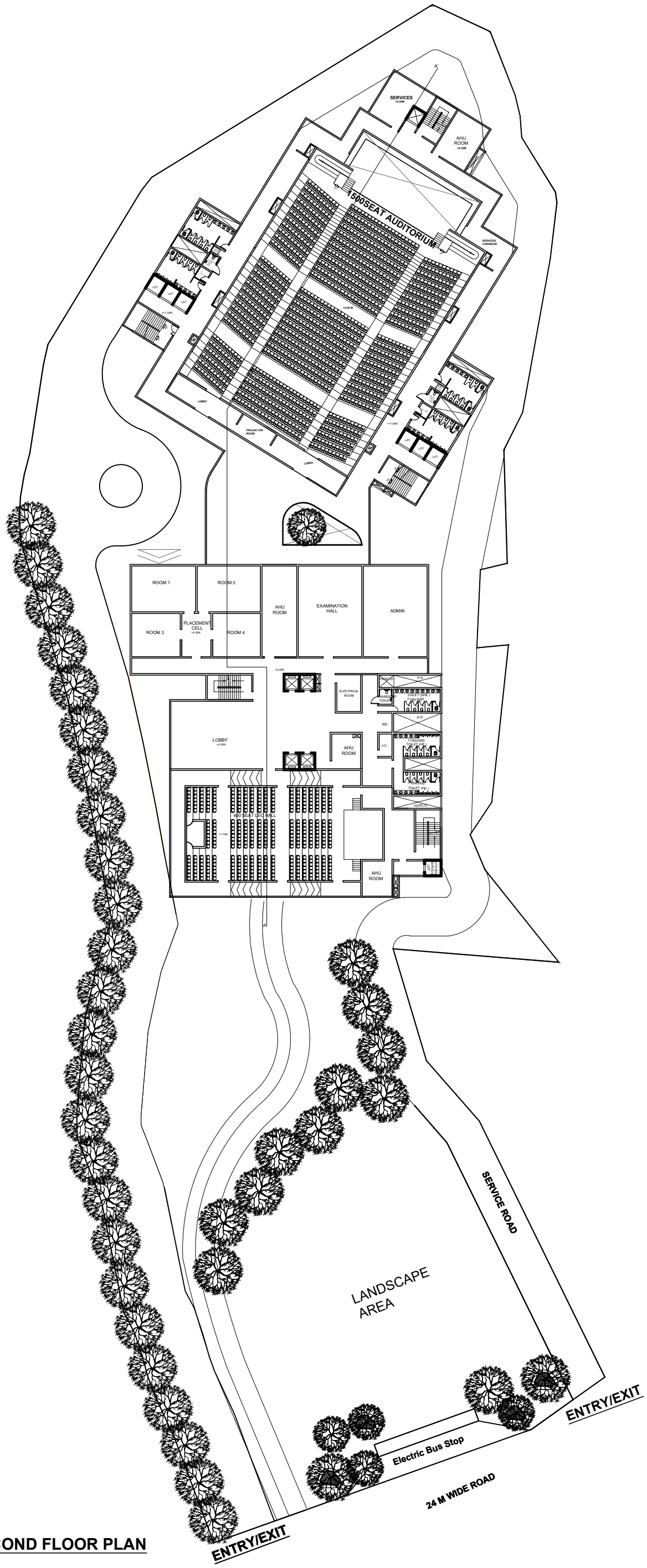

SECOND FLOOR PLAN

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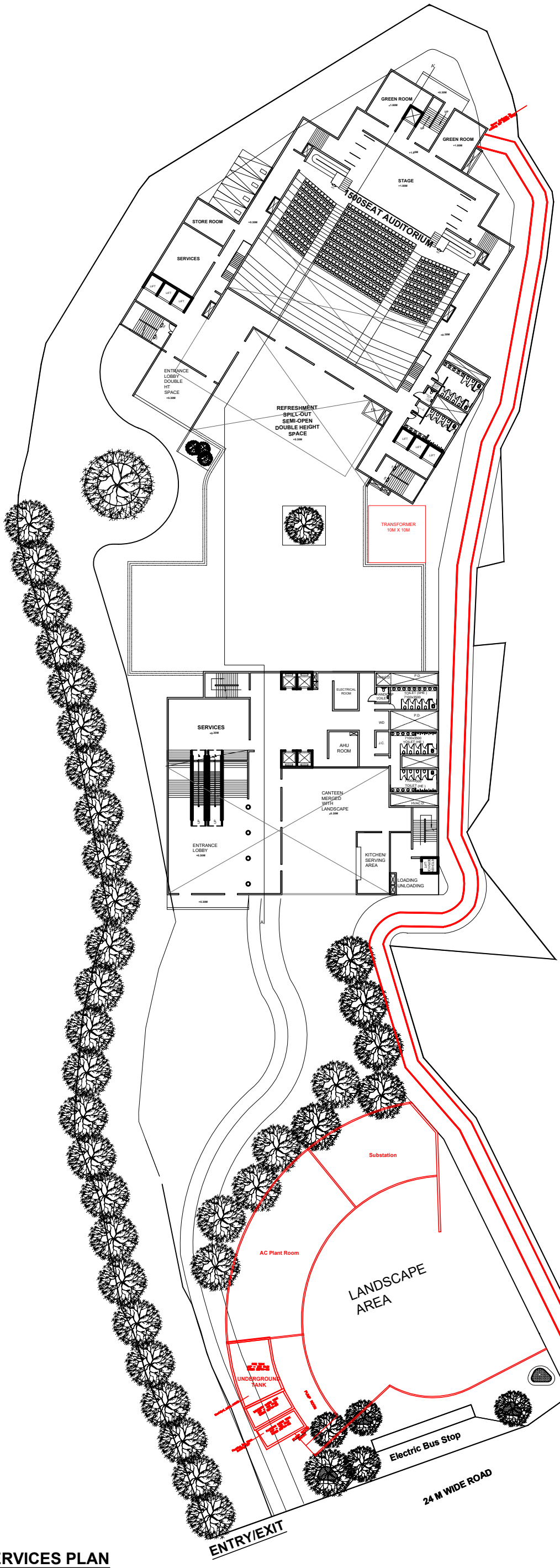

SERVICES PLAN

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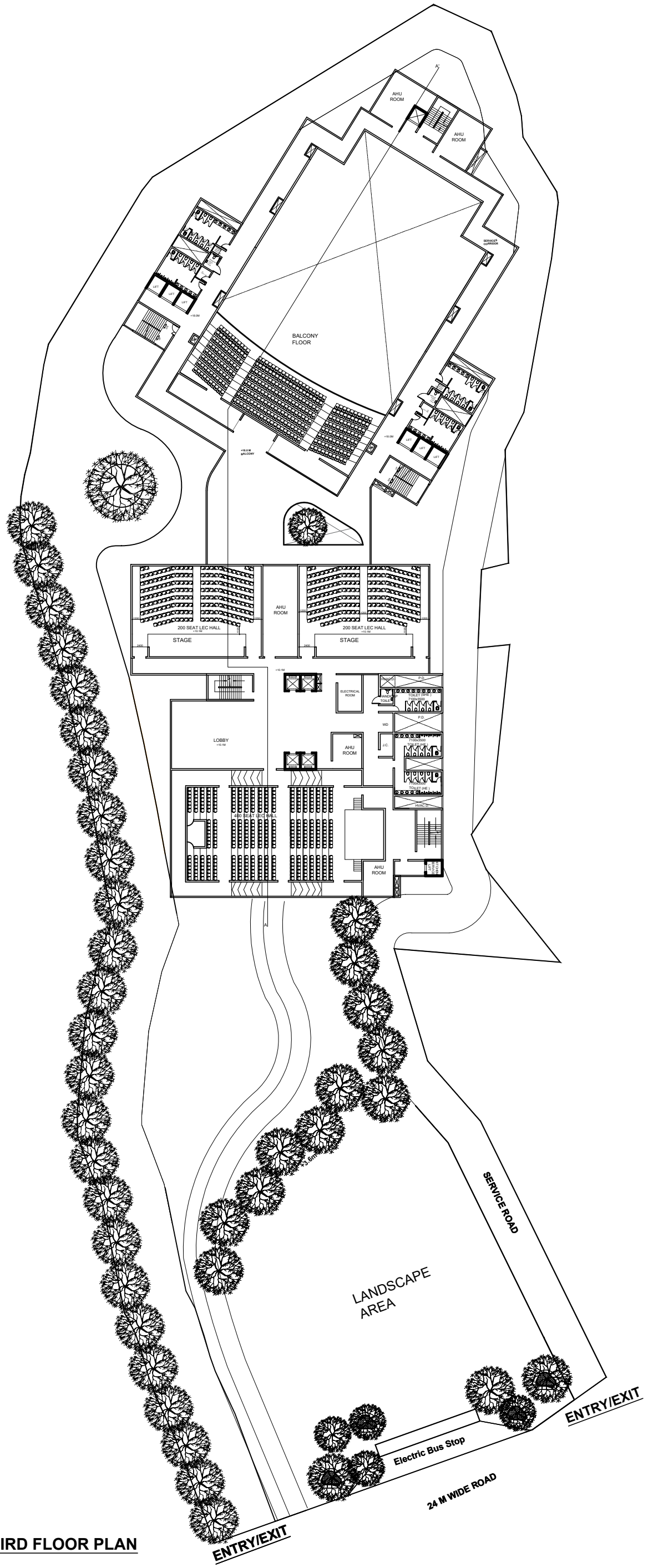

THIRD FLOOR PLAN

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SCALE : N.T.S
DRAWN BY :
DATE : 16-03-2022

DOCU. NO.-

North

SECTION - XII

FINANCIAL PROPOSAL

SUMMARY OF COST

SUMMARY OF COST FOR PERCENTAGE RATE TENDER

Description	Percentage Quoted (Excess / Less / at par)	Total Amount as per % Quoted (Including GST) (Rs.)
Construction of Centenary Building (Lecture hall and Auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.	**DO NOT FILL PERCENTAGE HERE**	**DO NOT FILL COST HERE**
Total amount in words: **DO NOT FILL COST HERE AS IT IS TECHNICAL PROPOSAL FILE**		

Note:-

- ***The Performa for filling the percentage rate is given in Microsoft excel sheet. Bidder shall fill the percentage only up to two decimal place in soft format. The bidder will upload same filled percentage quote in soft Microsoft Excel copy during uploading of financial bid.***

- ***<u>The Bidder shall quote Percentage up to two decimal only in bill of quantity of tender.</u>***

    - Prices quoted by the Bidder shall include all Materials, Tools & Plant, labour, supervision, profit; other levies together with all general risks, liabilities and obligations set out or implied in the contract, applicable Labour Cess, cost of insurance to this contract, all applicable tax liabilities like Income Tax & Surcharges, etc. Any other taxes /cess as per Government directives shall be deducted from each bill paid to the Contractor, from time to time. Prices quoted by the Bidder shall inclusive of GST. It is mandatory to bidders to deposit GST within time limit framed by Govt. of India, if applicable. The Goods and Services Tax (GST), shall be reimbursed to the Agency only after uploading of bills by Contractor on GST Portal " to avail Input benefit of GST

- The Contractor shall issue Tax Invoices to the Employer showing (i) Basic amount (ii) GST amount separately in each bill. It is mandatory to bidders to deposit GST within time limit framed by Govt. of India, if applicable. The Goods and Services Tax (GST), shall be

reimbursed to the Agency only after uploading of bills by Contractor on GST Portal "to avail Input benefit of GST".

- The company shall be performing all its duties of deduction TDS and other deduction on payment made to the contractor as per applicable legislation in force on the date of submission of bid or to be newly / amended introduced during the execution of the Contract.

SUMMARY OF COST

Sl. No.	Description	Qty	Unit	Rate (in Rs.)	Amount (in Rs.)
1.	Construction of centenary building (lecture hall and auditorium) including internal water supply, sanitary installations and electrical works; Storm Water Drains, Roads, Paths, Cycle Tracks, UG Sumps, External Water Supply & Irrigation Lines, Sewerage System, Electric Sub-stations Equipments, Fire Fighting, Fire Alarm System, DG Sets, HVAC, CCTV, Access Control, EPBAX, LAN & Data Networking, UPS System, Public Address System, Audio & Visual System, Integrated BMS System i/c SCADA, MRL Lifts, Pump Sets, Solar Hot Water System, HSD Fuel Storage & Pumping System, etc. at IIT(ISM) Dhanbad.	1	Nos	131,67,54,019	131,67,54,019
Total amount in Rs.				**Rs. 131,67,54,019/-**	

PAYMENT TERMS

SCHEDULE OF STAGE PAYMENT

Centenary Building

(For intermittent payments, Pro-rata payment will be released based on plinth area)

The Stage wise Payments shall be made in Percentage of the Total quoted Cost of works as quoted by the bidder/ contractor. The **"STAGE OF CONSTRUCTION"** for each component shall be as per the details below.

Mainly Payment will be made after completion of particular **"STAGE OF CONSTRUCTION"** as per the detail in the Scope of Work in compliance of all the conditions mentioned in the Tender Document. If any stage of construction is completed partially, then payment will be made on pro- rata basis, if agreed by Engineer – in - charge. The pro-rata percentage will be analyzed by the Engineer- in-charge and no dispute in this regard will be entertained

The main scope of work for each component shall be governed as detailed in "SECTION of SCOPE OF WORK" of the tender document and final payment shall be made accordingly, to the Contractor.

The works mentioned in column no. B of Stage of Construction, are milestone for progress of work. Percentage mentioned in column no. C &D are to facilitate the payment to contractor after completion of particular stage of construction. Percentage mentioned against particular Stage of Construction may not be actual cost of that particular stage of construction. The final 100% payment, depicts the total cost of work as per the scope of work and in compliance with all conditions mentioned in tender document.

If any works mentioned in the payment terms is not executed, then payment will be deducted as per the provision in DSR/DAR-2021 for scheduled items and Market Rate analysis for Non Schedule items.

PART A

S.No	Stage of Construction	Breakup of % of Item Contract	% of Item Contract Value	Cumulative % of Contract value
A	B	C	D	E
1	**Planning, Detailed Design and approval of the same by the Engineer-in-Charge.**		1.00%	1.00%
1.1	On completion of Geotechnical and Survey Investigation and submission of reports of the same	0.20%		
1.2	On approval of all detailed working Architectural Drawings good for construction from Engineer-in-Charge.	0.20%		
1.3	On submission of all vetted Structural Drawings and approval from Engineer-in-Charge.	0.20%		
1.4	On submission of all MEP services and development works Drawings and approval from Engineer-in-Charge.	0.20%		
1.5	On finalization of Specialized agency, Approval of Make of material, Sample etc. from Engineer-in-Charge.	0.20%		
2	**Completion of foundation & plinth including plinth beams & stitching slab at ground/stilt floor level.**		7.50%	8.5%
2.1	On completion of Anti termite works and PCC work including excavation for foundation in all respect and as per the Scope of work	0.50%		
2.2	On completion of all works up to plinth beam level including Anti-Termite work as per the scope of work	7.00%		
3	**Completion of RCC framed structure upto top of the building.**		32.00%	40.5%
3.1	On casting of columns above Plinth beam Level and upto beams soffit of first floor and Stitch slab at Ground floor level as per the Scope of work	2.4%		
3.2	On casting of First floor slab with beams and allied works as per the Scope of work	4.0%		

3.3	On casting of columns above First floor slab Level and upto beams soffit of second floor as per the Scope of work	2.40%		
3.4	On casting of second Floor slab with beams and allied works as per the Scope of work	4.0%		
3.5	On casting of columns above Second floor slab Level and upto beams soffit of third floor as per the Scope of work	2.40%		
3.6	On casting of Third Floor slab with beams and allied works as per the Scope of work	4.0%		
3.7	On casting of columns above Third floor slab Level and upto beams soffit of Forth floor as per the Scope of work	2.40%		
3.8	On casting of Forth Floor slab with beams and allied works as per the Scope of work	4.00%		
3.9	On casting of columns above Forth floor slab Level and upto beams soffit of terrace floor as per the Scope of work	2.40%		
3.10	On casting of Terrace Floor slab and Mumty Slab with beams and allied works as per the Scope of work	4.00%		
4	**Completion of Filler Wall upto top of the building.**		7.50%	48%
4.1	On completion filler wall work of Below plinth and ground floor along with provision of lintel etc. and providing and fixing door Frame, window frames & ventilator frame as per the Scope of work	1.40%		
4.2	On completion filler wall work of first floor along with provision of lintel etc. and providing and fixing door Frame, window frames & ventilator frame as per the Scope of work	1.40%		
4.3	On completion filler wall work of second floor along with provision of lintel etc. and providing and fixing door Frame, window frames & ventilator frame as per the Scope of work	1.40%		
4.4	On completion filler wall work of third floor along with provision of lintel etc. and	1.40%		

	providing and fixing door Frame, window frames & ventilator frame as per the Scope of work			
4.5	On completion filler wall work of Forth floor along with provision of lintel etc. and providing and fixing door Frame, window frames & ventilator frame as per the Scope of work	1.40%		
4.6	On completion filler wall work of Mumty, parapet wall along with provision of lintel etc. and providing and fixing door Frame, window frames & ventilator frame and internal and external plaster as per the Scope of work	0.50%		
5	**Completion of Plastering work upto top of the building.**		5.5%	53.5%
5.1	On completion of internal plastering of ground floor as per the Scope of work	0.50%		
5.2	On completion of external plastering of ground floor as per the Scope of work	0.50%		
5.3	On completion of internal plastering of first floor as per the Scope of work	0.50%		
5.4	On completion of external plastering of first floor as per the Scope of work	0.50%		
5.5	On completion of internal plastering of second floor as per the Scope of work	0.50%		
5.6	On completion of external plastering of second floor as per the Scope of work	0.50%		
5.7	On completion of internal plastering of Third floor as per the Scope of work	0.50%		
5.8	On completion of external plastering of Third floor as per the Scope of work	0.50%		
5.9	On completion of internal plastering of Forth floor as per the Scope of work	0.50%		
5.10	On completion of external plastering of Forth floor as per the Scope of work	0.50%		
5.11	On completion of internal external plastering of Terrace floor, Mumty and Parapet wall as per the Scope of work	0.50%		
6	**Electrical Internal work (stage 1)**		5.50%	59%
6.1	On laying and fixing of Slab/ wall	1.0%		

	conducting & MS box fixing in position of ground and first floor slab for electrical works as per the Scope of work			
6.2	On laying and fixing of Slab/ wall conducting & MS box fixing in position of First floor wall and Second floor slab for electrical works as per the Scope of work	1.0%		
6.3	On laying and fixing of Slab/ wall conducting & MS box fixing in position of Second floor wall and Third floor slab for electrical works as per the Scope of work	1.0%		
6.4	On laying and fixing of Slab/ wall conducting & MS box fixing in position of Third floor wall and Forth floor slab for electrical works as per the Scope of work	1.0%		
6.5	On laying and fixing of Slab/ wall conducting & MS box fixing in position of Forth floor wall and Terrace floor slab for electrical works as per the Scope of work	1.0%		
6.6	On laying and fixing of Slab/ wall conducting & MS box fixing in position of Mumty wall and slab for electrical works as per the Scope of work.	0.5%		
7	**Internal and External Plumbing work**		2.5%	61.5%
7.1	Overall laying of pipe network for internal Plumbing, fire fighting in position inside the building & connection with OHT and UGT and its testing as per the Scope of work.	1.5%		
7.2	Overall laying of pipe network for internal sanitary/ sewage, in position inside the building and connection upto Man hole of the building and its testing as per the Scope of work	1.00%		
8	**Flooring and Cladding works**		5.50%	67%
8.1	On completion of flooring/ dado/ skirting/ cafeteria shelves works in ground floor including staircase complete in all respect and as per scope of work	1.00%		
8.2	On completion of flooring/ dado/ skirting works in first floor including staircase complete in all respect and as per scope of work	1.00%		

8.3	On completion of flooring/ dado/ skirting works in second floor including staircase complete in all respect and as per scope of work	1.00%		
8.4	On completion of flooring/ dado/ skirting works in Third floor including staircase complete in all respect and as per scope of work.	1.00%		
8.5	On completion of flooring/ dado/ skirting works in Forth floor including staircase complete in all respect and as per scope of work.	1.00%		
8.6	On completion of flooring/ dado/ skirting works in Mumty floor including staircase complete in all respect and as per scope of work	0.50%		
9	**Grouting/ polishing and Railing fixing**		1.00%	68%
9.1	on completion of Grouting/Polishing works in floor including staircase complete in all respect and as per scope of work. On fixing railing in staircases, balcony, corridors etc. complete in all respect and as per scope of work	1.00%		
10	**Electrical wiring,Fixture fittings and fire fightings**		7.00%	75%
10.1	Complete Electrical fitting including wiring, switching, distribution board, panels, fans, geysers, lights, etc. upto main distribution board of the building complete in all respect and as per scope of work	3.00%		
10.2	Supply, Testing and Commissioning of Electrical work and Fire Alarm System complete in all respect and as per scope of work	4.00%		
11	**Door, Window and allied structure**		5.0%	80%
11.1	On providing and fixing door, window & ventilators shutters, cupboards, kitchen area cupboards, hardware fixtures & fittings, etc. on ground and first floor complete in all respect and as per scope of work	2.0%		
11.2	On providing and fixing door, window &	2.0%		

	ventilators shutters, cupboards, hardware fixtures & fittings, etc. on second and third floors complete in all respect and as per scope of work			
11.3	On providing and fixing door, window & ventilators shutters, cupboards, hardware fixtures & fittings, etc. on Forth along with Mumpty complete in all respect and as per scope of work	1.0%		
12	**Glazing works**		1.00%	81%
12.1	On providing and fixing of frameless toughened glass and structural glazing complete in all respect and as per scope of work	1.00%		
13	**OHT**		1.00%	82%
13.1	On completion of all Over- head Tanks complete in all respect and as per scope of work	1.00%		
14	**Water Proofing works**		1.50%	83.5%
14.1	Toilet water proofing complete in all respect with testing and rectification of defects from Ground floor to Second floor complete in all respect and as per scope of work.	0.50%		
14.2	Toilet water proofing complete in all respect with testing and rectification of defects from Third floor to Forth floor complete in all respect and as per scope of work.	0.50%		
14.3	Terrace water proofing & allied works complete in all respect and as per scope of work	0.50%		
15	**Finshing work**		4.50%	88%
15.1	External finsihinig work of building in balance area apart from structural glazing work including any embosed art logos as per architectural drawings on external walls complete in all respect and as per scope of work.	2.00%		
15.2	Internal painting works of building from Ground floor to top complete in all respect and as per scope of works.	2.50%		

16	**Alied works**		6.0%	94%
16.1	On completion of Underground Tanks complete in all respect and as per scope of work	0.50%		
16.2	on completion of installation, Testing and commissioning of pumps and equipment's and allied works complete in all respect and as per scope of work	0.50%		
16.3	Installation, testing and commissioning of fire - fighting system complete in all respect and as per scope of work	0.50%		
16.4	Installation, testing and commissioning of water line along with Hydro Pneumatic system, water coolers and RO complete in all respect and as per scope of work	0.50%		
16.5	Supply, installation, testing and commissioning of CCTV system complete in all respect and as per scope of work	0.50%		
16.6	Final coat of internal/external painting, polishing on each required surface, testing /commissioning of services prior to handing over as per scope of works and required false ceiling works as per approved architectural drawings.	0.50%		
16.7	Final fixing of all complete sanitary fitting, plumbing fittings, lighting, fans, electric Geysers, other fittings & fixtures etc. prior to handing over as per scope of works	1.30%		
16.8	Supply, installation, testing and commissioning of Lift system complete in all respect and as per scope of works.	1.2%		
16.9	Completion of trench services	0.3%		
16.10	Horticulture oprations including earth filling and grassing tree	0.2%		
17.00	**Handing Over**		6.0%	100%
17.1	After completion of balance work which are related to snaglist and not included in above stage of construction / payment	2.0%		

	terms but in the scope of work of contractor as per section of scope of work			
17.2	Handing over of the building with full satisfaction of Engineer in-charge/ IIT (ISM) Dhanbad.	2.0%		
17.3	Submission of As built drawings, along with literature, manuals, warranty certificates, etc., of various installed fittings, fixtures and equipment including electrical, LAN drawing and for the completed project	2.0%		

PART B – (Considering separate head for Furniture, Public announcement (PA) system, Audio Visual (AV) System)

18. Furniture

S.No	Stage of Construction	Breakup of % of Item Contract	% of Item Contract Value of furniture	Cumulative % of Contract value
18.1	Planning , Detailed design and Approval from engineer-in-charge	1.0%	100%	1%
18.2	Supply of materials	69.0%		70%
18.3	Installation	20.0%		90%
18.4	Testing and commissioning	4.0%		94%
18.5	Handing over to the client	6.0%		100%

19. Public Announcement (PA) system

S.No	Stage of Construction	Breakup of % of Item Contract	% of Item Contract Value of Public announcement system	Cumulative % of Contract value
18.1	Planning , Detailed design and Approval from engineer-in-charge	1.0%	100%	1%
18.2	Supply of materials	69.0%		70%

18.3	Installation	20.0%		90%
18.4	Testing and commissioning	4.0%		94%
18.5	Handing over to the client	6.0%		100%

20. Audio visual (AV) system

S.No	Stage of Construction	Breakup of % of Item Contract	% of Item Contract Value of Audio visual system	Cumulative % of Contract value
18.1	Planning , Detailed design and Approval from engineer-in-charge	1.0%	100%	1%
18.2	Supply of materials	69.0%		70%
18.3	Installation	20.0%		90%
18.4	Testing and commissioning	4.0%		94%
18.5	Handing over to the client	6.0%		100%