INDIAN INSTITUTE OF TROPICAL METEOROLOGY
PASHAN, PUNE-411008

(HPC Data Center/IITM/01/2013) **REQUEST FOR PROPOSAL**

Director, Indian Institute of Tropical Meteorology (An autonomous Institute under the Ministry of Earth Science, Govt. of India), Dr.Homi Bhabha Road, Pashan, Pune- 411 008 (India) invites sealed tenders (Part-I – Technical Bid, Part-II – Financial Bid) in separate sealed covers from Manufacturers / Suppliers and their accredited selling agents for the construction, supply, installation, commissioning, and satisfactory demonstration of ***"Data Centre for High Performance Computing (HPC) at this Institute's campus (Turnkey Job) & at NCMRWF, Noida, U.P. (Turnkey Job)."***

Tender documents with details can be obtained from Purchase & Stores Section of the Institute or can be download from Institute's website.

Last date of receipt of Tender at IITM, Pune : 26th June 2013 at 12:00 hrs.
Pre-Bid Meeting date : 14th June 2013 at 11:00 hrs.
Opening of Tenders (Technical bids only) : 26th June 2013 at 15:00 hrs.

The Institute reserves the right to reject any or all tenders without assigning any reason thereof. For details please visit Government's Central Procurement Portal (CPP) http://**www.eprocure.gov.in** as well as this Institute's Website: **http://www.tropmet.res.in**

Scientific Officer Gr.-I, for Director
Email :vipin@tropmet.res.in

REQUEST FOR PROPOSAL

ON

DATA CENTRE FOR HIGH PERFORMANCE COMPUTING (HPC)

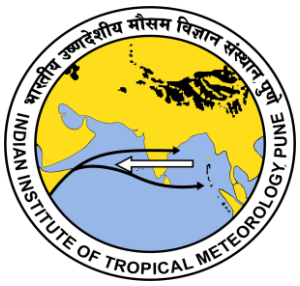
OPERATIONAL & RESEARCH INSTITUTES IN

MINISTRY OF EARTH SCIENCES

EARTH SYSTEM SCIENCES ORGANISATION

GOVERNMENT OF INDIA

Reference no: HPC DATA CENTRE/IITM/1/2013



INDIAN INSTITUTE OF TROPICAL METEOROLOGY

(AUTONOMOUS INSTITUTE, MINISTRY OF EARTH SCIENCES,

GOVERNMENT OF INDIA)

DR. HOMI BHABHA ROAD, PASHAN,
PUNE 411 008
MAHARASHTRA, INDIA

JUNE 2013

PART 1 - Invitation to Bid (ITB)

a. Director, IITM invites sealed Bids for building a Data Centre and to propose a turnkey solution Data Centre infrastructure System. Detailed functional and technical requirements have been given in PART 5 of this document.

b. The Bidder must be in existence at least for preceding five years, must have an avarage turnover of more than **Rs. 10 Crores per annum as an individual company** and must be a profit making company in the last 3 years.

c. The prospective bidder should have built at least 5 Data centers in last 5 years out of which 1 should have been successfully built of about 4000 sq. Feet on a turnkey solution basis comprising of the following works:

1. IT
2. Civil Interiors
3. Electrical works, LAN / WAN, D.G sets
4. Data Center Surveillance System
5. UPS & Battery System
6. HVAC system.
7. Access Control System.
8. Building Management System (BMS)
9. Fire Detection, Warning, Alarm & Suppression System.
10. Hi end Security Systems, Sensors and all the other activities deemed to be considered for successful installation, testing & commissioning of a Data Centre.

d. Necessary document establishing tie up with the sub contractors may be submitted

e. Bidders may obtain the Request For Proposal (RFP), Technical Specifications and Bill of Quantities from the Purchase and Stores Section of this Institute, having address INDIAN INSTITUTE OF TROPICAL METEOROLOGY, Dr. Homi Bhabha Road, Pashan, Pune – 411 008 by paying non-refundable DD for **Rs. 5,000 / -** (Rs. Five Thousand only) drawn in favour of **"Director, INDIAN INSTITUTE OF TROPICAL METEOROLOGY"** payable in PUNE. **Bidders can also download RFP Documents on this Institute's website http://www.tropmet.res.in as well as from Govt. of India's E-procurement Website http://www.eprocure.gov.in, however they may required to pay tender fee in the manner as prescribed above along with Technical Bid.**

f. The RFP is to be submitted at the following address:

The Director, Indian Institute of Tropical Meteorology
Dr. Homi Bhabha Road,
Pashan,
Pune – 411 008
Maharashtra, India.

Phone Numbers: 020 – 25904483 (Mr. V.R. Mali, Sci. Officer Gr.-I)
Email: vipin@tropmet.res.in

g. For queries and clarification regarding the RFP please feel free to contact us on the above mentioned address or telephone number or e-mail id

h. Please note that all the information desired needs to be provided. Incomplete information may lead to non-selection.

i. All Bids must be accompanied by Bid Security as specified in the Bid document.

j. This Institute reserves the right to change the dates mentioned above or in the RFP, which will be communicated

1.6.1 Date of commencement of Sale of Bidding documents	**06.06.2013**
1.6.2 Last date for Sale of Bids	**25.06.2013 by 12.00 HRS IST**
1.6.3 Pre-bid Meeting	**14.06.2013 at 1100 HRS at IITM, Pune**
1.6.4 Last date for submission of Bids	**26.06.2013 before 1200 HRS IST** **Bids submitted after the date and time will not be accepted**
1.6.5 Date of Opening Technical Bids	**26.06.2013 at 1500 HRS IST**
1.6.6 Address for communication	**Same as above**
1.6.7 Period of Completion	**120 Days from date of placing the L.O.I with 7 days as mobilization period.**

k. RFP documents contained the scope of work for two different locations:

(I) INDIAN INSTITUTE OF TROPICAL METEOROLOGY, PASHAN, PUNE, MAHARASHTRA – 411 008 (Named as DATA CENTRE – A)

(II) NATIONAL CENTRE FOR MEDIUM RANGE WEATHER FORECASTING, SECTOR-62, NOIDA, UTTAR PRADESH – 201 309 (Named as DATA CENTRE – B)

DATA CENTRE – A is related to scope of work of IITM, PUNE (Page No. 6 to 556) &

DATA CENTRE – B is related to scope of work of NCMRWF, NOIDA (Page No. 557 to 572)

It is therefore, prospective bidders may please note the following information carefully: -

(a) Technical & Commercial bids for DATA CENTRE –A & DATA CENTRE – B will be evaluated seperately & contract for work will also be awared seperately, hence bidder may submit the Bids for DATA CENTRE – A & DATA CENTRE – B in seperately.

(b) Details of the work scope, design & drawing related to DATA CENTRE – B will also be discussed / provided to bidders in pre-bid meeting. Bidders are requested to search / follow website of this Institute & Newspapers notice regularly for corrigendum issued/ amendment made on DATA CENTRE-B technical details, if any.

All prospective bidders are encouraged to attend Pre-Bid Meeting as per schedule. However, if any body is unabled to attend the meeting then may please refer this Institute's website for further details.

(c) Bidders can quote for DATA CENTRE-A and or DATA CENTRE-B or for both DATA CENTRES but can not be quoted partially for DATA CENTRE-A or DATA CENTRE-B. It may please be noted that both DATA CENTRE-A & DATA CENTRE-B has to be taken up on turnkey job basis. Considering the above, prospective bidders may quote as per their convenience within the stipulated time frame.

(d) All the terms & conditions mentioned in tender document of DATA CENTER-A are also applicable to DATA CENTRE-B.

(e) Bidders can submit the EMD amount for Rs.1,00,00,000/- (Rs. One Crore only) for DATA CENTRE-A or Rs.60,00,000/- (Rs. Sixty Lakhs only) for DATA CENTRE-B or Rs.1,60,00,000/- (Rs. One Crore Sixty Lakhs only) for both the DATA CENTRES according to their tender submission along with Technical Bids.

PART 2 - Disclaimer

The information contained in this Request for Proposal (RFP) document or information provided subsequently to bidder(s) or applicants whether verbally or in documentary form by or on behalf of Director, IITM, is provided to the bidder(s) on the terms and conditions set out in this RFP document and all other terms and conditions subject to which such information is provided.

This RFP is neither an agreement nor an offer and is only an invitation by IITM to the interested parties for submission of bids. The purpose of this RFP is to provide the bidder(s) with information to assist the formulation of their proposals. This RFP does not claim to contain all the information each bidder may require. Each bidder should conduct its own investigations and analysis and should check the accuracy, reliability and completeness of the information in this RFP and where necessary obtain independent advice. IITM makes no representation or warranty and shall incur no liability under any law, statute, rules or regulations as to the accuracy, reliability or completeness of this RFP.

PART 3 - INSTRUCTIONS FOR BIDDERS (IFB)

TABLE OF CLAUSES

DATA CENTRE - A

PART 3 - INSTRUCTIONS FOR BIDDERS (IFB)

A. Introduction

3.1 General

The Indian Institute of Tropical Meteorology is an autonomous research organisation fully funded by Ministry of Earth Sciences, New Delhi. It is a premier Institute of national and international repute, devoted to research in various aspects of atmospheric sciences with emphasis on Tropical Meteorology, particularly on the Climate Change and Indian Monsoon. It's activities include training to post graduates and motivate them to take up research careers in atmospheric and oceanic sciences required to improve prediction skill of weather and climate. The Institute has excellent infrastructural facilities such as High Performance Computers, modern library, workshop and other scientific support. It has a strong link with various universities and national and international organizations.

3.2 The Proposal and Broad Scope of Work

3.2.1 The Institute has recently procured HPC Solution and proposes to build Data Centre on two floors of about **2500 sq.feet** (approx) per floor to house this HPC system and its supporting infrastructure. The proposed Data Centre will be of **Tier 3 / Tier 4** standard as per the requirements of the HPC System. This RFP is being floated to select the most appropriate vendor to build & operate the data centre.

3.2.2 The scope of the RFP is to propose a turnkey errection of the Data Centre Infrastructure System which shall include the building of Data Centre and its operations.

- The solution shall comprise of supply, installation, testing, training and handing over of all materials, equipment, hardware, software, appliances and necessary labor to commission said system complete with all the required components strictly as per the enclosed tender specifications, design details.
- Also, the scope includes the supply, installation & commissioning of any material or equipment including civil works that are not specifically mentioned in the specifications and design details but are required for successful commissioning of the project.
- The vendor shall provide documentation including user, system and operation manuals as well as the necessary diagrams and design drawings;
- The vendor shall be responsible for performing verification tests to ensure all proposed software and hardware are functioning as designed.
- The vendor shall be responsible for providing support and maintenance for all equipment and systems proposed on **24 x 7 x 365** days basis;
- The vendor shall be responsible for providing acceptance checklists for the project.

- The vendor shall be responsible for proposing additional items that it may seem to be necessary but are not mentioned in this tender.

- The Data Center should be complete in all respects. The broad areas of the scope of work and their major elements are:

3.2.3. **Design of Data Center**

The proposed designs and draft drawings enclosed in the RFP document are for reference and for the purpose of bidding. The vendor so finalized would be required to make the necessary shop drawings within the layouts in consultation Institute so as to arrive at a final scheme in line with the requirements of the clients and in accordance with the requirements of Indian standards ISO and Green IT certifications. However no change whatsoever in the price schedules would be allowed after the award of the work and the price shall remain firm throughout the project and the works are to be executed within the quoted price schedules. Any extra item / works arising out of the changes in the scheme shall be first notified to the Institute, who shall take a review of the same and if convinced notify the clients about the execution of that item / work.

3.2.4 **Build of Data Center**

The vendor should build the entire data center infrastructure which includes civil works, interiors, environmental controls like humidity, temperature etc., security (including access/ monitoring equipment), electrical systems, power systems, power supply, UPS, D.G Sets etc. as specified in the detailed specification document.

The vendor shall provide qualified and experienced project manager on site for monitoring the DC build and should provide complete description with regard to the project's Manager's role, name of the person(s) proposed for the role, and a summary of their experience and qualifications who would be responsible for the installation of all the systems .

The vendor shall state how they will manage the installation, testing and hand over of all systems.

3.2.5 **Warranty & Annual Maintenance**

The offer include a minimum comprehensive on–site free warranty of **36** months from the date of installation and acceptance of the data center by IITM including all parts, updates and labour.

Preventive maintenance of equipments like UPS, AC, Generator, etc for all the products will be within the scope and needs to be undertaken by the bidder.

IITM will not accept any offer of used or refurbished products or equipment. The vendor shall warrant that all the products and equipment offered will be fresh from stock and / or factory. Vendor shall be fully responsible for the manufacturer's warranty in respect of proper design, quality and workmanship of all equipment, accessories etc. covered by RFP.

Vendor must warrant all equipment, accessories, spare parts etc. against any manufacturing defects during the warranty period. During the warranty period vendor shall repair / replace at the installed site, at no charge to Institute, all defective components that are brought to the Vendor's notice. Warranty should not become void, if IITM buys, any other supplemental hardware from a third party and installs it within these machines under intimation to the vendor. However, the warranty will not apply to such supplemental hardware items installed.

3.2.6 **Data Center Upgrade**

The vendor needs to provide services towards upgrade of data center facilities if required.

3.3 Information to the bidders

3.3.1 The bidders should provide the necessary supporting documents indicating their tie up with all the other agencies like Interior works, Electrical works, L.V etc.

3.3.3 Further, the bidders should be able to provide the necessary interfaces with the existing Service Provider/s of the Institute.

3.3.4 The bidders would be one point contact to provide the necessary infrastructure to the Institute. The selected bidders will provide the IITM complete infrastructure requirements.

'Successful Bidder' is the bidder whose technical bid has been accepted and whose price as per the commercial bid is the lowest.

A summary of the project implemented must be enclosed with the Technical Bid, giving the following details:

- Name of the Client
- Details of Data Centre like Address etc. Nature of the Project
- Scope of the Project
- Architecture of the solution implemented
- Date of award of Contract
- Date of commencement of the Project
- Date of successful commissioning of the Project
- Whether the Project has been vetted / audited by any independent Agency / Institutional Consultants of Repute, and if so, outcome thereof.
- Name of the person who can be referred to from Clients' side, with Name, Designation, Postal Address, Contact Phone and Fax numbers, E-Mail IDs, etc. (Attach copies of purchase orders)

(**Above Details are MANDATORY and to be included in technical bid. Without the above details, the Bid is liable to be Rejected**)

3.3.6 IITM also reserves the right to inspect such installation/s while evaluating the Technical Bid. The system integrator or bidder should obtain permissions and bear all the expenses in this regard.

3.4 Eligibility of Bidders

a) The Bidder must be in existence at least for preceding five years, must have an avarage turnover of more than Rs. 10 Crores per annum as an individual company in data center build and operation business and must be a profit making company in the last 3 years.

b) The prospective bidder should have built at least 5 Data centers in last 5 years out of which 1 should have been successfully built of about 4000 sq. Feet on a turnkey solution basis comprising of the following works:

1. IT
2. Civil Interiors
3. Electrical works, LAN / WAN, D.G sets
4. Data Center Surveillance System
5. UPS & Battery System
6. HVAC system.
7. Access Control System.
8. Building Management System (BMS)
9. Fire Detection, Warning, Alarm & Suppression System.
10. Hi end Security Systems, Sensors and all the other activities deemed to be considered for successful installation, testing & commissioning of a Data Centre.

The bidder must produce a reference certificate from such customers for satisfactory implementation of the project. The reference has to be from individual clients and for multiple sites from a single client. The client should be preferably research and academic Institutes with details like Name, Designation, Postal Address, Contact Phone and Fax Numbers, E-Mail Ids etc

c) The vendor should be a registered company as per Indian Companies Act 1956.

d) The Bidder shall possess the necessary registrations with Department of Income Tax, Sales Tax, Service Tax, ESIC, PF, Labour licenses etc and all such regulatory bodies. Necessary supporting certificated shall be enclosed at the time of submitting the bids.

(Above details are MANDATORY. The Bid is liable to be rejected without the above details).

e) IITM reserves the right to request for any additional information and also reserves right to reject or accept the bid of any bidder, if in the opinion of Institute, the qualification data is incomplete or the bidder is found not qualified to satisfactorily execute the requirements of the project.

f) IITM reserves the right to inspect such implementations/installations. The bidder shall arrange for site visit of this Institute's identified representatives at a mutually convenient time.

g) All systems and related services to be supplied under the Contract shall have their origin in countries allowed as per Import Trade Control Regulations in India.

h) "Origin" means the place where the products are produced or the place from which the related services are supplied. Products are produced when a commercially recognised product results that is substantially different in basic characteristics or in purpose or utility from its' components.

i) The origin of products and services is distinct from the nationality of the Bidder.

3.5 Cost of Bidding

3.5.1 The Bidder shall bear all costs associated with the preparation and cost of its Bid, and the IITM will in no case be responsible or liable for these costs, regardless of the conduct or outcome of the Bidding process.

B. The Bidding Documents

3.6. Content of Bidding Document/s

3.6.1 The products required, Bidding procedures, and contract terms are prescribed in the Bidding Documents. The Bidding Documents include:

(a) **PART 1** -Invitation to Bid (ITB)
(b) **PART 2** -Disclaimer
(c) **PART 3** -Instruction for Bidders (IFB)
(d) **PART 4** -Terms and Conditions of Contract (TCC)
(e) **PART 5** -Technical & Functional Specifications (TFS)
(f) **PART 6** -Bid Forms, Price Schedules and other forms (BF)
(g) **PART 7** -Schedule of Dates, Amounts, etc. (SDA)

3.6.2 The System integrator or bidder is expected to examine all instructions, forms, terms and specifications in the Bidding Document. Failure to furnish all information required by the Bidding Document or to submit a Bid not substantially responsive to the Bidding Document in every respect will be at the System Integrator or Bidder's risk and may result in the rejection of the Bid. It may be also noted that all the pages of the RFP document shall be duly signed and sealed on each and every page before submission.

3.7 Clarification of Bidding Document/s

3.7.1 A prospective system integrator or Bidder requiring any clarification of the Bidding Document may notify the IITM in writing or by Fax at the address / fax number / e-mail indicated in Invitation to Bid. IITM will respond at the time of **pre-bid meeting** to any request for clarification of the Bidding Document **received two days prior to the date of Pre-bid meeting upto 5:00 p.m.** Relaxation in any of the terms contained in the Bid, in general, will not be permitted, but if granted, the same will be communicated to all the Bidders. ***A copy of minutes of pre-bid meeting will be uploaded on this Institute's website in due course.***

3.8 Amendment of Bidding Document/s

3.8.1 At any time prior to the deadline for submission of Bids, IITM, for any reason, whether, at

its own initiative or in response to a clarification requested by a prospective system integrator or Bidder, may modify the Bidding Document/s, by amendment.

3.8.2 All prospective system integrators or Bidders that have received the Bidding Document will be notified of the amendment in writing or fax or E-mail and will be binding on them.

3.8.3 In order to allow prospective system integrators or Bidders reasonable time in which to take the amendment into account in preparing their Bids, IITM, at its discretion, may extend the deadline for the submission of Bids.

C. Preparation of Bids

3.9 Language of Bid

3.9.1 The Bid prepared by the System integrator or Bidder, as well as all correspondence and documents relating to the Bid exchanged by the System integrator or Bidder and IITM and supporting documents and printed literature shall be written in English.

3.10 Documents Comprising the Bid

3.10.1 Documents comprising the Technical Proposal Envelope, should be:

(a) Bid Form as per Format 6.1.1 completed in accordance with the clauses in the BID and duly signed by the Bidder along with the tender fees in the form of a non-refundable pay order in favor of IITM, payable in Pune if downloaded from the website.

(b) Documentary evidence establishing that the Bidder is eligible to Bid and is qualified to perform as per Clause 3.14 of the Bidding document if its Bid is accepted.

(c) Documentary evidence establishing that the products, systems and the ancillary services to be supplied by the Bidder are eligible products and services and conform to PART 5 of the Bidding Document.

(d) A full description of the Technical solution which must provide an acceptable solution to the business requirement described in PART 5 Technical & Functional specifications. **Any Technical Bid containing any Price information will be rejected.**

(e) Bid Security deposit (E.M.D) of **Rs. 1,00,00,000/- (Rupees One Crore only)** as specified in Clause 3.16

(f) Details of Project handled / Referral letters as per Clause 3.3.4.

(g) A Complete Bill of Material duly filled as per Format in envelope no 2 (Price bid).

(h) A non-disclosure agreement as per Format 6.2

(i) Manufacturers' / Producers' authorization form as per Format 6.8 wherever applicable

(j) Service Support Details form as per Format 6.11.

(k) Confirmation as per clause 3.15.3 (c).

While submitting the Technical Bid, literature on the data center solution should be segregated and kept together in one section / lot. The other papers like Bid Security, Forms as mentioned above etc. should form the main section and should be submitted in one lot, separate from the section containing literature and annual accounts.

Any Technical Proposal not containing the above will be rejected. The Technical Proposal should not contain any price information, such proposal will be rejected.

3.10.2 Documents comprising Price Proposal Envelope should be:

a) A Full Price Schedule of the Solution indicating all the components (including sub modules) of the solution and services **as per the price schedules enclosed**

b) The Bid as per Format furnished in the Bidding documents duly signed by the Bidder and completed.

c) Price bids containing any deviations or similar clauses will be summarily rejected.

d) **Soft copy of the BOQ and other related documents may be submitted along with price bid.**

3.11 Bid Form

3.11.1 The System integrator or Bidder shall complete both the two Envelopes of the Bid Form furnished in the Bidding Document separately and submit them simultaneously to the Institute. Bids are liable to be rejected if only one (i.e. Technical Bid or Price Bid) is received.

3.12 Bid Prices

The detail Bid price indicated in Price schedule should be separately quoted for Hardware, Equipments, Gadgets, Software Applications etc. The Hardware price schedule should include the entire Hardware infrastructure necessary at the Data Centre Site. The Software Application should also be quoted in such a manner that it should indicate the Application cost at the Data Centre.

3.12.1 The prices indicated in the Price Schedule shall be entered in figures and words. In case of any discrepancy between the two (figures and words), the latter shall prevail upon the bids.

a) The total price quoted must be in the form of Basic Cost of equipment(s)+ cost of providing services for installation, testing and commissioning of the solution and the Warranty + all applicable taxes, duties, levies, charges etc. (Cost of incidental services such as transportation, insurance, Sales Tax and / or VAT payable, Service tax & Central Excise tax, Cess, ESI, PF, Octroi or entry-tax or such similar tax, as well as taxes, levies, duties payable to Central / State Government, Municipal Authorities, Ward, Fire departments and all other statutory authorities etc.)

b) The cost of Annual maintenance service for a period as mentioned in relevant Clause on yearly basis after expiry of warranty period. .

c) Prices quoted as above shall be valid for a minimum period of **90 days** from last date of submission of tender.

d) In case of Indigenous Items the offer should contain the Basic Price and percentage of Excise Duty should be shown separately, since IITM, Pune is exempted from payment of Excise duty vide Govt. Notification No.10/97-Central Excise dated 15t March, 1997.

e) IITM is exempted from payment of Customs Duty vide Govt. Notification No.51/96-Customs dated 23rd July, 1996 and amendments thereafter.

3.12.2 Prices quoted by the System integrator or Bidder shall be fixed during the system integrator's or Bidder's performance of the Contract and shall not be subject to variation on any account, including exchange rate fluctuations, changes in taxes, duties, levies, charges etc. A Bid submitted with an adjustable price quotation will be treated as non-responsive and will be rejected.

3.13 Bid Currencies

3.13.1 Bids are preferably to be quoted in Indian Rupees. If quoted in foreign currency, preferably be quoted in US Dollars; (please note that both FOB and DDP prices (with all breakup like air/sea freight, Insurance, Custom Clearance, Custom Duty, Inland transportation etc. have to be quoted).

The cost of Services to be rendered in India should be quoted in Indian Rupees.

All expenses made in India should be quoted in Indian Rupees only.

Shipping, delivery, insurance for transportation up to site of installation.

Equipment installation charges and all cabling and miscellaneous ancillary equipment.

3.14 Documents Establishing System Integrator's or Bidder's Eligibility and Qualifications

3.14.1 The System integrator or Bidder shall furnish, as part of its Bid, documents establishing the system integrator's or Bidder's eligibility to Bid and its qualifications to perform the Contract, if it's Bid is accepted.

3.14.2 The documentary evidence of the system integrator's or Bidder's qualifications to perform the Contract if its Bid is accepted shall establish to the Institute's satisfaction:

a) that, in the case of a system integrator or Bidder offering to supply products and/or Systems under the Contract which the system integrator or Bidder did not produce, the system integrator or Bidder has been duly authorized as per authorization format enclosed.

b) Given in the Bid, by the products' Producer to supply the products and / or Systems in India;

c) that adequate, specialized software/hardware expertise are already available with the bidder in order to ensure that the support services are responsive and the System integrator or Bidder will assume total responsibility for the fault-free operation of the systems installed and maintenance during the warranty period and provide necessary maintenance services after end of warranty period, for a period mentioned.

3.15 Documents Establishing Eligibility of Products and Conformity to Bidding Documents

3.15.1 The system integrator or Bidder shall furnish, as part of its Bid, documents establishing the eligibility and conformity to the Bidding Documents of all products and/or System and/or services which the system integrator or Bidder proposes to supply under the Contract.

3.15.2 The documentary evidence of the eligibility of the products and/or System and/or services shall consist of a statement (attached to the Price Schedule) of the country of origin of the products and/or System and/or services offered, which shall be confirmed by a certificate of origin issued at the time of shipment.

3.15.3 The documentary evidence of conformity of the products and/or System and/or services to the Bidding Documents may be in the form of literature, drawings, and data, and shall consist of:

a) a detailed description of the essential technical and performance characteristics of the products and/or Systems as mentioned in Price schedules;

b) an item-by-item commentary on the Technical & Functional Specifications given in the Bid, demonstrating substantial responsiveness of the products and/or System and/or services to those specifications, or a statement of deviations and exceptions to the provisions of the Technical & Functional Specifications; and

c) a confirmation that, if the System integrator or Bidder offer systems and/or other software produced by another company, such software operates efficiently on the system proposed by the system integrator or Bidder; and the system integrator or Bidder is willing to accept responsibility for its successful operation.

3.16 Bid Security (E.M.D)

3.16.1 The system integrator or Bidder shall furnish, as part of its Bid, a Bid security of amount as mentioned under the relevant clause.

3.16.2 The Bid security is required to protect the IITM against the risk of system integrator's or Bidder's conduct, which would warrant the security's forfeiture.

3.16.3 The Bid security shall be denominated in Indian Rupees and shall be in the form of a Banker's Cheque / Demand Draft, Bank Guarantee issued by a Commercial Bank in India,

drawn in favour of IITM payable in Pune.

3.16.4 Any Bid not secured, as above, will be rejected by IITM, as non- responsive.

3.16.5 Unsuccessful system integrator's or Bidders' Bid security will be discharged or returned as promptly as possible but not later than **Forty Five (45)** days after the expiration of the period of Bid validity .

3.16.6 The successful system integrator's or Bidder's Bid security will be adjusted against the security deposit to be withheld by the Institute for the entire period of completion of the contract. upon the system integrator or Bidder signing the Contract and furnishing the performance security as per format 6.6.

3.16.7 The Bid security may be forfeited:

a) if a system integrator or Bidder withdraws its Bid during the period of Bid validity specified by the system integrator or Bidder on the Bid Form; or

b) if a system integrator or Bidder makes any statement or encloses any form which turns out to be false/incorrect at any time prior to signing of Contract; or

c) in the case of a successful system integrator or Bidder, if the system integrator or Bidder fails;

(i) to sign the Contract;

or

(ii) to furnish Performance Security as mentioned in Clause 3.33 herein.

3.17 Period of Validity of Bids

3.17.1 Bids shall remain valid for a period mentioned in the relevant clause, from the date of opening of the Bid. A Bid valid for a shorter period shall be rejected by the Institute as non-responsive.

3.17.2 In exceptional circumstances, the Institute may solicit the system integrators' or Bidders' consent to an extension of the period of validity. The request and the responses thereto shall be made in writing. The Bid security provided shall also be suitably extended.

3.18 Format and Signing of Bid

3.18.1 Each bid shall be in two parts:-

Part I covering the Technical, Masked Price Bid (Price bids without any Price), BoM and Qualification aspects hereinafter referred to as '**Technical Bid**'.

Part II covering only the price schedules hereinafter referred to as the '**Price Bid**'.

The two parts should be in two separate covers, each super-scribed with the name of the

Project as well as "Technical Bid" and "Price Bid" as the case may be, as detailed below. The superscription should also cover details regarding the project etc. as required vide clause 3.19 below.

3.18.2 The Bid shall be typed or written in indelible ink and shall be signed by the Bidder or a person or persons duly authorized to bind the Bidder to the Contract. The person or persons signing the Bids shall initial all pages of the Bids, except for un-amended printed literature.

3.18.3 Any inter-lineation's, erasures or overwriting shall be valid **only** if they are initialed by the person signing the Bids. The Institute reserves the right to reject bids not confirming to above

D. Submission of Bids

3.19 Sealing and Marking of Bids

3.19.1 The system integrators' or Bidders' shall seal the envelopes containing "Technical Bid" and "Price Bid" separately and the two envelopes shall be **enclosed and sealed in an outer envelope**. **The technical bid, price bid and all the necessary documents shall be submitted in duplicate. All pages of the technical bid, price bid and other necessary documents shall be signed and sealed by the bidder.**

3.19.2 The inner and outer envelopes shall:

a) be addressed to IITM at the address given; and

b) bear the Project Name ", **RFP- Data Centre Build - Technical Bid**" and **RFP- Data Centre Build - Price Bid**" in separate envelopes**.**

c) All envelopes should indicate on the cover the name and address of the Bidder.

3.19.3 If the outer envelope is not sealed and marked, the IITM will assume no responsibility for the Bid's misplacement or premature opening.

3.20 Deadline for Submission of Bids

3.20.1 Bids must be received by IITM at the address specified, not later than the date & time specified in the Invitation to Bid.

3.20.2 The Institute may, at its discretion, extend this deadline for the submission of Bids by amending the Bid Documents, in which case, all rights and obligations of the Institute and system integrators or Bidders previously subject to the deadline will thereafter be subject to the deadline as extended.

3.21 Late Bids

3.21.1 Any Bid received by IITM after the deadline for submission of Bids prescribed, will be

rejected.

3.22 Modification and Withdrawal of Bids

3.22.1 No Bid may be modified after the deadline for submission of Bids.

3.22.2 No Bid may be withdrawn in the interval between the deadline for submission of Bids and the expiration of the period of Bid validity specified by the Bidder on the Bid Form. Withdrawal of a Bid during this interval may result in the system integrator's or Bidder's forfeiture of its Bid security.

E. Opening and Evaluation of Bids

3.23 Opening of Bids by the Institute

3.23.1 **Opening of Technical Bids:** The Purchaser will open all Technical Bids, in the presence of Bidders' representatives who choose to attend the Technical Bid opening. Bidders may depute their Authorised representative (maximum 2 representative from each bidder) to attend the opening of the tender with proper authorization, without which the representative shall not be allowed to attend the tender opening. The Bidder's representatives who are present shall sign a register evidencing their attendance. In the event of the specified date of Bid opening being declared a holiday for the Purchaser, the Bids shall be opened at the appointed time and location on the next working day. No representative of the Bidder/Firm whose offer has not been received before the due date and time of opening of tender or who has not participated in the tender shall be allowed to attend the tender opening.

3.23.2The system integrators 'or Bidders' names, Bid modifications or withdrawals and the presence or absence of requisite Bid Security and such other details as IITM, at its discretion, may consider appropriate, will be announced at the Bid opening. No bid shall be rejected at bid opening, except for late bids.

3.23.3 Bids (and modifications sent) that are not opened at Bid Opening shall not be considered further for evaluation, irrespective of the circumstances.

3.23.4 **Opening of Price Bids:** Price Bids of Technically qualified bidders will be opened and compared after the technical evaluation has been completed.

3.23.5**Announcement of Bids**: The Financial Bids will be opened, in the presence of Bidders' representatives who choose to attend the Financial Bid opening on date and time to be communicated to all the technically qualified Bidders. The Bidder's representatives who are present shall sign a register evidencing their attendance. The name of Bidder, Bid Prices, Discount, etc. will be announced at the meeting

3.24 Clarification of Bids

3.24.1 During evaluation of the Bids, IITM, at its discretion, may ask the system integrator or Bidder for clarification of its Bid. The request for clarification and the response shall be in writing, and no change in the prices or substance of the Bid shall be sought, offered or permitted.

3.25 Preliminary Examination

3.25.1 IITM will examine the Bids to determine whether they are complete, required formats have been furnished, the documents have been properly signed, and the Bids are generally in order.

3.25.2 IITM reserves the right to accept / reject any or all the bids received at its discretion without assigning any reasons thereof.

3.25.3 Prior to the detailed evaluation, IITM will determine the responsiveness of each Bid to the Bidding Document. For purposes of these Clauses, a responsive Bid is one, which conforms to all the terms and conditions of the Bidding Document without material deviations. Deviations from, or objections or reservations to critical provisions, such as those concerning Bid Security, Applicable Law, Performance Security, Qualification Criteria, Insurance, Warranty, AMC and Force Majeure will be deemed to be a material deviation. IITM's determination of a Bid's responsiveness is to be based on the contents of the Bid itself, without recourse to extrinsic evidence. IITM reserves the right to evaluate the bids on technical & functional parameters including possible visit to inspect live site/s of the system integrator or bidder and witness demos of the system and verify functionalities, response times, etc.

3.26 Evaluation and Comparison of Price Bids

3.26.1. IITM will evaluate and compare the Price bids, which have been determined to be responsive.

3.26.2 Arithmetical errors will be rectified on the following basis. If there is a discrepancy between the unit price and the total price that is obtained by multiplying the unit price and quantity, the unit price shall prevail, and the total price shall be corrected. If the Successful system integrator or Bidder does not accept the correction of the errors, its Bid will be rejected, and its Bid security may be forfeited. If there is a discrepancy between words and figures, the amount in words will prevail.

3.26.3 L1 will be decided on the basis of sum total of the price as quoted in the Price Bid (Format 6.3).

3.26.4 Quotation of Prices for all Items. The system integrator or Bidder should quote for complete consignment of items proposed/listed in this Bid. In case, prices are not quoted by bidder, the Institute reserves the right to reject all such incomplete bids.

3.27 Contacting the IITM

3.27.1 Any effort by a system integrator or Bidder to influence IITM in its decisions on Bid evaluation, Bid comparison or contract award may result in the rejection of the system integrator's or Bidder's Bid.

F. Award of Contract

3.28. Post-qualification

3.28.1 All the Price bids after their evaluation on the parameters mentioned above would be arranged in ascending order and the contract would be awarded to the bidder whose bid has been evaluated to be the lowest.

3.29. Award Criteria

3.29.1 IITM will award the Contract to the successful system integrator or Bidder who has been determined to qualify to perform the Contract satisfactorily, and whose Bid has been determined to be responsive, and is the lowest evaluated Bid.

3.29.2 IITM reserve the right to increase or decrease the quantity / scope as per the Institutes requirement.

3.30. IITM's right To Accept Any Bid and to reject any or All Bids.

3.30.1 IITM reserves the right to accept or reject any Bid in part or in full, and to annul the Bidding process and reject all Bids at any time prior to contract award without assigning any reason thereof, thereby incurring any liability to the affected system integrator or system integrators or Bidder or Bidders or any obligation to inform the affected system integrator or system integrators or Bidder or Bidders of the grounds for the Institute's action.

3.31. Notification of Award

3.31.1 Prior to expiration of the period of Bid validity, IITM will notify the successful system integrator or Bidder in writing, that its Bid has been accepted.

3.31.2 The notification of award will constitute the formation of the Contract.

3.31.3 Upon the successful system integrator's or Bidder's furnishing of Performance Security, IITM will promptly notify each unsuccessful Bidder and will discharge its Bid security.

3.32. Signing of Contract

3.32.1 At the same time as IITM notifies the successful system integrator or Bidder that its' Bid has been accepted, IITM will send the system integrator or Bidder the Contract Form as per format enclosed incorporating all agreements between the parties.

3.32.2 Successful Bidder shall sign and date the Contract and return it to IITM within **14 days**.

3.33. Performance Security

3.33.1 Performance Security of **10%** in the required format to be submitted by the successful

system integrator or bidder within **7 days**

3.33.2 Failure of the successful system integrator or Bidder to comply with the requirement of Clause 3.31.2 or Clause 3.32.1 shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid security, in which event; IITM may make the award to the next lowest evaluated system integrator or Bidder or call for new Bids.

3.33 Corrupt or Fraudulent Practices

The Institute requires that the Institute as well as Vendor under this contract observe the highest standard of ethics during the procurement and execution of such contracts. In pursuance of this policy, the Institute shall reject a proposal for award if it determines that the vendor recommended for award after financial evaluation has engaged in corrupt or fraudulent practices in competing for the contract in question. It shall declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded a Institute Contract if any time it determines that the firm has engaged in corrupt or fraudulent practice in competing for, or in executing, a contract.

The Integrity pact as per format 6.13 should be signed and submitted along with the technical bid.

Note: Not withstanding anything said above, IITM reserves the right to reject / award the contract to any system integrator or vendor or cancel the entire process without assigning reasons thereto.

3.34 Ministry of Earth Sciences is also proposing to set up a Data Center at National Centre for Medium Range Weather Forecasting (NCMRWF), Noida (UP) to house their HPC System. Institute reserve right to add the scope of it in the tender.

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PART 4.- TERMS AND CONDITIONS OF CONTRACT (TCC)

TABLE OF CLAUSES

4.1. **Definition**

In this Contract, the following terms shall be interpreted as indicated:

4.1.1 Solution" means supply, installation, testing, commissioning, training and maintenance of all the components of the Data Center seamlessly integrated to work together to meet the Technical and functional requirements of the Institute indicated in this document.

4.1.2 "Supplier" is the successful Bidder who has been determined to qualify to perform the Contract satisfactorily, and whose Bid has been determined to be substantially responsive, and is the lowest evaluated Bid.

4.1.3 "The Contract" means the agreement entered into between the Institute and the Supplier, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein;

4.1.4 "The Contract Price" means the price payable to the Supplier under the Contract for the full and proper performance of its contractual obligations;

4.1.5 "The Product" means all of the software or softwares, all hardware, database, middleware, operating systems, equipments/machinery and/or other materials which the Supplier is required to supply to the Institute under the Contract;

4.1.6 "The Services" means those services ancillary to the supply of the Products, such as transportation and insurance, installation, commissioning, customization, provision of technical assistance, training, Maintenance and other such obligations of the Supplier covered under the Contract;

4.1.7 "TCC" means the Terms and Conditions of Contract contained in this section;

4.1.8 "The Project Site" means the building of IITM located at Dr. Homi Bhbha Road, Pashan Pune – 411008 (INDIA).

4.1.9 'System' means a Computer System consisting of all Hardware, Software, etc., which should work together to provide the services as mentioned in the Bid and to satisfy the Technical and Functional Specifications mentioned in the Bid.

4.1.10 Software' means Application/System software, Database, Middleware and other third party utilities which will seamlessly integrate with the environment described in this document without any hitch or hindrance.

4.1.11 'Site' shall mean site of Contract work as shown on the Drawings and any other land allotted by the Director IITM Pune for specific use during this Contract period.

4.1.12 'Contract' shall mean the notice inviting the Tender, Articles of Agreement, Contract conditions, special conditions, schedules, specifications in the form of Tender document including (not limited to) terms/ conditions. Drawings, specifications, price schedules attached here to and duly signed by Director IITM PUNE and Contractor including such deviations to Tender terms signed and accepted by both Director IITM PUNE and Contractor, as per Contract document and accepted correspondence/ corrections/ communications etc.

4.1.13 'Specifications' shall mean any terms specifying Director IITM PUNE requirements pertaining to the Contract - technical/ commercial/ others annexed to the Contract including detailed specifications, drawings, general/ special conditions of Contract.

4.1.14 **'Contract Amount/ Value'** Total amount/ value of the work under the scope of Contract.

4.1.15 **'Plant, Equipment, Work'** This shall mean and include material, plant and equipment to be supplied and/ or erected by the Bidder or any other related work under the Contract.

4.1.16 'Tests' shall mean all the tests to be carried out during pre-commissioning/ on completion/ manufacturer's works as per this Contract and as per relevant IS specifications.

4.1.17 **'**Engineer' shall mean the person approved by the Institute, acting under the orders of Director IITM Pune. The Contractor shall offer the Engineer every facility and assistance. The Engineer will have power to give notice to the Contractor/ their representative regarding non-approval of work; and such work shall be suspended/ discontinued till written decision of the Institute is obtained

4.1.18 **'**Notice in writing' shall mean a communication written by hand, typed or printed characters given to authorized employee of Contractor.

In case of a difference of opinion on the part of the Bidder in comprehending and/or interpreting any Clause / Provision of the Bid Document after submission of the Bid, the interpretation by the Institute shall be binding and final on the Bidder.

4.2. Country of Origin / Eligibility of Goods & Services

4.2.1 All goods and related services to be supplied under the Contract shall have their origin in eligible source countries, as per the prevailing Import Trade Control Regulations in India.

4.2.2 For purposes of this clause, "origin" means the place where the goods are mined, grown, or manufactured or produced, or the place from which the related services are supplied. Goods are produced when, through manufacturing, processing or substantial and major assembly of components, a commercially-recognized product results that is substantially different in basic characteristics or in purpose or utility from its components.

4.2.3 The Origin of goods and services is distinct from the nationality of the Bidder.

4.3 Standard

4.3.1. The Goods supplied under this Contract shall conform to the standards mentioned in the Technical Specifications, and, when no applicable standard is mentioned, to the authoritative standards appropriate to the Goods' country of origin. Such standards shall be the latest issued by the institution concerned.

4.3.2 Makes of the standard bought-out equipment: The make of the bought-out/ standard products are specified in the Tender. In case some other equivalent makes are to be used, the Contractor shall specify makes of the equipment offered. These shall be reputed makes and shall be subject to the approval of Director IITM PUNE. The Manufacturer's drawings and catalogues shall be submitted in 4 sets, within 4 weeks of date of award of the order or letter of intent. In any case this shall be before actual installation/ use of the equipment/ material at site. The operating instructions & maintenance manuals shall be handed over immediately on commissioning.

4.4 Use of Contract Documents and Information

4.4.1 The Supplier shall not, without the Institute's prior written consent, disclose the Contract, or any provision thereof, or any specification, plan, drawing, pattern, sample or information furnished by or on behalf of the Institute in connection therewith, to any person other than a person employed by the Supplier in the performance of the Contract. Disclosure to any such employed person shall be made in confidence and shall extend only as far as may be necessary for purposes of such performance.

4.4.2 The Supplier shall not, without the Institute's prior written consent, make use of any document or information for purposes of performing the Contract.

4.4.3 Any document, other than the Contract itself, shall remain the property of the Institute and shall be returned (in all copies) to the Institute on completion of the Supplier's performance under the Contract, if so required by the Institute.

4.4.4 The bidder shall sign a non disclosure agreement as per format 6.2

4.5. Patent Rights

4.5.1 In the event of any claim asserted by a third party of infringement of copyright, patent, trademark, industrial design rights, etc. arising from the use of the Goods or any part thereof in India, the Supplier shall act expeditiously to extinguish such claim. If the Supplier fails to comply and the Institute is required to pay compensation to a third party resulting from such infringement, the Supplier shall be responsible for the compensation to claimant including all expenses, court costs and lawyer fees. The Institute will give notice to the Supplier of such claim, if it is made, without delay. The supplier shall indemnify the Institute against all third party claims.

4.6 Performance Security

4.6.1 Within the period **of 7 days** from Date of receipt of notification of Contract award, the Supplier shall furnish to the Institute, the Performance Security for an amount of **10% of** Contract value valid till the completion of the work (i.e till the time the Institut's issue of a Completion certificate).

4.6.2 The proceeds of the performance security shall be payable to the Institute as compensation for any loss resulting from the Supplier's failure to complete its obligations under the Contract.

4.6.3 The Performance Security shall be denominated in Indian Rupees and shall be by way of Demand draft payable in favor of The Director Indian Institute of Tropical Meteorology, Pune payable At Pune and issued by a commercial bank in India, acceptable to the Institute.

4.6.4 The performance security will be discharged by the Institute and returned to the Supplier as per the period specified in the clause above.

4.7 Inspection and Quality Control Tests

4.7.1 The Institute reserves the right to carry out pre-shipment inspection by a team of Institute

officials, of any of the existing live installations of the Supplier referred to in the Technical Bid or demand a demonstration of the solution proposed on a representative model in bidder's office.

4.7.2 The Institute's right to inspect, test and where necessary reject the products after the products arrival at the destination shall in no way be limited or waived by reason of the products having previously being inspected, tested and passed by the Institute or its representative prior to the products shipment from the place of origin.

4.7.3 Nothing stated hereinabove shall in any way release the supplier from any warranty or other obligations under this contract.

4.7.4 **Manuals**

4.7.4.1 Before the products / system is / are taken over by the Institute, the Supplier shall supply technical / systems Manuals for all the Software supplied and for all required interfaces. Operation and maintenance Manuals for all the systems and applications covering the operations needed to start, run, other operations, transfer to fall back system including business continuity plan to be provided by the vendor. The manuals shall be in English.

4.7.4.2 Unless and otherwise agreed the products and equipment shall not be considered to be completed for the purpose of taking over until such manuals have been supplied to the Institute.

4.7.4.3 The Supplier shall provide one set of Design Manual, System Manual, User manual and Security Manual for the Application Software. The Supplier shall also provide one soft copy of each of the manuals. Soft and hard Copy Manuals shall commensurate with number of installations of Products in the Institute.

4.8 For the System & other Software, the following will apply:

The supplier shall provide complete and legal documentation of all subsystems, licensed operating systems, licensed system software, licensed utility software and other licensed software. The supplier shall also provide licensed software for all software products whether developed by it or acquired from others. The supplier shall also indemnify the Institute against any levies / penalties on account of any default in this regard.

In case the primary vendor is coming with software which is not his proprietary software then the primary vendor must submit evidence in the form of agreement he has entered into with the software vendor which includes support from the software vendor for the proposed software for the full period required by the Institute.

4.9 Acceptance Procedure:

4.9.1 On successful completion of installation, commissioning, acceptability test, receipt of deliverables, etc., and **after the solution runs successfully for six months after going live** and Institute is satisfied with the working on the system, the acceptance

certificate (as mutually decided and approved by the Institute) signed by the Supplier, Institute's Consultants and the representative of the Purchaser will be issued. The date on which such certificate is signed shall be deemed to be the date of successful commissioning of the systems.

4.10 Packing of Products

4.10.1 The Supplier shall provide such packing of the products as is required to prevent their damage or deterioration during transit to their final destination. The packing shall be sufficient to withstand, without limitation, rough handling during transit and exposure to extreme temperature, salt and precipitation during transit and open storage. Size and weights of packing case shall take into consideration, where appropriate, the remoteness of the Products final destination and the absence of heavy handling facilities at all transit points.

4.10.2 Packing Instructions: The Supplier will be required to make separate packages for each Consignment. Each package will be marked on three sides with proper / indelible ink with the following:
(i) Project; (ii) Contract No.; (iii) Country of Origin of products; (iv) Supplier's Name; (v) Packing List reference number.

4.11 Delivery and Documents

4.11.1 Delivery of the Products / Software shall be made by the supplier in accordance with the system approved / ordered. The details of the documents to be furnished by the Supplier are specified hereunder:-

i. 3 copies of Supplier's Invoice showing Contract number, Products description, quantity, unit price and Total amount.

ii. Delivery Note or acknowledgement of receipt of Products from the Consignee or in case of products from abroad original and two copies of the negotiable clean Airway Bill.

iii. 2 copies of packing list identifying contents of each package.

iv. Insurance Certificate.

v. Manufacturer's / Supplier's warranty certificate.

vi. Inspection certificate issued by the nominated inspection agency, if any, and the Supplier's factory inspection report and Quality Control Test Certificates.

vii. Certificate of Origin.

The above documents shall be received by the Institute before arrival of Products (except where it is handed over to the Consignee with all documents) and if not received the Supplier will be responsible for any consequent expenses.

4.12 Insurance

4.12.1 The insurance shall be in an amount equal to 110 percent of the value of the Products from "Warehouse to final destination" on "All Risks" basis including War Risks and Strikes, valid for a period not less than 3 months after installation and commissioning and issue of acceptance certificate by the Institute. Even during the course of execution of the work, the contractor shall obtain the CAR policy at 110% of the total contract price and all the other necessary insurance policies including third party insurance at Rs. 5,00,000/- per occurrence for a maximum of three occurrences against all the possible calamities.

4.12.2 Should any loss or damage occur, the Supplier shall:-

a. initiate and pursue claim till settlement and

b. promptly make arrangements for repair and / or replacement of any damaged item irrespective of settlement of claim by the underwriters.

INSURANCE OF WORKS/ LABOURS

The contractor must take comprehensive insurance policy to cover his works, labours against all risks and include the cost of his policy in the tender price.

The Contractor shall at his own expense, without limiting his liabilities and obligations under any provisions of the Contract, effect and maintain until the completion of the Contract such insurance policies as are required under the Employee's State Insurance Act (ESI), the Factories' Act and any other Labour Law as may be applicable.

The Contractor shall procure such insurance policies with an insurance company as approved by the Director IITM Pune, against all risks in respect of which the Contractor is required under this clause to indemnify the Director IITM Pune, in particular, the Contractor shall effect and maintain an insurance policy of at least Rs.5.00 lakhs for per person engaged for the execution and completion of Work, Rs.5.00 lakhs per accident for injury or death and at least Rs.5.00 lakhs per accident for any damage caused to any third party property and the Contractor shall adequately indemnify the Director IITM Pune against all such third party accident/damage, losses or claims which may arise in respect of the Work or in consequence thereof.

The Contractor shall also maintain adequate insurance/medical policies against all claims which may be made upon the Director IITM Pune whether under the workmen's compensation act or any other statute in force during the currency of the Contract. All such insurance /medical policies shall be in the joint names of the Director IITM Pune and the Contractor and shall be deposited with the Director IITM Pune.

The Contractor shall be responsible for any such damage, loss of person or property or any other claim arising out and incidental to the negligence or failure of the Contractor or Contractor's personnel to execute the Work in accordance with the Contract, and for all such damages, losses or claims for which the insurance policies as stated above have not been procured by the Contractor.

FIRE INSURANCE

Unless otherwise instructed by the Employer, the Contractor shall on signing the Contract, insure the Work(s) and the materials to be used for the execution and completion of the Work and keep them insured until the virtual completion of the Contract, against any loss or damage arising due to fire and/or earth-quake

Such insurance policy shall be with an insurance company as approved by the Employer and shall be in the joint names of the Employer and the Contractor and for such amount and the consultants fees and for any further sum if called upon to do so by the employer the premium of such further sum being allowed to the contractor as an authorized extra. Such policy shall be adequate to cover the property of the Employer lying on the Site and the Consultant's fees in connection with the Consultant's services generally in the reinstatement and shall not cover any property of the Contractor or of any Sub-contractor or employees. The Contractor shall deposit such policies and receipts for the premium with the Employer within twenty-one days from the date of signing the Contract unless otherwise instructed by the Employer. In the event of any default of the Contractor in insuring, as provided above, the Employer may so insure and may deduct the premiums paid from any money due or which may become due to the Contractor. The Contractor shall, as soon as the claim under the policy is settled, or the work is reinstated by the insurance office should they elect to do so, proceed with all due diligence of the completed Work(s) to ensure that the Work is fully replaced and restored in the same manner as though the fire or any other event which had caused such destruction had not occurred and the Work in all respects complies with conditions and specifications of the Contract. The Contractor, in case of rebuilding, replacing or reinstatement after fire, shall be entitled to such extension of time for completion as the Employer may deem fit.

4.13 Transportation

4.13.1 Where the Supplier is required under the Contract to transport the Goods to a specified place of destination within India, defined as the Project Site, transport to such place of destination in India, including insurance and storage, as shall be specified in the Contract, shall be arranged by the Supplier, and the related costs shall be included in the Contract Price.

4.14 Incidental Services

4.14.1 The incidental services to be provided are as under:-

(a) Furnishing Manuals for each appropriate unit of the Supplied Products as mentioned under the relevant Clauses.
(b) Maintenance and software updates of the supplied Products, Technicalsupport thereof for a period as specified in the relevant Clause after expiry of the warranty provided that this service shall not relieve the Supplier of any warranty obligations under this contract.

4.15 Warranty

4.15.1 The Supplier warrants that the products supplied under the Contract are of the most recent

version and that they incorporate all recent improvements in design and / or features. The Supplier further warrants that all the Products supplied under this Contract shall have no defect, arising from design or from any act of omission of the Supplier that may develop under normal use of the supplied products in the conditions prevailing in India

4.15.2 The minimum warranty period shall be **36 months** from the date of commissioning & acceptance of the work in totality. The Supplier shall in addition comply with the performance guarantees specified under the Contract. If, for reasons attributable to the Supplier, these guarantees are not attained inwhole or inpart the Supplier shall make such changes, modifications and / or additions to the Products or any part thereof as may be necessary in order to attain the contractual guarantees specified in the Contract at its own cost and expense and to carry out further performance tests.

4.15.3 The Institute shall promptly notify the Supplier in writing of any claims arising under this warranty.

4.15.4 Upon receipt of such notice the Supplier shall with all reasonable speed, repair or replace the defective products or part thereof without cost to the Institute. The response time should not be more than **half an hour** and the resolution time should **not be more than 4 hours**.

4.15.5 If the Supplier, having been notified, fails to remedy the defect(s) within the period specified above, the Institute may proceed to take such remedial action as may be necessary, at the Supplier's risk and expense and without prejudice to any other rights, which the Institute may have against the supplier under the Contract.

4.15.6 Preventive Maintenance of equipments like UPS, AC, Generator etc. for all the products will be within the scope and needs to be undertaken by the bidder

4.15.7 During the warranty period vendor shall repair/replace at the installed site, at no charge to Institute, all defective components that are brought to the Vendor's notice. Warranty should not become void, if Institute buys, any other supplemental hardware from a third party and installs it within these machines under intimation to the vendor. However, the warranty will apply to such supplemental hardware items installed.

4.15.8 Uptime

a) During Warranty Period/AMC, Supplier guarantees an **Uptime of 99.9 %** on quarterly basis for the entire turnkey solution provided.

4.16 Maintenance Service

4.16.1 The Supplier shall provide free maintenance services during the period of warranty. After warranty period, the Supplier will do annual maintenance of the entire system, for a period of **3** years after the defect liability period (Warranty) of 36 months. **The cost of AMC will be considered for evaluating the L-1 criteria in the price bid.** During the period of AMC, if the service provided by the bidder is not satisfactory, the Institute reserves the right to terminate the AMC contract and appoint any other agency. During the period of AMC, the bidder to submit Bank guarantee from Nationalized / Scheduled Bank in

India, equivalent to the 10% amount quoted in the AMC contract per year for a period of 3 years.

4.16.2 During maintenance period also, the Supplier guarantees on quarterly basis an uptime of 99.9% of the entire solution provided. Accordingly it is expected that necessary redundancy is built into the provided solution for all components whether software or hardware and response time for maintenance complaint from the site installation should be kept minimum so as to maintain uptime of 99.9.

4.17 Training

4.17.1 **Vendor has to provide training to IITM Technical Staff as an when requested by the Institute.**

4.18. **PAYMENT TO THE CONTRACTOR'S:-**

(1) Payment term for Major Equipment like UPS/Batteries, D.G Sets, Precision AC units, Transformer, FM 200 cylinders, Electrical HT / LT Panels, Racks, CCTV equipments

(a) PAYMENT: 60% payment against delivery of the equipment,
(b) 30% payment shall be released after completion of satisfactory installation, commissioning, demonstration of the Data Center
(c) Balance 10% will be released upon receipt of Bank Guarantee from Indian nationalized / commercial bank for 10% of total Order value towards performance bank guarantee to be valid for the period of warranty including extension if any, from the date of installation.. If no Bank Guarantee is given, the balance 10% will be paid after assessing, after sales service during warranty period i.e. payment after warranty period.

(2) Other items
(a) 90% payment shall be released after completion of satisfactory installation, commissioning, demonstration of the Data Center
(b) Balance 10% will be released upon receipt of Bank Guarantee from Indian nationalized / commercial bank for 10% of total Order value towards performance bank guarantee to be valid for the period of warranty including extension if any, from the date of installation.. If no Bank Guarantee is given, the balance 10% will be paid after assessing, after sales service during warranty period i.e. payment after warranty period.
(3) Services payment schedule - Quarterly payment against satisfactory performance as per SLA

4.19 Prices

4.19.1 Prices payable to the Supplier as stated in the Contract shall be firm and not subject to adjustment during performance of the Contract, irrespective of reasons whatsoever, including exchange rate fluctuations, changes in taxes, duties, levies, charges, etc. The contractor shall consider in the bid all the taxes such as VAT, Service tax, Professional tax, Octroi, Central excise duties, levies, Insurance, freight charges, transportation charges &

related taxes etc. Please note that under no circumstances, the addition of any taxes, duties or levies shall be allowed post opening of the bids.

4.20 Change Orders

4.20.1 The Institute may, at any time, by a written order given to the Supplier, make changes within the general scope of the Contract in any one or more of the following:

(a) Method of shipment or packing;
(b) Place of delivery;
(c) Technical and functional specifications
(d) Services to be provided by the Supplier.

4.20.2 If any such change causes an increase or decrease in the cost of, or the time required for the Supplier's performance of any provisions under the Contract, an equitable adjustment shall be made in the Contract Price or delivery schedule, or both, and the Contract shall accordingly be amended. Any claims by the Supplier for adjustment under this clause must be asserted within **thirty (30) days** from the date of Supplier's receipt of Institute's change order.

4.21 Contract Amendments

4.21.1 No variation in or modification of the terms of the Contract shall be made, except by written amendment, signed by the parties.

4.22 Assignment

4.22.1 The Supplier shall not assign, in whole or in part, its obligations to perform under the Contract, except with the Institute's prior written consent.

4.23 Delays in the Supplier's Performance

4.23.1 Delivery, installation, commissioning of the Products/Solution and performance of Services shall be made by the ***Supplier*** in accordance with the time schedule prescribed by the Institute.

4.23.2 If at any time during performance of the Contract, the ***Supplier*** or its subcontractor(s) should encounter conditions impeding timely delivery of the Products and performance of Services, the ***Supplier*** shall promptly notify the Institute in writing of the fact of the delay, it's likely duration and its cause(s). As soon as practicable after receipt of the ***Supplier***'s notice, the Institute shall evaluate the situation and may, at its discretion, extend the ***Supplier***s' time for performance, with or without liquidated damages, in which case, the extension shall be ratified by the parties by amendment of the Contract

4.23.3 Except as provided in the above clause, a delay by the ***Supplier*** in the performance of its delivery obligations shall render the ***Supplier*** liable to the imposition of liquidated damages, unless an extension of time is agreed upon without the application of liquidated damages.

4.24 PENALTY / Liquidated Damages

4.24.1 Delay in Delivery - If the **Supplier** fails to deliver any or all of the Products or perform the Services within the time period(s) specified in the Contract, the Institute shall, without prejudice to its other remedies under the Contract, deduct from the Contract Price, as liquidated damages, a sum equivalent to 1.0% per week or part thereof of contract price subject to maximum deduction of 10% of the delivered price of the delayed Products or unperformed services for each week or part thereof of delay, until actual delivery or performance. Once the maximum deduction is reached, the Institute may consider termination of the Contract.

4.24.2 Delay in Completion of Contract: - The penalty shall be 1% of total Contract value per week or part thereof subject to a maximum of 10% of the total Contract value for the delay beyond the agreed completion dates for various stages / phases. If during the course of the Contract it is clear to the Director IITM Pune that the project is delayed by more than 5 weeks due to reasons totally attributable to the Contractor, the Director IITM Pune shall have right to terminate the Contract or get part or whole of the remaining work executed by some other agency at the Contractor's risk and cost, besides applying the penalty for delay caused to the project.

4.24.3 For Non Maintaining uptime / performance of Service during Warranty period

Sr. No.	Availability (On quarterly basis)	Non-performance deduction in each case
1	99.9 % or above	No deduction
2	Less than 99.9 % & up to 95%	3% of the contract value for the month excluding taxes.
3	Less than 95 %	8% of the contract value for the month excluding taxes.

Liability: The total Liability of the supplier is limited to the total value of the contract.

4.24.3 For Non Maintaining uptime / performance of Service during Comprehensive AMC period

Sr. No.	Availability (On quarterly basis)	Non-performance deduction in each case
1	99.9 % or above	No deduction
2	Less than 99.9 % & up to 95%	3% of the contract value for the month excluding taxes.
3	Less than 95 %	8% of the contract value for the month excluding taxes.

Liability: The total Liability of the supplier is limited to the total value of Comprehensive AMC contract.

4.25 Termination for Default

4.25.1 The Institute, without prejudice to any other remedy for breach of Contract, by a written notice of default sent to the ***Supplier***, may terminate the Contract in whole or in part:

(a) If the ***Supplier*** fails to deliver any or all of the Products and Services within the period(s) specified in the Contract, or within any extension thereof granted by the Institute;

Or

(b) If the ***Supplier*** fails to perform any other obligation(s) under the Contract.

4.25.2 In the event the Institute terminates the Contract in whole or in part, it may procure, upon such terms and in such manner as it deems appropriate, Products and Services similar to those undelivered, and the ***Supplier*** shall be liable to the Institute for any excess costs for such similar Products or Services. However, the ***Supplier*** shall continue performance of the Contract to the extent not terminated.

4.26 Force Majeure

4.26.1 Notwithstanding the provisions of TCC, the ***Supplier*** shall not be liable for forfeiture of its performance security, liquidated damages, or termination for default if and to the extent that its delay in performance or other failure to perform its obligations under the Contract is the result of an event of Force Majeure.

4.26.2 For purposes of this clause, "Force Majeure" means an event beyond the control of the ***Supplier*** and not involving the ***Supplier***'s fault or negligence and not foreseeable. Such events may include, but are not restricted to, acts of the Institute in its sovereign capacity, wars or revolutions, fires, floods, epidemics, quarantine restrictions, and freight embargoes.

4.26.3 If a Force Majeure situation arises, the ***Supplier*** shall promptly notify the Institute in writing of such condition and the cause thereof. Unless otherwise directed by the Institute in writing, the ***Supplier*** shall continue to perform its obligations under the Contract as far as is reasonably practical, and shall seek all reasonable alternative means for performance not prevented by the Force Majeure event.

4.27 Termination for Insolvency

4.27.1The Institute may, at any time, terminate the Contract by giving written notice to the Supplier if the Supplier becomes Bankrupt or otherwise insolvent. In this event, termination will be without compensation to the Supplier, provided that such termination will not prejudice or affect any right of action or remedy, which has accrued or will accrue thereafter to the Institute.

4.28 Termination for Convenience

4.28.1 The Institute, by written notice sent to the Supplier, may terminate the Contract, in whole or in part, at any time for its convenience. The notice of termination shall specify that termination is for the Institute's convenience, the extenttowhich performanceof the Supplier under the Contractis terminated, and the date upon which such termination becomes effective.

4.29 Resolution of Disputes

4.29.1 The Institute and the Supplier shall make every effort to resolve amicably by direct informal negotiation, any disagreement or dispute arising between them under or in connection with the Contract.

4.29.2 If, the Institute and the Supplier have been unable to resolve amicably a Contract dispute even after a reasonably long period, either party may require that the dispute be referred for resolution to the formal mechanisms specified herein below. These mechanisms may include, but are not restricted to, conciliation mediated by a third party and/or adjudication in an agreed national forum.

4.29.3 The dispute resolution mechanism to be applied shall be as follows:

(a) In case of Dispute or difference arising between the Institute and the Supplier relating to any matter arising out of or connected with this agreement, such disputes or difference shall be settled in accordance with the Arbitration and Conciliation Act, 1996. Where the value of the Contract is above Rs.1.00 Crore, the arbitral tribunal shall consist of 3 arbitrators, one each to be appointed by the Purchaser and the Supplier. The third Arbitrator shall be chosen by mutual discussion between the Purchaser and the Supplier.

(b) Arbitration proceedings shall be held at **Pune,** and the language of the arbitration proceedings and that of all documents and communications between the parties shall be English;

(c) The decision of the majority of arbitrators shall be final and binding upon both parties. The cost and expenses of Arbitration proceedings will be paid as determined by the arbitral tribunal. However, the expenses incurred by each party in connection with the preparation, presentation, etc., of its proceedings as also the fees and expenses paid to the arbitrator appointed by such party or on its behalf shall be borne by each party itself; and

4.30 Governing Language

4.30.1 The governing language shall be English.

4.31 Applicable Law

4.31.1 The Contract shall be interpreted in accordance with the laws of the Union of India and the Bidder shall agree to submit to the courts under whose exclusive jurisdiction the Registered Office of the Institute falls.

LABOUR LAWS

The contractor shall abide by the provisions of state/ central govt. / local labour laws and discharge his obligations towards any liability arising out of such laws in respect of his workers/ sub contractors workers. In case, the contractor fails to comply with the law requirements, the Director IITM PUNE will have to intervene and settle the demands/ disputes of the contractor or his sub contractors labour and debit the cost to the contractors' account. The contractor shall maintain all such records for the attendance of his

labour/ other people as may be required. In no case, the same would be mixed up with records of the Director IITM Pune/ his other contractors.

4.32 Addresses for Notices

4.32.1 The following shall be the address of the Institute and Supplier.

Institute's address for notice purposes:
Indian Institute of Tropical Meteorology,
Dr. Homi Bhabha Road,
Pashan, Pune – 411008
India

Supplier's address for notice purposes (To be filled in by the Supplier)

……

4.32.2 A notice shall be effective when delivered or on effective date of the notice whichever is later.

4.33 Taxes and Duties

4.33.1 The Supplier will be entirely responsible for all applicable taxes, duties, levies, charges, license fees, road permits, etc. in connection with delivery of products at site including incidental services and commissioning.

4.33.2 **Tax deduction at Source:** Wherever the laws and regulations require deduction of such taxes at the source of payment, the Institute shall effect such deductions from the payment due to the Supplier. The remittance of amounts so deducted and issuance of certificate for such deductions shall be made by the Institute as per the laws and regulations in force. Nothing in the Contract shall relieve the Supplier from his responsibility to pay any tax that may be levied in India on income and profits made by the Supplier in respect of this contract.

4.34 Supplier's Integrity

The ***Supplier*** is responsible for and obliged to conduct all contracted activities in accordance with the contract using state-of-the-art methods and economic principles and exercising all means available to achieve the performance specified in the Contract.

4.35 Supplier's obligations

The ***Supplier*** is obliged to work closely with the Institute's staff, act within its own authority and abide by directives issued by the Institute and implementation activities.

The ***Supplier*** will abide by the job safety measures prevalent in India and will free the Institute from all demands or responsibilities arising from accidents or loss of life, the cause of which is the ***Supplier***'s negligence. The ***Supplier*** will pay all indemnities arising from such incidents and will not hold the Institute responsible or obligated.

The Supplier is responsible for managing the activities of its personnel or sub-contracted personnel and will hold itself responsible for any misdemeanors.

The Supplier will treat as confidential all data and information about the Institute, obtained in the execution of his responsibilities, in strict confidence and will not reveal such information to any other party without the prior written approval of the Institute.

4.36 Patent Rights/Intellectual Property Rights

In the event of any claim asserted by a third party of infringement of trademark, trade names, copyright, patent, intellectual property rights or industrial design rights arising from the use of the Products or any part thereof in India, the Supplier shall act expeditiously to extinguish such claim. If the Supplier fails to comply and the Institute is required to pay compensation to a third party resulting from such infringement, the Supplier shall be responsible for the compensation including all expenses, court costs and lawyer fees. The Institute will give notice to the Supplier of such claim, if it is made, without delay.

4.37 Site preparation and installation

The Institute will designate the installation site before the scheduled installation date, to allow the Supplier to perform a site inspection to verify the appropriateness of the site before the installation / commissioning of the hardware & software.

4.38 Installation/Commissioning of Hardware/Software

The Supplier is responsible for all unpacking and installation of Products. The Supplier will test all hardware/system operations and accomplish all adjustments necessary for successful and continuous operation of the hardware/software at all installation sites.

4.39 Technical Documentation

The Technical Documentation involving detailed instruction for operation and maintenance of the hardware (if any) and software is to be delivered. The language of the documentation should be English.

4.40 Discretionary Right to use the product till replacement

If after delivery, acceptance and installation and within the guarantee and warranty period, the operation or use of the product is found to be unsatisfactory, the Institute shall at its discretion may have the right to continue to operate or use such product until rectification of defects, errors or omissions by partial or complete replacement is made without interfering with the Institute's operation.

4.41 Safety and Labour laws:-

CONTRACTOR shall comply with the provision of all laws including Labour Laws, rules, regulations and notifications issued there under from time to time. All safety and labour laws enforced by statutory agencies and by local bodies shall be applicable and the

compliances of the same shall be the sole responsibility of the bidder under the performance of this CONTRACT and CONTRACTOR shall abide by these laws.

CONTRACTOR shall take all measures necessary or proper to protect the personnel, work and facilities and shall observe all reasonable safety rules and instructions. No smoking shall be permitted outside the living quarters, and welding jobs will be carried out with full safety precautions. The contractor's employees also shall comply with safety procedures/policy.

The CONTRACTOR shall report as soon as possible any evidence which may indicate or is likely to lead to an abnormal or dangerous situation and shall take all necessary emergency control steps to avoid such abnormal situations. Moreover the contractor shall get the entire necessary work site, employees and his personnel insured under CAR policy. However, that such liability shall be limited to 110% of the CONTRACT Price and other necessary insurance schemes as well as the acts such as Workmen's compensation Act, ESI Act & PF Act under the relevant acts of the Government as required for the execution of the project and shall consider the amounts arising out of the same in the bid quoted.

4.42 INDEMNITY AGREEMENT:

INDEMNITY BY CONTRACTOR:

CONTRACTOR shall indemnify and keep indemnified the Institute, from all actions, proceedings suits, claims, demands, liabilities, damages, losses, costs, charges, expenses(including without limitation, wreck or debris, removal costs, where wreck or debris removal is ordered by a competent authority) judgments and fines arising out of or in the course of or caused by the execution of work under the CONTRACT or other obligations hereunder directly or indirectly associated herewith including but not limited to :

a) Personal injury, illness or death of :

i) Any of Contractor's or subcontractor's personnel (even if caused by or contributed to by the negligence or fault and

ii) Subject to clause 17.2 (a) (I) any other person to the extent the injury, illness or death is caused by the negligence or fault of the Contractor or Contractor's personnel or subcontractors or subcontractor's personnel and

b) Loss or damage to :

i) Any property owned, hired or supplied by Contractor or Contractor's personnel or subcontractors or subcontractor's personnel including Constructional Plant (even if caused by, or contributed to by, the negligence or fault or

iii) Subject to clause 17.2 (b) (I) any other property to the extent the loss or damage is caused by the negligence or fault of the Contractor or Contractor's personnel or subcontractors or subcontractor's personnel.

4.43 ARBITRATION:

Except as otherwise provided elsewhere in the CONTRACT if any dispute, difference, question or disagreement arises between the parties here to or the respective representatives or assignees, at any time in connection with construction, meaning, operation, effect, interpretation or out of the CONTRACT or breach thereof the same shall be decided by an Arbitral Tribunal consisting of three Arbitrators. Each party shall appoint one Arbitrator and the Arbitrators so appointed shall appoint the third Arbitrator who will act as presiding Arbitrator.

In case a party fails to appoint an arbitrator within 30 days from the receipt of the request to do so by the other party or the two Arbitrators so appointed fail to agree on the appointment of third Arbitrator within 30 days from the date of their appointment, upon request of a party, the Chief Justice of India or any person or institution designated by him (in case of International Commercial Arbitration) shall appoint the Arbitrators/ Presiding Arbitrator. In case of domestic contracts, the Chief Justice of the High Court or any person or institution designated by him within whose jurisdiction the subject purchase order/contract has been placed/made, shall appoint the Arbitrator/ Presiding Arbitrator upon request of one of the parties.

If any of the Arbitrators so appointed dies, resigns, incapacitated or withdraws for any reason from the proceedings, it shall be lawful for the concerned party/arbitrators to appoint another person in his place in the same manner as aforesaid. Such person shall proceed with the reference from the stage where his predecessor had left if both parties consent for the same; otherwise, he shall precede de novo.

It is a term of the CONTRACT that the party invoking arbitration shall specify all disputes to be referred to arbitration at the time of invocation of arbitration and not thereafter.

It is also a term of the Agreement that neither party to the Agreement shall be entitled for any antelate (pre-reference) or pendente-lite interest on the amount of the award.

The Arbitral Tribunal shall give reasoned award and the same shall be final, conclusive and binding on the parties.

The venue of the arbitration shall be the place from where the Agreement has been placed.

The fees of the arbitrators shall be borne by the parties nominating them and the fee of the presiding Arbitrator, costs and other expenses incidental to the arbitration proceedings shall be borne equally by the parties.

Subject to as aforesaid, the provisions of Arbitration and Conciliation Act, 1996 India and any statutory modifications or re-enactment in lieu thereof shall apply to the arbitration proceedings under this clause.

REJECTION CRITERIA

Technical rejection criteria

The following vital technical conditions should be strictly complied with failing which the bid will be rejected:

1.0 Bid should be complete and covering the entire scope of job/ supply and should conform to the technical specifications indicated in the bid documents, duly supported with technical catalogues/ literatures wherever required. Incomplete and non-conforming bids will be rejected outright.

1.1 Bidder should have the required qualified manpower, tools, statuary licenses for installation, testing and commissioning data center facilities.

1.2 Bidder has to quote separately for a comprehensive AMC for the Data Center and also for operational Support **24 X 7 X 365 days for 4th , 5th and 6th year**. These quotes should be for the entire Data Center including all the subsystems given above. Quotes for Comprehensive AMC and Operational support shall be given separately, year-wise.

1.2.1 The prices quoted for Comprehensive AMC and operational Support for 4th, 5th and 6th year will be considered for price evaluation of bids.

1.3 Bidders may take up supply, installation and commissioning of the system components either by themselves or through partner, for services of a System Integrator, for the system components as given above. However, the bidder need to declare it at bidding time and the bidder will be primarily responsible for the turnkey completion of the job and for maintenance and management of the operational support for a period of 36 months and subsequently during Comprehensive AMC period.

1.4 Bidder should specifically confirm that the quoted products i.e. technology/supply is not in the process of being phased out. They should specifically confirm that the hardware / software / technologies are the latest, meeting all the technical specifications and also shall be supported at least for a **period of 6 years** from date of supply.

1.5. Technological Up gradation: Bidder may offer hardware / equipment which has better / improved technology, performance, technical specifications, at no extra cost to Institute. However, before such offers shall be benchmarked and approved by the Institute that they meet the intended for use of the application softwares necessary with the better /improved technology.

1.6 Change in Quantities whether increase / decrease, the quantities for various System Components for all the line item components for which Quotes are available in the commercial Tender. However, these changes, increase/decrease will be appropriately intimated by Institute.

1.7. The quantities and the items given vide the BOM for various System Components have been exhaustively worked out and are strictly for the purpose of bidding for the job, which is approximate in nature as detailed out the RFP. However,

bidder has to agree that it is the responsibility of the bidder for supplying and installing any items, required if any, other than those mentioned in the RFP and with the same quoted rate for any increase / decrease in the quantity, to meet the overall objective of implementing the Data Center. Bidder has to mention in their techno-commercial bid, if any.

4.44 RISK PURCHASE CLAUSE

If in the opinion of the Director IITM Pune, the contractor fails to perform and discharge his obligations at any time during tenure of the contract including maintenance period, the Director IITM PUNE shall give 7 days' notice in writing to the contractor to improve his performance. If the contractor fails the Director IITM PUNE reserve the right to cancel the whole or part of the order and get the same carried out by other agencies at the contractors' risk, cost and responsibilities and recover the costs from the contractors' outstanding bills or security deposit or retention amount.

4.45. SETTLEMENT OF DISPUTE / AMBIGUITIES

In case of disputes/ ambiguities while interpreting any of tender/ contract conditions Director IITM Pune decision in the matter shall be final and binding.

4.46 BENEFICIERY FOR INSURANCE POLICIES

Insurance policies mentioned in the respective clauses shall be taken within 10 days of award of the order/ LOI. Director IITM PUNE shall be the sole beneficiaries for these policies. Copies of these policies shall be produced when asked. If contractor fails to take out these policies within the stipulated period, Director IITM PUNE reserve their right to take out these policies on contractor's behalf and debit the cost to contractors' account

4.47 COMPLIANCE TO STATUTORY RULES / REGULATIONS / ACTS

The contractor will have to comply with all the rules/ regulations/ acts prescribed under the Factories Act, Provident Fund Act, ESI Act, Shops and Establishment Act, Workmen's Compensation Act and such other Acts and labour laws as may be applicable and any liability arising out of non observance of the regulations and Acts in respect of his employees, in respect of this contract work, will have to be fully assumed and met by the contractor. The contractor should ensure that he satisfies all the above regulations acts etc.

4.48. REGULATIONS

The contractor and his employees shall observe all prevailing rules and regulations of working in **IITM, Pune** and modified/ upgraded/ amended from time to time.

4.49. SITE SUPERVISIONS AND SITE INSTRUCTION BOOK

The contractor shall deploy qualified and responsible engineer at site for site supervision and this engineers shall be available at site during working hours to take instructions and answer queries.

4.50. MEETINGS

Senior representative of the contractor along with the site engineer shall attend scheduled site meetings and make himself available for any other meetings with the Director IITM PUNE as and when required at site. The contractor shall co-ordinate his work with those of other agencies and Director IITM PUNE shall decide the priorities.

4.51. MAINTENANCE OF RECORDS

The contractor shall maintain at site proper record of the contracts agreement, drawings, site instructions or any other records as requested by Director IITM PUNE and shall make these available to Director IITM PUNE as and when required during site visits.

Safety instructions are discussed in detail in section 16.

4.52. HOUSE KEEPING

The contractor shall provide proper housekeeping, keep working place neat and clean and store materials neatly and properly at the closure of each day's work. Protecting electrical equipment from other contractor's activities (e.g. Painting, etc.) shall be contractor's responsibility with intimation to safety officers.

4.53. TAC APPROVAL

Installation shall be subject to approval of Tariff Advisory Committee (TAC) of Fire Insurance Association of India. Hence contractor shall use all materials approved by TAC and it would be contractor's sole responsibility to fill in insurance forms, prepare necessary drawings and submit the same to Fire Insurance Authorities and obtain their approval for the electrical installation. Materials under Director IITM PUNE' scope of supply shall be procured from suppliers approved by TAC.

4.54. SAMPLE APPROVAL

Even though the approved makes are mentioned in the tender, it is necessary to get approval for samples of supply items by project consultant as well as by Director IITM Pune. With such promptness as to cause no delay in his work or in that of any other sub-contractor. This shall be delivered free of cost. Work shall be carried out in accordance with approved samples. Sample prior to approval to Director IITM Pune needs to be approved by MSETCL/MSEDCL.

4.55. ACCESS TO THE WORK

The Director IITM Pune and their representatives shall have access to the works and the workshops or other place of the Contractor where work is being carried out for the Contract and when work is to be so prepared in workshops or other places of a Sub-Contractor (whether or not a nominated Sub-Contractor.) at all reasonable times. The

Contractor shall have a term in the Sub-Contract so as to secure a similar right of access to those workshops or placed for the Director IITM Pune and his representatives and shall do all things reasonably necessary to make the right effective.

4.56 Dismissal

The Contractor shall on the request of the Director IITM Pune immediately dismiss from the works any person employed thereof by him who may in the opinion of the Director IITM Pune be incompetent or misconducts himself and such person shall not be again employed on the work without the permission of the Director IITM Pune

Director IITM Pune

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PROJECT INFORMATION / SCOPE

FOR

HT & LT ELECTRICAL WORK, HVAC,

BMS AND INTERIORWORK

INDEX

SECTION –A

PROJECT INFORMATION & SCPOE

NAME OF INSTITUTE	:	DIRECTOR IITM PUNE INDIAN INSTITUTE OF TROPICAL METEOROLOGY,PUNE
PROJECT	:	PROPOSED DATA CENTRE AT PUNE
WORK	:	INTERNAL & EXTERNAL ELCTRICAL WORK OF PROPOSED DATA CENTRE AT PUNE
AVG. RAIN FALL	:	800MM
TEMPERATURES	:	45° C MAX. & 15° C MIN.
INCOMING SUPPLY	:	22kV 3 PHASE
DISTRIBUTION	:	415 V 3 PHASE, 4 WIRE

DETAILED SCOPE OF WORK:

1. This Specification covers the requirements of HT & LT Supply, Installation, Testing and Commissioning (SITC) of electrical equipment and accessories mentioned as here under and the attached Bill of Quantities for the various items described therein. This also covers the procedure to be adopted for Inspection, Testing and Commissioning for all electrical equipments at site. The works shall be carried out strictly in accordance to the Tender conditions.

2. The scope of contract is explained below.
Plan Approval from Electrical Inspector, TAC (if required), etc.

Supply, Erection, testing & commissioning of RMU, HT Panels, Transformers, 4000A Busduct& Accessories, 500 & 100 KVA UPS System, Isolation Transformers, 22 KV Grade XLPE/PVC HT Cable, 415V 6 X 625 KVA DG SETS cum synchronising Panels, LT Panels in proposed Panel room& in Building area as shown in drawings.

1100V grade LT XLPE/PVC, power/control cables on pre-fabricated trays / underground and End termination of cables, Main LT panel to downstream panel in the DATA CENTRE AT PUNE Panel room and Cabling/wiring in the including allied work & street light, Cabling, street light panel.

Supply and erection of Cable trays, supports/ MS sections fabrication.

Supply & erection of DBs, power sockets, point wiring in MS/PVC conduits, junction boxes/accessories for light, fan, exhaust fan, call bell, 5A, 15A points & 1100V grade Mains wiring for power outlets for machine load & convenience power etc.

Supply & installation of lighting fixtures & fans.

Supply & installation of street light / Flood Light poles / high mast with accessories.

Supply, erection, & testing of Earthing system including earth conductors, earth leads, earth electrodes with test facility for Transformer substation including Transformer with OLTC, RTCC & H.T. Breaker Panels & Equipment (as in installation scope) supports structure body Earthing.

Supply, installation & testing of Lightning arresters.

Supply & installation of Aluminium Raceways, PVC/M.S. conduit in office area for UPS/Raw mains wiring, data, telephone wiring.

Supply, laying, testing commissioning of mains wiring for computer, power & telephone wire/cable, data cabling related to switch cabinets, workstations etc

Supply, fabrication, erection & painting of M.S. supports for various panels/Equipments, and misc. work like civil work related to Electrical trench excavation, refilling etc.

Quantities as estimated or approximated are as mentioned in schedule of quantities. Contractor shall however ascertain the exact quantity required at site and supply and install the materials accordingly, for which quantity based rates shall be payable.

Supply of the Materials shall be to the Specification of this Tender document and installation shall be as described, as per drawings approved, instructions issued by consultant and/or the purchase from time to time. Certain jobs shall be as per prevailing practices of Maharashtra state Electricity Board (MSEDCL) & IE codes.

The Contractor shall take into account prevailing ambient temperature/ weather conditions at site while designing the equipment. Any de-rating factors related to ambient temperature shall be considered as per relevant IS specs.

This scope shall be generally as per Contract Agreement and shall include additional jobs or additional quantities as may be required to be carried out for the completion of the electrical installation work in the opinion of the Director IITM Pune. Any other jobs/ items required to be carried out shall be evaluated on the basis of similar item rates under the Contract. Where such similar items do not exist the Contractor shall submit cost analysis to arrive at the item rates for the approval of Director IITM Pune.(Actual invoice / price list & discount, tax details shall be submitted along with

rate analysis for each extra item.) Maximum 10 % overheads, profit, etc. shall be allowed to the contractor on landed cost accepted by Director IITM Pune.

1.0 Overview

As a part of this RFP, IITM will build its own Captive Data Centre at Pune to host its high density servers.

The overall broad Scope of Work (SoW) for the DC Bidder or DC Turnkey Partner (DCTP) includes the following:-

(i) Design and Site Preparation of the proposed Data Centre in terms of the civil, electrical, Safety & Security System and mechanical work required to build the Data Centre including false ceiling, raised flooring, moisture sealing and fortification of the windows and all other necessary components.

(ii) Supply, installation and setting up of the Data Centre basic Infrastructure (State of Art Transformer, UPS and Air-Conditioning System, Fire Prevention, Detection and Suppression System, Diesel Generator Units, Lightings, , Power Panels (HT/LT System), Power Cabling, BMS management system etc.

(iii) Supply, installation and setting up of the multi-layer Physical Security infrastructure like biometric based access-control system, CCTV/ surveillance systems.

(iv) Five years on-site maintenance of all the equipments and their components supplied in setting up the basic infrastructure in the proposed Data Centre.

(v) Onsite support for Data Centre Infrastructure Operations on 24*7*365 basis by qualified engineers/ personnel for a period of five years to ensure at least 99.982% uptime on a monthly basis.

Phases : The project is divided in three phases as per following:-

(i) Phase-1 (Design and approval)

(ii) Phase-2 (Implementation and Acceptance)

a) Design, Engineering, Construction Drawings
b) Material Ordering & Pre-Dispatch Inspection
c) Material Delivery
d) Installation and Commissioning
e) Integrated System Acceptance Test (ISAT)
f) Certification, Handover and Documentation

(iii) Phase-3 (O&M)

2.0 Data Centre Work/Sub-Work Packages

The bidder shall design, implement, operate & maintain the complete data Centre physical infrastructure (Non-IT) and its support facility for following Work Packages/ Sub-Packages as per RFP requirements and shall include all the statuary approvals as applicable.

Sr No	**Work/Sub-Work Package Component Description**
1	Electrical System Work Package
1a	**Electrical Distribution**
I	HT Distribution Panels and System (HT Breakers, panels, Battery chargers, cables etc)
II	HT Distribution - HT Cable and other low side works
III	HT Transformers
Iv	HT Transformers Low Side Works
V	LT Distribution Panels- Electrical Panels such as DG Panels, LT Main Panels, DG changeover Panels, Capacitor Panels, Input and Output Electrical Panels for UPSs, HVAC Electrical Panels, CRAC Units Electrical Panels, Electrical Panels and distribution boards for Lighting , Electrical Panels for other utility services for Data Center requirement etc
VI	Power distribution units (PDU‘) for IT Racks Power with K4 transformer
VII	BUS-Bar Trucking complete with flexible, flanges, connectors, mounting support, canopy, accessories etc (i) Main HT Transformer to Main LT Panels (ii) DG Sets to Main DG panels, change over Panels, APFC, Transformer tap changing panels
VIII	Electrical LT power Distribution- LT power cables and control Cables
IX	Electrical LT power Distribution low side works-Cable tray, tray support, race ways, fixing accessories etc
X	Earthing Pits, Earthing Strips and Earthing grid
XI	Lighting fixtures
XII	Others- TVSS, Static Switch, First Aid Box, Shock treatment chart, No Smoking Board, Electric caution Board, Rubber Mat for Each Electrical Panel of suitable specification etc
	DG Systems
I	DG System
II	DG System Low side Works- day oil tanks, Canopy, Exhaust Structure, Fencing, cabling ,Piping, Sand Buckets, Fire Extinguisher, etc
III	DG Bulk storage tank of 50KL with all low side pumps and piping and automated controls and sensing. Necessary explosive and CCOE Nagpur approval to be considered.
1c	**UPS System**
	• IT UPS: N+N configuration with 15 minutes backup (12 V SMF batteries) • Non IT UPS: N+N configuration with 15 minutes backup (12V SMF batteries) for Pumps, emergency lights etc • Batteries: o 12V SMF batteries and backup time calculated at UPS output power factor (>0.9) and full load for IT and non-IT. End cell voltage 1.75v o Dedicated Batteries with each UPS
2	**HVAC WORK PACKAGE**

1	Air cooled chillers
	Air Cooled Chillers low side works piping, controls, primary & secondary pumps, valves as per design etc
	Data Center Precision Air-conditioning
	Precision-Air conditioners units for Medium density cooling and room cooling and humidity control (Dx or CW based) along with low side work
2c	**Comfort Air-Conditioning**
I	High Sensible comfort Air-conditioning system for Battery, UPS, electrical rooms, BMS
Ii	Ventilation units for Electrical and battery rooms
2d	**Very High Density Cooling (Rear Door Heat Exchanger)**
i.	Rear Door Heat Exchanger (RDHx) with Dedicated Chillers. *RDHx will come fitted with the servers*
ii.	Necessary Low side work like CW pipelines, butterfly valves, insulations, manifold, flex piping, CDUs etc as applicable as per the designed scheme
3.	**Civil and Interior**
	Civil Works-Raised Flooring, Walls Partition, Wall Finishes, Tile Flooring, Doors, Ceilings etc
	Furniture for BMS room, stores etc
4	Fire and security
4a	**Safety System**
	Fire Detection System
	Public Address System
	Hand Held Extinguishers
	VESDA/Aspirating Smoke Detection System
	Gas based fire suppression system
4b	**Security Systems**
	Access Control System
	IP CCTV system
	Water leak detection system
	Rodent Repellent
4c	**Integrated Management System with 5 Client user system**
4d	**Help Desk Support System with minimum 5 users access license**

3.0 Data Centre Space Estimation

Zone A: Total DC White Space Indoor

- IT Server room
- CRAC units
- PDUs
- **Area:** Approx~2300 sqft
- **Location**: First Floor

Zone B

Support Area Indoor
Electrical, UPS, Battery, BMS room
Area :~ 2400 sqft
Location: Ground Floor

Zone C

Utility Substation Area

- Transformers, HT panel, Synch Panel, RTC panel, Change over panel
- RMU will be placed in HT metering cubicle.
  The new equipment need to placed along with the existing panels.

ELECTRICAL SYSTEM

Following are broad guidelines:

System to allow concurrent maintenance.

TVSS to be put in all panels except lighting panels.

Dual feed for server racks through IEC connectors.

It needs to be ensured that the voltage drop in the electrical system shall not exceed to 3% under steady state operations

Electrical Distribution:

- New RMU to Proposed HT panel : HT cable
- Proposed HT panel to Transformer: HT Cables
- Transformer to ATS Panel: LT XLPE Cable
- DG set to Main DG panels: LT XLPE Cable
- Main DG Set Panel to ATS Panel : Outdoor/Indoor LT Busduct
- ATS Panel to Main LT panel: Al XLPE cable
- LT Main panel to HVAC panels: LT XLPE cables
- HVAC Panel to power distribution up to CRAC : Al /Copper PVC armoured cables
- UPS input cables: Cu ,flexible cable single core cable
- UPS output cables: Cu ,flexible cable single core cable.
- Output panels to PDU: Cu flexible , FRLS
- PDU to racks: Cu flexible FRLS
- Power Distribution-others, miscellaneous: Al or copper which is logical and consistent with overall design and distribution.
- All power cabling inside server room will be FRLS
- PDU – data centre IT rack: PDUs to have K4 isolation transformer and have Energy analysers as well as MCCB before and after the K4 Transformer
- Distribution to individual racks will be Dual.
- Each I-data flex server rack will have 4 nos of 3 phase, 5 (3P+N+G) wire 32 A supply (IC 309).
- Tape library: 2 nos per rack of 1 phase 16 A (P+N+G)
- Each row should have 4 quantities of 32 A of IC 309 connectors as spare and for Tape library row should have 2 quantity of 32 A 1 phase connector(IC 309) as spare.
- Power distribution box needs to be placed within a distance of 1.5 metre below the rack.

Lighting

- Lighting in server room 500 Lux at 3 feet from raised floor level and 400 Lux at utility Room.
- Emergency Lights to be 20% on UPS

DG sets

DG min rating 6*625KVA in N+1 with necessary AMF/ Synchronization and control panels is required. The synchronization and load management will be based by PLC or microprocessor based controllers.

80% loading in each DG sets

6 x 625KVA DG sets in N+1

The bidder shall provision for Diesel Generators sets to support the Data center physical infrastructure equipments load in providing emergency power supply to the computer equipment during a prolonged power outage. The DG set shall support other essential facilities and equipment such as the air-conditioning system, security and access control system and lighting. The DG set shall come on-line automatically within 30 seconds of AC mains failure. DG system shall have N+1 configuration. Harmonics generated by Load shall be accounted while designing the DG system. On-site fuel storage shall be sized to provide a minimum 50KL of on-site fuel storage The scope shall include but not limited to:-

(i) Required numbers of right capacity DG Sets & acoustically treated room with ventilation arrangement
(ii) Exhaust piping with heavy duty residential silencer, insulation of exhaust piping, Height of exhaust piping as per pollution control norms.
(iii) Diesel engine complete with all accessories and Alternator directly coupled to the engine through flexible/ rigid coupling, complete with all accessories for starting, regulation and control, including base frame, foundation bolts, interconnecting piping and accessories, power and control cable glands and lugs. Engine shall have command and control through power command centre or equivalent.
(iv) Diesel Local/Remote control panel, DG control panel, DG auxiliary panel including power cables, control cables to be provided.
(v) DG Set should have an Synchronizing/ AMF Panel & AMF panel controller between main power and DG set
(vi) Equipment necessary for fuel storing and distribution, day oil tank with level switches, piping, pumps, valves, level indicators etc.
(vii) Flexible connections & residential type silencer of exhaust system, including thermal lagging and height of exhaust structure should be minimum 30 meters or subjected to applicable pollution control norms for all DG system.
(viii) Batteries with Mild Steel/ Stainless steel battery stand and battery charging equipment, including their connections with tools & accessories for battery maintenance.
(ix) Anti Vibration Mountings, etc.
(x) Supplying and erecting bulk storage diesel tank with pumps etc. and covering entire yard with fencing & gate.
(xi) Preparing all related drawings for approval from IITM and statutory bodies.
(xii) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and all other statutory bodies. Obtaining explosive license and NOC certificate for installation of diesel bulk storage tank from explosive department and NOC from state.

(xiii) Carrying out performance & guarantee test, making arrangements for loads etc. as required.

(xiv) First fill of fuel oil, lubricating oil, etc., including cleaning and flushing out the system.

(xv) Fuel & oil fill for testing, trial run till ISAT .All cost of fuel, Oil and operation shall be borne by the the bidder.

(xvi) Prepare and submit to IITM for approval- Detailed shop drawings depicting the general arrangement of DG sets, its accessories, fuel tank, fuel oil piping, pumps, control panel, exhaust piping, Chimney/ Scrubber unit, Acoustic container etc. The bidder shall also furnish the detailed foundation drawings for DG sets.

(xvii) Compliance to the deliverables/ requirements, the solution shall also be in accordance and compliance to other building / building services norms as applicable at the proposed project location.

(xviii) DG installation shall be provisioned with protection system and safety devices.

(xix) Aux & Control Cabling requirements and interface with the Electrical scheme.

(xx) DG's shall have Local Emergency Stop integrated with the DG Panel Controls for a co- coordinated operation / monitoring and management.

(xxi) DG shall have appropriate Building Management System integration provisions / ports as well as hardwired alarm/ critical monitoring provisions with details of integration.

(xxii) The scope covers excavation, underground & overhead Piping for fuel storage system lines with appropriate protection & distance from other services as per the site conditions, including trench refilling and also foundation for DG sets and required trenches to lay cables.

(xxiii) Erection of pipe Exhaust structure as per pollution control norms and should have **aviation lights** in the exhaust pipes if the height is 30 meters.

(xxiv) Fuel storage pumping system shall be designed to have a trouble-free automated system without manual intervention for auto-filling of Day Tanks.

(xxvi) The system should not allow for oil pilferage and spills. If such incidences are found, it would show poor quality of manufacturing, work and/ or maintenance and will reflect on its performance.

(xxvii) The overall configuration shall be N+1 in nature, with no single point of failure', which can be put to use in case of failure of any one of the component especially the Fuel Pumps.

(xxviii) Monitoring provision shall be included with Potential free contacts / option to connect Flow Meters inside fuel lines / Underground Level Sensor Provision on tanks etc which shall provide for smooth operation / planning of fuel for the DC operation.

(xxix) Necessary Grounding for DG System shall be provided as per IEEE (Green Book) or relevant BIS norms.

(xxx) Work package shall include Fire Safety & Protection equipments including signage as may be necessary as per the statutory guidelines.

(xxxi) Pumping scheme may include with Overflow protection with Local over flow tank with Oil return provision with connectivity with the Under Ground tank.

(xxxii) Overall system design and scheme shall be fail-proof.

(xxxiii) All necessary statutory approvals including, but not limited to, CEIG approval, CCOE approval, Fire authority approval, etc. as applicable to DG System and Bulk oil storage tank shall be taken by the bidder.

DG Bulk Storage Tank

2* 25KL of underground storage tank with all low side work and redundant pumps

Fuel Storage tanks-Fuel Level monitoring, transfer line flow metering, each pump run status, Fuel high & low level monitoring, supply flow rate monitoring & other critical monitoring components. Fuel storage tank should be designed to have trouble free automated system without manual intervention fo auto-filling of day tank and also have BMS connectivity of monitoring only.

Piping to be done to cater to the existing (6*625KVA) as well as new DG sets also.
All required statutory approvals of fire and explosive departments will be in the scope of the bidder.

Utility Transformer

2500KVA Oil filled transformers with OLTC, Dyn-11.
Tap range: +10% to -15% in steps of 1.25%
Temp Rise: 55 Deg above ambient
Neutral CT for REF is required
Transformer oil: 10% extra over required capacity

Earthing/Grounding:

- Maintenance free chemical earthing pits for entire data centre.
- Lighting protection system
- Data centre grounding in server room as per IEEE
- Server rooms should have 25x3mm copper grid under the raised floor for rack body earth connected by copper flexible cables
- The bidder shall provide the grounding pits and ensure proper grounding for the complete Data centre system and facility. IEEE grounding practices shall be followed for the entire facility while ensuring near zero ground differentials.
- All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded as a safety measure.
- Low maintenance chemical earthing pit and equipotential grid system should be provided for all equipments for the Data Center and its support utilities.
- The connection to the earth or the electrode system should have sufficient low resistance (the tests shall be carried out as per IS: 3043. No earth electrode shall have resistance of more than 1 ohm to ensure prompt operation of respective protective devices in event of a ground fault, to provide the required safety from an electric shock to personnel & protect the equipment from voltage gradients which can damage the equipment.
- Ground resistance shall be automatically measured on an online basis at a pre-configured interval. Low Ground resistance alarm shall be provided if the ground resistance increases than the threshold value and preventive/ corrective action should be initiated based on the observation. Automatic grounding resistance measurements shall be provided as a part of the UPS annunciations system.

- All metallic bodies shall be equi-potentially bonded.
- The cross sectional area of earthing conductor shall not be less than half that of the largest current carrying conductor
- All panels and equipments should be earthed to avoid accidents to the personnel.
- Signal reference grid should be laid below false floor.
- The pedestals of the false floor should also be earthed.
- Methods to control Electro static discharge should be adopted by employing hand straps, mats, etc.
- Emergency Power off (EPO): EPO to be factored in the designed for server room.

Central power Monitoring through BMS: Utility, main transformer, UPS, DG, feeder circuits breakers, ATS, PDU, surge protection, critical load branch circuits.

The bidder shall plan the Energy Meters (Multifunction meter with communication protocol RS485 parallel port which can be integrated with main Energy/ Building Management System) at the following but not limited to:-

(i) Each feeder Circuit Breakers for Utility Distribution Main Panel (HT Panel & LT Panels-I/P & O/P Feeder)

(ii) HVAC Panels (I/P & O/P Feeder), each Chillers, Main LT Panel (I/P & O/P Feeder), DG Panel (I/P & O/P Feeder), Each UPS System (I/P and O/P Feeder at LT Panel side), Main Transformer (I/P & O/P Feeder), Automatic Transfer Switch, PDU's (I/P & O/P Feeder), Other utility service feeders (Main Input Feeder) & any breakers above 250 Amp.

(iii) Dual Energy meters should be provided at all incomers of main LT panels to measure the grid power and DG sets power.

(iv) Metered PDUs should be provided for each racks and which should be integrated with Data Center Infrastructure management software system and BMS.

Testing/Load Bank: DG sets, UPS sets to be tested for the rated load and back-up.

Also with that Integrated Load testing for 24 Hours at full load including all components of Electrical and HVAC.

UPS

- UPS configuration for IT Load : N+N
- UPS configuration for non-IT Load; N+N
- Automatic Bypass enabled through dedicated feeder
- Battery string : Dedicated for each module
- Technology: True on-line, IGBT based inverter and rectifier

4. 10 General Point : The bidders need to note the following:

(a) Some modifications need to be done in existing RMU of 22KV supply. After the existing cubicle ,one new RMU would have to added with one input and two outgoings. One

feeder will go to new Data centre (HPC-2) and the second one will go to existing HPC-1. There will be a downtime of 8 hours and existing setup of IITM will run on the existing DG sets.

(b) It should be also noted that HT panels and LT panels etc need to be divided between Existing Substation panel room and ground floor of DC.

(c) Bidders to factor the trenches for HT cables from Metering room to substation panel room and from Substation Panel room to DC building. The route will be adjacent to the existing trenches.

5.0 PREDISPATCH FACTORY INSPECTION

The factory inspection of UPS and DG sets and Electrical Panels. This is applicable if equipment is manufactured in India. The manufacturer's factory test report will be applicable for imported sets. Representative of IITM may present at the time of Testing. The test results shall be recorded on a prescribed form. The test certificate for the test carried out at factory and at site shall be submitted in duplicate to the IITM project in-charge for approval.

6.0 Project Execution and Timelines

6.1 Approval Process

The Selected DC turnkey partner (DCTP) should coordinate with IITM project in-charge for approval of drawings and all project related points

6.2 Design phase:

The Bidder shall submit the following deliverables:-

a. Coordinated Data Centre Layout document including all the work/Sub-Work Packages services
b. Design requirement document respective to Building Construction work
c. Schedule of quantities/ Bill of material document for all Work/Sub-Work Packages
d. Product Specification Document for all Work/ Sub Work Packages
e. Product Make/Model along with Capacity sizing calculation document for all work/ Sub-Work packages
f. Electrical SLD (Complete up to Rack Level), Schematics, equipment design drawing document
g. Breakers Total Discrimination scheme with curve for overall solution and design
h. Air-conditioning cooling solution design calculation
i. Air-conditioning solution Schematic and drawing documents
j. Safety & Security and Building Management Schematic and drawings
k. Civil- DC architectural layout, Floor Loading Details, DC elevation and Sectional Drawing
l. BMS Data Point summary document
m. Data Centre 3-Dimensional Layout and Data Centre 5mins Walk through Video as per final approved layout and drawing
n. Structural foundation details of equipment such as transformers, HT System, Bulk oil storage tank, chillers, DG systems, UPS Battery Bank etc.
o. All the above mentioned deliverables shall be for each Work packages/ Sub-Work Packages and document shall be submitted as each package wise.

The bidder shall submit 3 copies of these documents and 2 copies in CD/DVD media

Completion criteria

Submission of the above listed deliverables to IITM constitutes the completion of activity.

Completion Timelines Within **100** days from start of contract

6.3 Phase 2- implementation and Acceptance

DCTP shall design, supply, install, commission and acceptance testing for Work Packages/ Sub-Packages

Implementation phase is been divided into following stages:-

(i) Design, Engineering & Construction Drawings

(ii) Material Ordering & Pre-Dispatch Inspection

(iii) Material Delivery

(iv) Installation and Commissioning

(v)Integrated System Acceptance Test (ISAT), Handover and Documentation

Providing Tools, tackles, spares, safety & security arrangement, consumables, water for construction and testing, fire safety equipments, Power for construction, Power for inspection, testing &commissioning till the system final acceptance (ISAT) shall be sole responsibility of DCTP & shall be provided by DCTP at its own cost.

Design, Engineering & Construction Drawings

Preparation of services coordinated design drawings for all Work/Sub-Work Packages and finalize the co-ordinated construction drawing approved as ready for construction. Following activities shall be carried out as Pre-implementation activities,

Scope of Services

(i) Before proceeding with the work, DCTP shall submit the general layout and assembly drawings and such additional assembly and subassembly detail drawings as may be necessary to demonstrate fully that all parts of the equipment-set/system to be furnished will conform to guidelines. DCTP shall also submit catalogues and selections of the individual items in the equipment set/ system. Further, the equipment set/ system and material delivered to the site shall conform strictly to the specification and requirement as per RFP.

(ii) Preparation of coordinated Design Drawings followed by construction drawings with detailed specifications

(iii) DCTP shall visit and inspect the site to study the designated plot and the structural infrastructure details issued by IITM

(iv) DCTP shall provide detailed designs for various proposed work packages and services. This would cover the detailing of each work packages.

(v) Preparation of Package Design including Single Line Diagrams with Design data and typical installation detailing to specific equipments to clarify and guide the overall work package to its equipment level.
(vi) DCTP shall review the building infrastructure availability and recommend necessary suggestion & features incorporation in the design to meet overall DC design requirements.
(vii) Schematic diagrams for various sub-systems.
(viii) Preparation of working drawings for the complete DC facilities.
(ix) Provide all technical assistance related to electrical liaising work.
(x) DCTP to provide self approved schedule of Quantities/ Bill of material to IITM which should be as per IITM approved design drawings documents.
(xi) Integrate architectural & engineering features related to Data Centre in accordance with established design criterion
(xii) Site Infrastructure Requirement / Report
(xiii) Preparing Data Centre Coordinated Layout

Deliverables

DCTP shall submit the following deliverables:-
(i) Coordinated Design Drawings
(ii) Coordinated Data Centre Layout document for all the work/Sub-Work Packages services
(iii) Schedule of quantities/Bill of material document for all Work/Sub-Work Packages
(iv) Product Specification Document for all Work/Sub Work Packages
(v) Product Make/Model with Capacity sizing calculation document for all work/Sub-Work packages
(vi) Electrical SLD (up to Rack Level), Schematics, equipment design drawing document
(vii) Breakers tripping end to end coordination design and scheme
(viii) Air-conditioning cooling solution design
(ix) Air-conditioning solution Schematic and drawing documents
(x) Safety & Security and Building Management Schematic and drawings
(xii) Civil- DC architectural layout, Floor Loading Details, DC elevation and Sectional Drawing
(xiii) BMS Data Point summary document

All the above mentioned deliverables is applicable for each Work packages/Sub-Work Packages and document shall be submitted as each package wise.

Completion Criteria

Submission of the above listed deliverables and respective approval IITM project In charge or his designated representative constitutes the completion of this activity.

Completion Timelines

The activity should be completed before **100** days after signing the contract.

Material Ordering and Pre-Dispatch Inspection

Scope of Services

This shall comprise of

(i) Ordering of material as per approved design
(ii) Pre-dispatch inspection & Factory Acceptance testing of the equipment
a) Electrical System Work Package
UPS System
Electrical – LT Electrical Power Panels & PDU's
DG Sets
HT System -HT Panels
HT Transformer
Bus-Bar Trunking (Indoor/Outdoor)

b) Mechanical HVAC system work package
Chiller System
Computer Room Precision Air conditioner

(iii) DCTP shall prepare & submit the equipment inspection checklist for IITM approval

(iv) Based on readiness for inspection from OEM's, DCTP shall issue Inspection call 15 days in advance for Factory Inspection by IITM/ IITM's authorized entity before delivery of material at site.

(v) All the test as per relevant IS standards shall be performed on material/equipments provided by the Bidder and the cost shall be borne by the Bidder

(vi) All expenses with respect to such visit(s) to the OEM's Factory/ teleconferencing/ video conferencing, the cost of travel, boarding and lodging of the IITM/PMC's inspection team (maximum three person) , shall be borne by the Bidder.

Material Delivery

Covers the delivery of approved components &equipments in line with the Bill of Materials and approved design drawings for respective Work/Sub-Work Packages

Scope of Services

(i) Check and facilitate the readiness of site to receive the equipments at site
(ii) Procure all material and equipments for complete work packages
(iii) Intimate the expected delivery date & time of material reaching at site after the inspection of material is completed & accepted by IITM.
(iv) Co-ordinate for Delivery of Materials as per the final Bill of Materials in line with final approved design by IITM
(v) DCTP shall build its project office using temporary material and storage space on site on its own cost and risk.

Deliverables

On-Site Material Delivery Receipt Report document as per schedule of quantities/ bill of material.

Deliverables shall be for each Work packages/ Sub-Work Packages and Document shall be submitted package wise.

Installation and Commissioning

Scope of Services

(i) Initiate the installation of Data Centre Work Packages as per the detailed project schedule.

(ii) Weekly Review Meeting with Project Management Team from IITM.

(iii) Reporting of Project status to IITM on regular interval,

(iv) Regular supervision & checking of the project work at site as per the Project Management Plan

(v) Regular checking of quality of materials delivered and workmanship at site.

(vi) Preparation of Risk identification, Assessment, Allocation & Management during the progress of the project.

(vii)Project Team and Resource Management

(viii) Co-ordination in getting the Installation Report signed by IITM for the items installed on a pro-rata basis.

(ix) Tracking and reporting of the project for the timely completion.

(x) DCTP shall provide regular site supervision for each Data Centre work packages as envisaged

(xi) DCTP shall conduct regular progress meeting to monitor project details, identify and act upon any potential variations based on detailed time / work program for monitoring purpose.

(xii) DCTP shall co-ordinate the installation of work package and services in line with the respective Work Package Construction Drawing & Specifications.

(xiii) DCTP shall perform testing on installed package component / equipment / set of equipment to form a sub-system.

(xiv) DCTP shall conduct regular meeting to review project quality and progress.

(xv) DCTP shall co-ordinate between different agencies for smooth progress of Installation especially for interdependencies between different agencies deployed on Site.

(xvi) DCTP shall conduct review of technical document, process and responsibilities.

(xvii) DCTP shall perform verification and testing of supplied equipment and services in line with the quality requirements during construction.

(xviii) DCTP shall co-ordinate for the Integrated System Test covering the DC subsystems and record the results.

(xix) DCTP shall prepare and submit packages wise equipment test checklist for IITM approval.

Deliverables

Installation Report & Equipment Test Report document for each Work packages/Sub-Work Packages and document shall be submitted package wise.

Completion Criteria

Submission of the above listed deliverables and respective approval by IITM/ PMC constitutes the completion of this activity.

Completion Timelines

The activity should be completed within four **100 days** from the date of contract.

Integrated System Acceptance Test (ISAT)

Each Deliverable Item will be accepted in accordance with the following procedures:

I - Inspection. This procedure involves the visual inspection of the item to ensure that it conforms to the Specifications.

D - Demonstration. This procedure involves a demonstration of the functions provided by the item to ensure that it conforms to the Specifications.

A - Analysis. This procedure involves the use of analytical techniques, such as sampling, to ensure that the item conforms to the Specifications.

T - Test. This procedure involves the testing of the item in accordance with an agreed upon test plan to ensure conformance to the Specifications.

Acceptance Test Plan

Acceptance Test Plan sets out the process and criteria to determine that the Materials to be accepted by the test procedure and the System meets the specifications.

Acceptance Test Plan shall be documented by DCTP and submitted for approval to IITM. The Materials and the System will be accepted by the IITM after the functions and features to be tested meet the acceptance criteria specified in the Acceptance Test Plan. During the performance test, a log of all items failing to meet the completion criteria will be maintained by DCTP for taking corrective action and re-approval by IITM.

User Acceptance Testing

(i) The objective of User Acceptance Testing is to demonstrate the capabilities of the system in the end-user's environment and obtain their approval of the system. Key criteria for successful end-user acceptance tests will be developed by DCTM & submitted for IITM approval

(ii) The equipment-set/ system shall be tested as per RFP guidelines. Routine and type tests for the various items of equipment-set/ system shall be performed at the work site and DCTP shall furnish test certificates for the same. After the installation has been completed, DCTP shall perform all such tests and inspections as required by IITM to determine whether or not full intent of the guidelines has been fulfilled.

(iii) In case the work does not meet the full intent of the guidelines, further tests as necessary will be carried out by DCTP on its own cost.

(iv) All calibrated instruments required for tests shall be of the required accuracy and shall be furnished by DCTP at no extra cost.

(v) All the test as per relevant IS standards shall be performed on material/equipments provided by the Bidder and the cost shall be borne by the Bidder

(vi) DCTP shall carry out site performance tests. Necessary load for site performance testing shall be provided by the DCTP (i.e.) electric heaters / load bank for simulating internal load. In case DCTP fails to carry out the performance test, the Defects Liability Period shall stand extended until completion of such tests subject to performance of the equipment-set/system as per the RFP Guidelines.

Scope of Services

(i) Preparation of Integrated System acceptance plan & checklist as per OEM requirements.

(ii) DCTP shall develop test cases for functional and integration test as per the Site Acceptance Test Criteria
(iii) Conduct the testing at site and compare the real time data with respect to the expected results. Conduct Integrated System Test in line with the final approved Data Point Summary
(iv) All UPS's Battery discharge test for specified back up time on full load shall be conducted.
(v) DCTP shall perform Integrated System Testing upon completion of all individual work packages & services for the Data Centre.
(vi) Preparation of good for construction As-Built Drawing.
(vii) Submission of project documentation.
(viii) DCTP shall provide on-the-job training session to the support staff of IITM on various work packages listed and installed.

Heater Load test (DC Shape Down Test)

DCTP shall perform the heater load test for integrated acceptance testing as follows:-

(i) DCTP shall conduct the heater load test (as per design load capacity as is IT Load) for complete DC facility as a part of DC acceptance testing.
(ii) These heater loads will be installed at the place of IT Racks and will be powered from Tap off Box sockets installed for powering the IT Racks.
(iii) The capacity of each heater load should be as per the respective specified kW/ rack rated design capacity.
(iv) Test shall be conducted on load continuously for twenty (24) hours to check & verify the operational redundancy of each equipment & electrical system as per system design.
(v) The checklist for load test shall be prepared by DCTP and should be submitted to IITM for approval before commencing the integrated acceptance test.

Since the heater load does not have the same load characteristics as IT Load & sole purpose of this activity is to check & verify the functionality of complete system design, performance and redundancy on full design load.

The Tools, tackles, spares, safety & security arrangement and equipments, heater loads and Diesel/ Fuel for entire activity shall be arranged by DCTP at its own cost.

Deliverables

(i) Post acceptance testing of the equipment along with accessories in total, DCTP shall submit three sets of Handing over Documentation (HOD) neatly bound to corporate standards along with 4 copies in CD/ DVD media. The following are to be included in the Handing over documents
(ii) No modification whatsoever should be made in drawings once it has been approved, without prior consent in writing. DCTP shall also arrange to furnish complete set of drawings for assembly, erection, maintenance, repair and operation of the equipment-set/system. All parts in the drawings can be suitably numbered for identification. Two set of relevant drawing, general layout/ arrangement drawing of A2 size to be laminated and kept at site for reference.

(iii) DCTP shall furnish and install a neatly typed set of operating instructions laminated and securely framed in the plant room.

DCTP shall submit the following deliverables:-

- As Built Drawing
- Site Performance Acceptance Testing Report
- Installation and Commissioning Report
- Factory Acceptance Test Reports
- UPS's Battery Autonomy Test Report
- Specifications Sheet
- Final Schedule of quantities/ Bill of material
- Product brochures for respective equipments for individual work packages
- Test Readings/ Reports. (Installation testing and commissioning Report)
- Spare Part List
- Maintenance Schedule
- OEM Operating Manual
- Service Escalation Matrix
- Do's & Don'ts
- Warranty Certificate
- 2 hours Fire rating test certificate for relevant civil work package component
- Factory test Report
- Approved Integrated Acceptance Test Plan
- Heater Load Test Report with measured parameter and observations
- Statutory Approval documents
- Emergency operation details.
- Log book/ Service record.
- Emergency contact of list with Phone/ Residential phone/ Mobile/ Fax/ E-mail/ Etc.

All the above mentioned deliverables shall be for each Work packages/Sub-Work Packages and document shall be submitted as each package wise.

Completion Criteria

Submission of the above listed deliverables and respective approval by IITM constitutes the completion of this activity.

Completion Timelines

The activity should be completed within **100 days** from the date of Data Center contract

6.4 Total Project Timelines

100 days from date of signing the contract.

7.0 Defects Liability period

The Defects liability period for all the Data Centre equipment shall be 12 months after the Performance Sustenance period. This period would serve as a check to vet the quality of the work and equipment supplied by the DCTP. Failures and malfunctioning of the equipment shall be closely monitored and in case it is found that the faults/ number of failures/ downtime for any equipment is abnormal, it would entail that the support period would liable to be extended apart from the penalties to be imposed as per the SLM compliance requirement..

AMC for 3 years after completion of warranty period

Documents to be submitted with the bid

A. Documents for substantiating the Pre-requisites

B. Technical Solution Offered

- Solution/Design Description/Layout Drawing
- Compliance with standards / makes
- Project execution team including Numbers, qualifications, skills and experience of People proposed for the project
- Solutions Scalability
- Energy efficient design: PUE calculations at 100%, 75% and 50% load
- List of activities for Physical Infrastructure Management and Maintenance Services
- Project Implementation and Management Methodology Proposed
- Operations team, skill set & experience
- Bill of Material

C. Commercials in Commercial template

D. MAF of all equipments

GENERAL SCOPE:

Scope shall include testing and commissioning of all items installed by contractor. Necessary support by manufacturer can / shall be provided.

Scope also includes unloading of free issue items at site, & storing of these items. Contractor's person can accompany client's representatives for shop inspection if necessary for above items.

Contractor has to carry out all works as per respective IS standards & I.E.C. All required tools & tackles, testing kits, measuring instruments, safety equipment's shall be provided by contractor with skilled manpower required.

LIASIONING

1. This shall include following and everything associated with the Execution, supervision testing and commissioning job.
2. Getting the installation approval and obtaining permission to energise the system.
3. Arranging visit of electrical inspector to site (including DG sets) as and when required.
4. Submission of necessary test reports.

Achieving necessary drawing approvals. The Director IITM Pune intends to carry out the above said work(s) by appointing contractor(s) by calling competitive offers.

The Director IITM Pune will enter into Contract(s) with the successful Bidder(s) for carrying out the works as per specifications & conditions detailed here under. Notwithstanding the above, the Director IITM Pune reserves the right to reject any or all of the offers, without assigning any reason thereof. The Bidder shall not be entitled for any Compensation/ Claims towards the cost of preparation and submission of the offer.

The intent of this document is to describe, through specifications & drawings, the requirements of the works to be carried out by the contractor. The specifications and the accompanied drawings shall be read in conjunction & are intended to be complementary. Any other associated supply or works required for the completion shall be considered as if required under this tender.

Following documents shall form part of this tender enquiry:

- Tender notice & tender form.
- This specification including all terms & conditions.
- Bill of quantities.
- Tender drawings issued herewith.

All the documents as listed above are intended to be complementary. In the event of variance and/or ambiguity between various documents, following order shall prevail:

- Special conditions of Contract.
- Commercial conditions of Contract.
- BOQ Description.
- Tender Drawings.
- Technical Specifications.

The Specific qualifying requirements for the Bidder are as specified in the special conditions of the Contract.

ELCTRICAL

SPECIAL CONDITIONS OF CONTRACT

CONDITIONS

1. ADDITIONAL WORK

Any additional work if required/ ordered by the Director IITM Pune shall be taken up immediately and completed within the agreed time schedule.

2. WORKING DRAWINGS

Electrical layout drawings furnished by Director IITM Pune during order placement shall be referred for a general guideline purpose. Errors or inconsistencies discovered by the Contractor in the Drawings and Specifications shall be promptly brought to the attention of the Director IITM Pune through the Project Engineer for interpretation or correction. Local conditions, which may affect the work, shall likewise be brought to the Director IITM Punes attention. If at any time, it is discovered that work is being done which is not in accordance with the Contract Drawings / approved working drawings and Specifications, the Contractor shall correct the work immediately.

All Drawings, Bill of Quantities and Specifications, including copies thereof furnished to the Contractor are the property of the IITM, Pune. They shall not be used on any other work and shall be returned to the Director IITM Pune on request upon completion or termination of the contract.

Contractor shall submit installation detail working drawings for Director IITM Pune approval within 1 week of the award of contract.

The details shall comprise but not limited to the following.

- Earthing pits, Earth bus, equipment/ panel earthing, etc.
- Lighting
- Cable trays: - Details shall include pre-fabricated accessories such as risers, bends, tees, couplers, reducers, etc.
- Civil work like wall opening/ cut out/ inserts/ pockets sleeves/ Hume pipes/ RCC pipes for laying cables at road crossings required.
- Any other drawings as may be required by Director IITM Pune for completing the project on time without cost over-run.

3. EQUIPMENT/ WORKMANSHIP

The equipment to be supplied under this Contract shall be strictly as per specifications of the Contract and relevant IS specifications. In the event of any ambiguity/ dispute the Director IITM PUNEs verdict shall be final and binding on the Contractor.

4. DEFECTS / MODIFICATIONS

If in the opinion of Director IITM PUNE the work carried out is defective, the Contractor shall rectify such defects without any additional cost to Director IITM PUNE; or carry out modifications to make the work complete in all respects and acceptable to the Director IITM PUNE. To get satisfactory test readings, the Contractor shall carry out required modifications (which may include even replacement of defective items) without any additional cost of whatsoever nature to Director IITM PUNE. The work shall be guaranteed to yield the specified rating(s), design conditions within tolerance as per relevant IS specs. Any equipment, which in the opinion of the Director IITM PUNE does not meet specified requirements for which it is installed, may be rejected and Contractor shall replace it free of cost and within such time as may be reasonably allowed to him. The delay in the execution of the project on this account is not acceptable.

5. COMPLETION CERTIFICATE

The Contractor shall inform the Institute, completion of erection for inspection and witnessing the site tests. Required tools/ instruments for such tests shall be arranged by the Contractor. The equipment shall be commissioned only after obtaining written acceptance of pre-commissioning tests (as per requirement) by the Director IITM Pune and issue completion certificate to the Contractor. The Director IITM Pune reserve the right to issue the completion certificate in parts. If due to Contractor's inefficiency the Contractors completion certificate is delayed, the Director IITM PUNE reserve their right to put the equipment to use. The maintenance period or defects liability period shall start from the date of completion to the satisfaction of the Director IITM PUNE as mentioned in the completion certificate. Before issue of completion certificate, Contractor shall supply AS-BUILT drawings and operation and maintenance manuals as per relevant clause.

6. COMPLETION CERTIFICATE UNDER DEVIATION

The Director IITM Pune may consider issuing completion certificate for the Contract along with the list of deviations for which the Contractor shall give an undertaking that the deviations shall be attended and rectified within two months from the date of completion certificate. The right of issuing such a certificate lies exclusively with the Director IITM Pune depending on nature of deviations.

7. DEFECTS LIABILITY PERIOD & FINAL ACCEPTANCE CERTIFICATE

Defects liability period shall commence on the date of completion mentioned in the completion certificate (with or without deviation list) and shall not finish for at least Two years. On completion of the defects liability period, the Director IITM Pune shall carry out final inspection of work and issue a list of defects/ deviations, if any. The Contractor shall attend to and rectify these defects/ deviations immediately. During the defects liability period, if there is any defect observed in the work carried out by the Contractor; the contractor shall rectify such defects immediately. At the end of the defects liability period and after rectification of all deviations, the Institute shall issue final acceptance certificate. The Director IITM PUNE will release the retention amount or bank guarantee within 15 days; of presentation of final acceptance certificate by the Contractor.

If after defect rectification, the item is not acceptable to Director IITM PUNE, the Contractor shall replace the item by right quality item, free of cost. "The nature and quantum of defect,

it's reporting to the Contractor, Contractor's response" thereof shall be recorded in writing by the Director IITM Pune and acknowledged by the Contractor as the case may be.

The Contractors shall handover the running equipment to the Director IITM Pune, for use and routine maintenance. However the Contractor is responsible for quality of work for defect liability period and quality of supplied equipment. The erection shall be as per Contract specifications and relevant IS Specifications.

The Contractor shall obtain, well in time, before/ during and after completion of erection, approval from MSEB and electrical inspector, factory inspector, other statutory authorities as and when required. Charges for co-ordination/ liaison to are considered separately.

8. PERFORMANCE Guarantee

If the performance of the equipment fail to prove the guarantee set forth in the specification, Supplier shall investigate the causes and provide free of cost to Purchaser equipment within one month period to prove the guarantees.

If Supplier fails to prove the guarantee within the one month period, Purchaser shall have the option to take over the equipment and rectify, if possible, the equipment to fulfil the guarantees and or to make necessary additions to make up the deficiency at Supplier's risk and cost. All expenditure incurred by the Purchaser in this regard shall be to Supplier's Account.

The manufacturer's guarantee for all brought out equipment shall be made available to the Purchaser and shall be valid for the entire defects liability period. If the manufacturer does not issue such guarantees, the Supplier shall guarantee the brought out items for the entire defects liability period along with this guarantee for the equipment.

9. WORKMANSHIP

Good workmanship and neat appearance are pre-requisites of the Contract. Work shall be carried out in accordance with statutory rules and regulations in force and confirm to MSEB standards, electrical inspector's requirements, IE rules and relevant IS specifications and to the satisfaction of Director IITM Pune.

10. EXTENSION

Upon it becoming reasonably apparent that the progress of the work is delayed, the Contractor shall forthwith (within a maximum period of seven days) give written notice of the cause of the delay to the Director IITM Pune and if, in the opinion , the completion of the work is likely to be or has been delayed beyond the "Date of completion" stated in the agreement hereto or beyond any extended time previously fixed under this clause.

a) By force majeure,
b) Reason of any exceptionally inclement weather,
c) Reason of loss or damage occasioned by any one or more of the contingencies referred to in this document
d) Reason of social commotion, local combination of workmen strike or lockout affecting any of the trades employed upon the works or any of the traders engaged in the preparation manufacture or transportation
e) Any of the goods or materials required for the work,
f) Reason of the Director IITM Pune instructions issued
g) Reason of the Contractor not having receiving in due time necessary instructions, drawings, details or levels from the Director IITM Pune for which he specifically applied in

writing on a date which having regard to the date of completion stated in the appendix hereto or

h) Any extension of time then fixed was neither unreasonably distant from nor unreasonably close to the date on which it was necessary for him to receive the same

I) Delay on the part of nominated Sub-Contractors or nominated suppliers which the Contractor has taken all practicable to avoid or reduce, or

j) Delay on the part of artists, tradesmen or others engaged by the Director IITM Pune in executing work not forming part of this contract, or

k) Reason of the opening up for inspection of any work covered up or of the testing of any of the works, materials or goods in accordance with clause 31.7 above (including making good in consequence of such opening up or testing) unless the inspection of test showed that the work materials or goods were not in accordance with this Contract, or

l) Reason of the Contractors' inability for reason beyond his control and which he could not reasonably have foreseen at the date of this Contract to secure such labour, goods or materials as are essential to the proper carrying out works, then the Institute shall estimate the length of the delay beyond date or time aforesaid make in writing a fair and reasonable extension of time for completion of works, provided always that the contractor shall use constantly his best endeavours to prevent delay and shall do all that may reasonably be required to the satisfaction of the Director IITM Pune to proceed with the work.

The Contractor will forfeit his claim for extension if he does not report the cause of the delay in completion date within seven days of the date of occurrence.

11. TOOLS & OTHER MATERIAL

All special tools and tackles required for the proper erection and assembly of equipments covered by the Contract shall be obtained by the Contractor himself. All sundry materials such s foundation bolts, nuts etc. required for the erection of equipments/ switch boards including base channels (If required & mentioned) to raise the level of the switch boards shall be included in the erection costs of respective items. Necessary scaffolding shall be arranged by the Contractor. Scaffolding shall be so fastened that swaying/ swinging from structure or building shall be prevented.

12. QUANTITIES

Quantities mentioned in the Tender documents are approximate. Before placing order Bidder is advised to check the quantity with his working drawings and arrive at actual required quantities as per site conditions. In any case, the payment will be made on the basis of finally supplied and erected quantities on completion of work. Director IITM PUNE keep option to pay for any additional quantities left balance and not erected, but do not bind themselves to do so. If the orders are split for supply and erection, it is the responsibility of erection Contractor to prepare working drawings and inform Director IITM Puneso that supply Contractor can be informed to supply quantities required for satisfactory completion of project.

Bidder to note that no claims for loss/ compensation/ escalation on the grounds of increase/ decrease in the quantities indicated in the tender schedule of quantities, shall be entertained under any circumstances, nor will the Contractor shall be entitled to prefer any claims whatsoever on these grounds.

13. AS BUILT DRAWINGS

On completion of work the contractor shall submit a soft copy along with 4 sets of as-built drawings in hard copy. These shall include -

1. Detailed drawing showing layouts cables routing, earthing, lighting system, etc. as installed.
2. Manufacturers' operation and maintenance instructions manuals for supplied items.
3. Test results after Consultants acceptance.
4. Contractor's instructions for routine maintenance of the work.
5. Any other drawings/ details deemed necessary by the Director IITM Pune for satisfactory maintenance of the work.
6. List of recommended spares for 2 years operation.
7. Relay co-ordination details (if any)
8. Quality assurance plan
9. Catalogues of major equipments
10. Commissioning reports and settling parameters
11. Warranty certificates by OEM
12. Release orders by authorities
13. Commissioning documents with MSEB.
14. Acknowledgement/ Memos etc.
15. Approvals and NOCs in originals

14. CARE OF WORKS

From commencement to the completion of works the Contractor shall take full responsibility of all work related to this Contract and those of other agencies, including temporary works. In case of any damage, loss or injury to the works; either of Contractors or other agencies the Contractor shall repair/ make good and acceptable.

The Contractor is also liable for any damages to the works his or others, caused by him in the course of any operations carried out by him for the purpose of carrying out his obligations. Any delay occurring on account of any of the above shall be to the account of Contractor. Contractor may employ watchman for safe custody of materials. Security and safety of all works related to this Contract is Contractor's sole responsibility.

The Contractor shall make good all civil works damaged/ disturbed by him while carrying out electrical installation, immediately after installation work or in any case before end of the Contract.

HVAC

SPECIAL CONDITIONS OF CONTRACT

1.0 PROGRAMME :

The Contractor shall prepare, in consultation with the Owner, a programme for the completion of the work, which may be carried by agreement in writing between the Owner and the Contractor. The contractor shall maintain progress throughout the contract period so as no to delay other traders or Contractors.

2.0 DIMENSIONS :

Dimensions are to be adhered to as stated in the specifications or as figured on the drawings. Large scale details and written particulars furnished by the Owner are to be used in preference to small scale drawings and are to be strictly followed as to their true intent and meaning. However, Contractor should check physical dimensions before proceeding with any work. Any discrepancies between drawings and physical dimensions to be brought to the notice of Owner's Site Engineer.

3.0 INCLEMENT WEATHER :

The Contractor shall take note of the climatic conditions as pertaining to the areas in which the works are located and shall be deemed to have included all costs for protecting from injury by weather all works and materials that may be so affected.

4.0 FREE ISSUE OF MATERIALS :

All items of equipment as accepted by the Contractor from any other places shall be erected by the Contractor without any damage.

5.0 SUPERVISION OF WORK :

The Owner reserves the right to interview the Contractor's nominated site representative and skilled tradesmen either prior to the award of the contract or prior to commencing work on site. Should the nominated representative not be considered suitable, the Contractor shall provide further representatives and skilled tradesmen for interview until such time as the Owner is satisfied that a competent man will be appointed. That the Owner may have approved the appointment will in no way relive the Contractor of any responsibility under the terms of contract. All costs including travelling expenses etc., incurred by the Contractor in following the above procedure shall be born by the Contractor.

6.0 LABOUR DISPUTE :

The Contractor shall keep the Owner fully informed on all matters concerning labour disputes, strikes, etc., involving the Contractor's labour force and the effects on the

progress of work. The Owner shall be kept fully informed of the course of action proposed to remove or alleviate the cause of the dispute.

7.0 COMPLETION :

7.1 Completion shall be as defined in the Time Schedule.

a. Following completion, the Contractor shall have the rights of access to all parts of the plant at all reasonable time in so far as operation of the plant by the Owner permits for the purpose of completing outstanding work and inspection and making tests and modifications to fulfill obligations under the contract. Such access shall be at the Contractor's risk. The Contractor shall not bring visitors to the plants as potential customers or for other purpose without prior agreement in writing of the Owner on each occasion.

8.0 RESPONSIBILITIES OF OWNER :

8.1 Provide an adequate area adjacent to the site to accommodate the Contractor's temporary facilities.

8.2 Provide and maintain suitable access to the job sites for the Contractor's personnel, equipment and materials.

9.0 POSSESSION OF SITE :

The Owner shall give the Contractor facilities for carrying out the works on the site from the date set for the beginning of work on the site. Access to a possession of the site shall not be exclusive to the Contractor. The Contractor shall give to any other Sub-Contractor every reasonable facility for the execution of concurrent work.

10.0 The Contractor will arrange to carry out all necessary work associated with holes for pipes though brick work, concrete or steel work and for drilling all holes for fixings.

11.0 PHOTOGRAPHS :

The Contractor shall not take photographs of any part of the works without the written permission of the Owner.

12.0 CONSUMABLES :

The Contractor shall use all the consumables but not limited to industrial gas, argon gas, oil & grease, jointing compounds, PTFE tape, emery tape, cleaning rags, saw blades, welding filter wires and electrodes etc.

13.0 CONTRACTORS CONTROL :

It is the intention of the Owner to monitor and control progress of the works and authorise interim payments. The Owner will expect the full co-operation of the Contractor in the preparation of the valuations and reporting systems and the contractor's price is inclusive of all such costs.

14.0 OTHER CONTRACTORS :

The Contractor shall take fully into account the effect of other concurrent work being carried out in the area or on the same site by other Contractors on the site will be expected from the contractors to ensure that the works are completed in a trouble free, efficient and neat manner.

15.0 **The Contractor shall submit the CFD analysis of HVAC for the server room**

16.0 **Chiller /PAC Manufacturer shall have min Three Installation of Server room in India in past five years..**

17.0 **Blank BOQ Shall be submitted with the compliance or deviation if any, separate deviation sheet shall be submitted along with technical bid.**

ADDITIONAL CONDITIONS :-

1. Please note all required tools tackles, ladders, scaffolding etc. for execution / completion of site shall be organised by the successful contractor for carrying out their work.

2. Main incoming supply 3phase/ 1phase, 415V/230V, 50hz, will be provided by the buyer at one point. The successful contractor shall carry out further distribution between the electrical panel and equipments with necessary cabling.

3. Drain piping shall be properly laid and connected at the drain point as per specifications and as shown by the consulting engineers as per site condition

4. The buyer shall carry out all required major civil work like opening in walls & making good of all holes. All fire seals for the openings shall be carried out by the successful contractor of F-90 Class

5. All required labour and material handling equipment required for execution at site shall be organised by the successful contractor for carrying out their work.

6. Please note all the labour engaged at site for execution of work shall be covered under ESI/PF as per the government rules, and all necessary details shall be submitted to the client before starting the execution work at site.

7. The contractor shall have a comprehensive all risk (CAR) & Workman Compensation (WC) of the full amount of the contract value.

8. For carrying out extra work or if the contractor decides to work after duty hours, special permission shall be taken from the authorities before doing so.

9. All labour employed at site shall use safety belts, safety shoes, safety gloves, safety helmet, safety goggles etc., If any of the contractor found not adhering to the safety precautions, his work at site would be stopped immediately & a penalty of Rs.1,000/- per day will be charged to him. However this delay should not reflect in the overall project delay, as it might lead to penalty as per the LD clause. Client/owner shall not be held responsible for any accidents / Mishap that may happen on site due to negligence / overlook of safety precautions.

PART II

ELIGIBILITY CRITERIA, MANAGE SERVICES SCOPE

AND

TECHNICAL SCORING CRITERIA

ELIGIBILITY CRITERIA

S.No.	Criteria	Documents to be Provided
1	(a) The bidder should be a company registered under the Companies Act, 1956 and in operation for at least 5 years as on 31.03.2013 and should have their registered offices in India. (b) The company must be registered with appropriate authorities for all applicable statutory duties/taxes	Valid documentary proof of: Certificate of incorporation Certificate of Commencement Certificate consequent to change of name, if applicable Copy of Memorandum of Association Valid documentary proof of: Central Sales Tax/VAT number. Service Tax registration number. Income Tax registration/PAN number Income Tax returns for the last three years
2	The bidder must have ISO 9001: 2000 certification.	Valid Copy of the Certification
3	The bidder shall be the single point of contact and shall be solely responsible for all warranties and upgrades etc. Consortiums will not be allowed. Only SI's are allowed to bid.	An undertaking by the bidder duly signed by the authorized signatory.
4	During the last three financial years as on date of release of tender document the Tenderer should have installed and commissioned at least One Data centre projects similar to this in India which should include activities like Design, Site Preparation, Supply, Installation, Testing, Commissioning, Operations and Maintenance of Basic Infrastructure for the establishment of a Data Centre of a Tier III Level. The above projects should be under the Operations and Maintenance phase for at least six months. The Tenderer should provide details of at least one of the two data centre projects which should at minimum be of the following capacity: 3,000 sq. ft. server farm area Experience in Supply, Installation, Testing, Commissioning, Operations	Copy of work orders for minimum two data centre projects supported with relevant documentary evidences for the design parameters as mentioned in criteria 4 and the completion certificates by the client. Self declarations will not be entertained. For bidders who have built their data centre for commercial use will need to provide relevant documentary evidence like Certificate from CA/CS confirming the order value, supported with relevant documentary evidences for the design parameters as mentioned in criteria 4.Such evidences will also require client certificates stating the kind of services delivered and their satisfaction on these services This should be supported as per the format specified in Section IV - Annexure 4.9 – Details of Experience of responding firm

	and Maintenance of Basic Infrastructure Minimum 11 KV system and associated equipment, Minimum 1000 KVA transformer with multiple transformers, Minimum 1000 KVA DG power with multiple DG sets and its synchronizing panel, Minimum 500 KVA UPS and PDUs and Minimum 350 tonnes chiller/gas based system with PAC& high density rack cooling solution Note: Tenderer in- house data centres shall not be considered Tenderer who have built their own Internet Data Centre ("IDC") for commercial use will be considered	
5	(a) The bidder should have positive net worth as on 31st March 2013 (b) The bidder should have an annual turnover of at least Rs. **100** Crores in each of the last three financial years viz; 2010-11, 2011-12, 2012-13 Note: The net worth and turnover refers to bidder and not the composite turnover of its subsidiaries/sister concerns etc.	(a) A certified document by the Chartered Accountant stating the net worth of the bidder. (b) As per Criteria 5 the bidder will be required to index/highlight the requisite figures related to the positive net worth and turnover in the appropriate documents referenced.
6	The bidder must have on its roll at least 100 technically qualified professionals in systems integration, product installation/ commissioning & related services out of which 10 should have certification as Data center professional(CDCP) , 3 CDCS & 4 PMP's involved in active projects of similar nature	• Certification from MD/CEO for the people on roll (excluding contractors/ outsourced/ daily wage staff) • Copy of Certificates in respect of 10 employees
7	The bidder should furnish, as part of its bid, an Earnest Money Deposit (EMD) of **Rs. 1,60,00,000/- (Rupees One Crore Sixty Lakhs only)** or Rs.1,00,00,000/- (Rs. One Crore only) or Rs.60,00,000/- (Rs. Sixty Lakhs only) whichever applicable as stated on Page	The EMD should be denominated in Indian Rupees, and should be in the form of a Demand Draft issued by a Nationalized / Scheduled Bank, in favour of IITM

	No. 3.	
8	The Bidder shall not be under a Declaration of Ineligibility for corrupt or fraudulent practices or blacklisted with any of the Government or Public Sector Units during the past 5 years viz; 2008-09, 2009-10, 2010-11, 2011-12 & 2012-13	Declaration in this regard by the authorized signatory of the bidder as per the format specified - Details of Litigations / Ineligibility for corrupt or fraudulent practices / Blacklisted with any of the Government or Public Sector Units
9	The bidder should submit valid letter from all the OEMs confirming the following: Authorization for bidder Confirm that the products quoted are not "end of life products Undertake that the support including spares, patches for the quoted products shall be available for next 10 years OEMs include: Transformer UPS HVAC Diesel Generator Fire detection & Suppression Surveillance Any other	Relevant documentary evidence like Authorization letters
10	The OEM (s) should be an established industry player in its respective domain like Fire Detection and Suppression, Surveillance, UPS, Transformer etc. and should form a part of the Industry standard quadrant on the likes of Forrester, IDC, Gartner, etc.	Relevant Documentary Evidence
11	The bidder should have an branch office in Pune	Relevant Documentary Evidence

MANAGED SERVICES SCOPE

Specifications for Data Center Operations

1. Introduction

1.1. Document Purpose

To detail out the Scope for Operations and Maintenance support structure and ways to measure it to maintain the functionality of the Data Center with minimum impact to business.

1.2. Measurement of Service level

The purpose of this Service Level Agreement (hereinafter referred to as SLA) is to clearly define the levels of service which shall be provided by the Bidder to IITM for the duration of the 5 year contract.

1.3. Definitions

For purposes of this Service Level Agreement, the definitions and terms as specified in the contract along with the following terms shall have the meanings set forth below:

"Uptime" shall mean the time period for which the specified services / components with specified technical and service standards are available to the state and user departments. Uptime, in percentage, of any component (Non-IT) can be calculated as:
Uptime = {1- [(Downtime) / (Total Time - Maintenance Time)]} * 100

"Downtime" shall mean the time period for which the specified services / components with specified technical and service standards are not available to the state and user departments and excludes the scheduled outages planned in advance, the link failures and reasons beyond Vendor Control .

"Incident" refers to any event / abnormalities in the functioning of the Data Centre Equipment / specified services that may lead to disruption in normal operations of the Data Centre services.

"Resolution Time" shall mean the time taken (after the incident has been reported at the helpdesk), in resolving (diagnosing, troubleshooting and fixing) or escalating (to the second level or to respective Vendors, getting the confirmatory details about the same from the Vendor and conveying the same to the end user), the services related troubles during the first level escalation.

2. Service Level Agreement

Sr No	List of Utilities	Components Details & Specifications	Criticality	Redundancy	SLA Definition
1	Precision Air-Conditioning System (PAC)	--- TR Capacity x 3 No	High	N+1	99.9 %
2	Comfort Air conditioning	--TR / ---TR	High	N+1	99.9 %
3	Chiller	--- TR Capacity x 3 No	High	N+1	99.9 %
4	UPS System	3 nos 500kVA – 2Sets with 15 Min Back-up on each UPS	High	N+N	99.9 %
		100 KVA x 2 No. UPS for Critical Supply i.e. BMS and Emergency lighting	High	N+N	99.9 %
5	Electrical Infrastructure	2 nos of Main DC incoming LT power panels with 4000 Amp Incomer.	High	N+N	99.9 %
6	DG set	6x 625kVA DG set with panel	High	N+1	99.9 %
7	Fire Detection and Fire Alarm System	Photoelectric Smoke Detectors for Server farm as well as for other areas of the Datacenter	High		99.9%
8	VESDA System	Aspiration type Smoke and fire detection system (Very Early Smoke Detection & Activation System - VESDA) for Server Farm and UPS and Electrical rooms	High		99.9%
9	Fire Suppression System	NOVAC 1230 Gas suppression System	High		99.9%
10	CCTV Surveillance System	CCTV Cameras	Medium		99.9%
11	Rodent Control System	Rodent repellant Systems for all rooms	Low		99.9%
12	Building Management System	Building Management System with having capacity to accommodate 1000 points(hard& software)	Medium		99.9%
13	Water Leak Detection System	2-4 Zone Water Leak Detection System	Medium		99.9%
14	Access Control System	Intelligent TCP/IP based Door Controller	medium		99.9%
15		Smart card and Biometric Access Windows based Report Generation Software	medium		99.9%
16	Public Address System	6W ceiling Mounted Speakers and amplifier	Low		99.9%

4. Penalty:

The SLA metrics provided specifies performance parameters as baseline performance, lower performance and breach. All SLA calculations will be done on quarterly basis. The SLA also specifies the penalties for lower performance and breach conditions. Payment to the successful bidder is linked to the compliance with the SLA metrics. Availability shall be calculated on quarterly basis. Availability will be based on the report of representative of IITM, based on system logs, equipment logs, downtime and rectification reporting etc. In case the availability for each of the system under Warranty/AMC is less than SLA the non-performance deduction from payments for the system under Warranty/AMC shall be as per the Clause No. 4.24 of PART 4.- TERMS AND CONDITIONS OF CONTRACT (TCC):

5. Operations and Maintenance

The data center going live is one of the major milestones for any organization. However, there is a lot of effort that goes into operating and maintaining the data center. IITM gives due importance to the operations and maintenance aspect well in advance, at the stage of designing the data center itself. Adequate care is taken to ensure that the design can take care of providing high availability and strict service levels while at the same time keeping the operating costs low.

6. Scope of services

Submission of daily, weekly and monthly service performance reports in the format specified as per the requirement of the infrastructure facilities at the premises. Understand & analyzing the product covered in equipment list performance on periodic basis and provides the technical recommendations for improvements.

Measurement and Monitoring with taking readings and checking parameters of different facility equipments as defined. Analyzing the readings and escalating for any abnormality observes. Whenever new equipment or systems are to be / being installed by OEM vendors, supervise installation and maintenance work conducted by external vendors. Ensure, maintaining and updating all standard labeling of all critical systems, infrastructure equipment and components.

Adequate onsite and offsite spare parts and spare component must be maintained by the successful bidder to ensure that the uptime commitment as per SLA is met. To provide this service it is important for the selected bidder to have back to back arrangement with the OEMs. The selected bidder would be required to provide a copy of the service level agreement signed with the respective OEMs. Component that is reported to be down on a given date should be either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame indicated in the Service Level Agreement (SLA). In case the selected bidder fails to meet the above standards of maintenance, there will be a penalty as specified in the SLA.

Adequate onsite and offsite spare parts and spare component must be maintained by the successful bidder to ensure that the uptime commitment as per SLA is met. To provide this service it is important for the selected bidder to have back to back arrangement with the OEMs.

The selected bidder would be required to provide a copy of the service level agreement signed with the respective OEMs. Component that is reported to be down on a given date should be

either fully repaired or replaced by temporary substitute (of equivalent configuration) within the time frame indicated in the Service Level Agreement (SLA). In case the selected bidder fails to meet the above standards of maintenance, there will be a penalty as specified in the SLA.

Electrical Systems

- UPS systems and Batteries
- PSS
- DG
- PDUs
  All Electrical panels and Equipments.

Cooling Equipment

- PAC Units
- CAC Units
- Chiller Units
- Ductable Units

Building Automation System

- BMS system
- CCTV
- Public Address System
- Water Leakage Detection System
- VESDA
- Fire Alarm System
- Fire Suppression System Access Control System

DAILY CHECKS:

Access Control System:

- 24x 7 checking of Access System for alert and alarms.
- Monitoring of Status.
- Abnormality of System / errors
- Access Card Activity
- Report of Access to Data Center
- Report of Forceful Access (Invalid Access)
- Generation of Logs / reports and submission to FM Manager for review and necessary
- action/s Maintenance of reports
  Testing & checking of all Doors, Magnetic locks and Sensors.

CCTV:

- Daily Checking of DVR System & Cameras
- Suspicious Action Report

- Abnormality of System
- Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports

Fire Alarm System:

- Daily Checking of FAS Panel
- Immediate Action to Alarm Generated
- Monitoring of MCP
- Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports

Novec 1230 Gas:

- Daily checking of Pressure of Gas.
- Release Panel Status
- Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports

VESDA:

- Status of Panel
- Monitoring of Alarms.
- Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports

Water Leak Detection (WLD):

- Status of Panel.
- Monitoring of Alarms.
- Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports

Rodent Repelled:

- Status of Panel.
- Monitoring of Alarms.
  Generation of Logs / reports and submission to FM Manager for review and necessary action/s Maintenance of reports IBMS

Precision AC ,Chillerand Comfort AC

- Monitoring of PAC's Temperature every half an hour physically.
- Monitoring of Alarms & Immediate Action to it Comparison of Software readings with Actual Reading.

7. Fire Drill Test:

Maintenance Activities will be carried for the System/Devices in Coordination with Principle Engineer & Technician

Daily Reports:

1. Hourly basis monitoring of UPS & PAC & concern System

2. Reports of Energy meter reading of all meters.
3. Readings of main LTA Panel.
4. Fuel in DG fuel tank.
5. Immediate response to electrical complaints by any Working staff.
6. Following of effective power consumption chart provided by Customer.
7. Maintaining Critical Electrical parts.
8. Generation of Logs / reports and submission to FM Manager for review and necessary
9. action's Maintenance of reports

Weekly Reports:

1. All Electrical Systems Health Check Report
2. Vendor call tracking until closure
3. UPS & DG: On load Report.
4. Fire Alarm System: Reports of False Alarm.
5. Access System: Data Backup.
6. CCTV: Backup of DVR Status.
7. WLD: Test of Water Leak Detection Sensor Cable.
8. All System Health Report.
9. PAC, Chiller and comfort AC

Monthly Reports:

1. Follow up of schedule regarding PMC.
2. Presentation of consumption of meter units by Pie diagram.
3. Vendor Performance Reports.
4. Report of pending calls/problems.
5. MIS Report Presentation for Each Month

Call Logging Process with OEM/Vendors

The onsite team will get alerts on any issue in the data center. The onsite team will identify the area of problem and define problem severity into minor or major call. Call severity will be decided on basis of unit under suspect and impact on functions inside data center like - electrical power in DB, racks, cooling efficiency. Based upon this on site team will either manage to close the problem in case of minor alerts/alarms or In case of major alarms the team will raise an alarm over phone and email to OEM/Vendor with information to IITM designated team and O&M in-charge. O&M team will follow the Escalation matrix. The OEM will identify problem area and will work towards resolution of problem keeping SLA in consideration.

Once the call is completed the Operations team will record this log into the call register and update in daily monitoring report. Depending upon the severity of call and impact of business caused due to the call the Uptime will be calculated.

An incident report will be generated by Operations team and will be flashed within 24 hours of the time incident was reported with a preventive and corrective action description. This report

will be flashed after Operations in-charge scrutinizes the problem and provides concurrence to the Incident report. The action against preventive action will be tracked by Operations in-charge till its closure and approved by IITM.

a. Change Management

Any change in configuration of equipments due to loss of efficiency or isolated frequent failures of units deployed inside Data Center by O&M team will be the responsibility of Bidder. Even if O&M Team will own the responsibility of such changes in configurations the final decision of any such modification will be jointly discussed and agreed by both IITM and Bidder before the change is done.

Operation & Management Structure

Operating Timings and Procedure

- 24X 7X 365 days Operations of DC.

The minimum manpower required for operation and maintenance during warranty period and Comprehensive period as follows, however the bidder may propose extra manpower in order to maintain Data Center operational uptime of 99.9%

Shift In-charge will operate in respective shifts as per the below table

Shift	General (Supervisor)	I Shift	II Shift	III Shift
Timing	9:00-18:00	7:00-15:30	14:30-23:00	23:00-7:00

Sr.No	Technical Resource	Outsource	Qualification	Experience	Shift			Total	
					I	II	III	'General shift'	
1	Supervisor	Outsource	BE in Electrical / Electronics/ Mechanical /IT	4-5 yrs exp. Data center Maint.	-	-	-	1	1
2	BMS Operator	Outsource	BE/Diploma in Indust. Electron	3-4 yrs exp.in Fire & Security maint	1	1	1		3
3	Electrician	Outsource	ITI in Electrical with Govt. icense	2-3 yrs exp.in maint.of HT, LT supply,UPS,DG, Air condition system	1	1	1		3
4	Helper	Outsource	SSC pass		-	-	-	1	1
5	HVAC Operator	Outsource	ITI in AC Refrigeration with Govt.license	2-3 yrs exp.in maint. of Air condition system	1	1	1		3
					Total			11	

In each shift there will be two persons out of which one will be an electrician with minimum five years experience and ITI certified and the other as BMS operator with graduation & with minimum three years of experience

Roles and Responsibilities

SUPERVISOR

Responsible for overall management of the Data Center operation

Handle all infrastructure operation Management, leading a team of experienced technicians to operate the Data Center with respect to the Electrical, Cooling and BMS systems

Oversee the upkeep of the facility ensuring adequate manpower is available

Send MIS report to customer on health of the facility Conduct periodic audits

Co-ordinate for Statutory Approvals

Co-ordinate with OEMs for routine maintenance activities

BMS Operator and Electrician

Responsible for Electrical, Cooling and BMS Systems Operation Ensure the Data Center is manned at all times

Co-ordinate all Preventive Maintenance activities of the Electrical, Cooling and BMS systems

Periodic checking of critical parameters of the systems and filling in the log sheets maintaining the shift reports

Proper handover to the next shift In-charge

TECHNICAL SCORING CRITERIA

1	**Past Experience of the bidder**	**Maximum 10 marks**
	● Experience of the bidder in executing work similar to following criteria: (Minimum 2 projects - 5 marks each) • 5,000 sq. ft. server farm area • Experience in Design, Site Preparation, Supply, Installation, , Testing, commissioning, Operations and Maintenance of Basic Infrastructure o Minimum 11 KV system and associated equipment, o Minimum 1000 KVA transformer with multiple transformers, o Minimum 1000 KVA DG power with multiple DG sets and its synchronizing panel, o Minimum 500 KVA UPS and PDUs and o Minimum 300 tonnes chiller/gas based system with PAHU & high density rack cooling solution	
2	**Approach & Methodology (Implementation)**	**Maximum 7.5 marks**
	● Understanding of Scope of Work and Requirements ● Level of details captured in the Solution Design ● Implementation Methodology adopted ● Time and Effort required for the implementation ● How the Tenderer intends to bring experience / knowledge from prior projects on to this project (Basis - Case studies)	
3	**Approach & Methodology (Operations/ Maintenance)**	**Maximum 7.5 marks**
	● Understanding of Scope of Work and Requirements ● Operations/ Maintenance Methodology proposed ● Proposed Escalation structure ● How the Tenderer intends to bring experience / knowledge from prior projects on to this project (Basis - Case studies)	
4	**Technical Specifications**	**Maximum 65 marks**
	Data Center Layout	***10* marks**
	1. Has Tenderer optimally utilized available floor space to accommodate required no of racks? 2. How efficiently Tenderer has placed the racks in between the beams and utilized available height? 3. Has Tenderer optimally utilized available floor space to accommodate BMS Room, Storage Media Room, Store Room and Staging Area in available space? 4. How efficiently the available space is utilized for laying out the Cables, pipes and ducts? (Reference: Cabling, Pipes and Ducting Layout plan)	
	Power requirement	**Maximum 10 marks**
	1. Power consumption efficiency - How efficient is the conversion of raw power into usable power? 2. Estimated Electricity consumption each year	
	UPS	**Maximum10 marks**
	1. Proposed back-up time for full load operation (Maximum requirement = 30 minutes) 2. Efficiency of UPS running at partial load 3. Noise level generated by UPS (Maximum 65 DBA measure 1 meter away) 4. Compliance with Standards like IEC, EN, TU/GS(European), VDE (German), TIA 942	
	Emergency Power Supply	**Maximum 5 marks**
	How quickly DG sets come on-line automatically after AC mains failure? (Maximum requirement - 30 seconds)	

	HVAC	**Maximum 20 marks**
	• How well the Tenderer has grasped the Design philosophy & the Design Approach as described in the RFP and adopted that in their Design? • How efficiently is the HVAC system designed to cater to varying load requirements within Datacenter? • Has the Tender planned for Scalable and modular HVAC system which will keep initial investments lower and stagger CAPEX and running costs based on growth • Methodology proposed by the Tenderer to ensure the HVAC systems is able to function in the event of a duty equipment failure. In short have they eliminated all single point of failures in design? • How good the Level of accessibility is provided to all HVAC equipments for maintenance and can the Tiered Infrastructure Maintenance Standard III (TIMS III) be done without calling for interruption of service? • Has the Best practices as mentioned in the RFP adopted in designing the HVAC system? • Has the Tenderer used the best of equipments in the Design? • Is the HVAC design Flexible to accommodate future changes in IT configuration?	
	• How well the Tenderer has grasped the Design philosophy & the Design Approach as described in the RFP and adopted that in their Design? • How efficiently is the HVAC system designed to cater to varying load requirements within Datacenter? • Has the Tender planned for Scalable and modular HVAC system which will keep initial investments lower and stagger CAPEX and running costs based on growth • Methodology proposed by the Tenderer to ensure the HVAC systems is able to function in the event of a duty equipment failure. In short have they eliminated all single point of failures in design? • How good the Level of accessibility is provided to all HVAC equipments for maintenance and can the Tiered Infrastructure Maintenance Standard III (TIMS III) be done without calling for interruption of service? • Has the Best practices as mentioned in the RFP adopted in designing the HVAC system? • Has the Tenderer used the best of equipments in the Design? • Is the HVAC design Flexible to accommodate future changes in IT configuration?	
	Fire Detection & Prevention	**Maximum 5 marks**
	• How optimally the complete datacenter area is covered with adequate number of fire sensors?	
	Data Center surveillance & Security	**Maximum 5 marks**
	• How optimally the complete data center area is covered with adequate number of CCTV cameras? • Logical division of datacenter space into multiple zones with graded security	
5	**Management**	**Maximum 10 marks**
	Experts for (Curriculum Vitae of Key People to be submitted)	
	Datacenter Design	2.5
	HVAC	2.5
	Power and Electrical	2.5
	Subcontractors deployed for the project	2.5

- Technical Bids receiving a score greater than or equal to a cut-off score of 70 % with a minimum of 75% marks under "4 - Technical Specifications" and minimum of 50% score in remaining individual parameters will be eligible for consideration in the subsequent rounds. If required, the Purchaser may seek specific clarifications from any or all Tenderer(s) at this stage. The Purchaser shall determine the Tenderer that qualify for the next phase after reviewing the clarifications provided by the Tenderer(s).
- Any bid found to be unsatisfactory in terms of any of the evaluated parameters as mentioned in 27.5.3 may be rejected and will not be considered for commercial evaluation. Bids that are technically qualified would only be taken up for commercial evaluation.

SECTION-I

DEVIATIONS FROM GENERAL CONDITIONS

All deviations from General Conditions of Contract shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from general conditions of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

SECTION-J

DEVIATIONS FROM TECHNICAL SPECIFICATIONS

All deviations from Technical Specifications shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from Technical Specifications of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

PART 5- TECHNICAL & FUNCTIONAL SPECIFICATION

ELECTRICAL

1. This specification covers in brief the requirements for the installation HT works, related LT power & control Cable works, earthing, Transformer installation and the downstream installation. It is not the intent to specify herein all the details of material, equipment, installation, testing and commissioning; however the same shall be of high standard of engineering and shall comply to all currently applicable Standards, Regulations and Safety Codes, Maharashtra State Electricity state Board practices. Also it is not possible to specify the quantity of every item, but it is Bidders' responsibility to execute the job with recommended engineering practices in best workable manner. Material specification for major equipment such as Metering Kiosk, HT Panel, LT Panels, Transformer, DG, UPS, LT Panels and Cables etc. shall be issued separately provided these are part of contractor's scope of supply. The same shall be confirmed by contractor in writing with client prior to material procurement.

2. Necessary clearances such as- horizontal clearances from structures / live conductors / building, vertical Clearances from ground, span, sag etc. as per I.E. rules and other statutory Requirements shall be followed. The drawing furnished along with tender is indicative and contractor to prepare working details.

3. Necessary correction in 'tender Bill Of Quantities' and rates thereof shall be carried out as the final arrangement is decided, in such cases rates shall be derived from unit rates quoted or as per 'rate analysis' submitted by contractor and evaluated by DIRECTOR IITM PUNE.

4. HT/LT Switchgear Panels, HT/LT Cables, Power and Lighting DB and Control Panel.

5. This shall be applicable to switchgear panels, power and light distribution boards, instrument distribution boards, DCDB, control panel, etc. Manufacturer's instructions, drawings and instructions of the Engineer-in-Charge should be studied and strictly followed during handling, erection, testing and commissioning of the switchgear. The panels should be handled with care, avoiding impact to the equipment, by the experienced riggers under the guidance of a competent supervisor. Dragging of the panels should be avoided and use of a crane and trailer should be made for the handling purpose while transporting to various sites. The panels should be properly supported on the truck or trailer by means of ropes to avoid any chances of damage or tilting due to heavy vibrations. The panels should be lifted by making use of lifting eye-bolts only, fully tightened after ensuring that panel supports, nuts and bolts are all intact and tightened. When lifting panels, utmost care should be taken to avoid any damage to insulators, bushings, metering and protective equipment. The panels should be preferably kept inside the cases till foundations are ready.

6. The panels should be taken out from the packed cases and moved one by one to the proper place. All the panels should be assembled, aligned and levelled and it should be ensured that panel to panel coupling bolts, busbar links fit properly without any strain on any part. It should also be checked-up that lowering, lifting, racking in and out operation of the breaker and all other motions are free from any obstruction. The fixing bolts should be grouted only after satisfying all these requirements. All Switchgear of any other equipment

supplied & installed by contractor shall be tagged with engraved name-plate indicating device no & the source of supply panel.

7. The panel erection will consist of the following:

   Placing the panels on the foundation, aligning and grouting / tak welding to supporting structure wherever possible. Levelling shall be within ± 1 mm with respect to the level specified. The panels shall be made vermin and dustproof with M-Seal for Interpanel joints as directed by Institute. Checking the equipment for any apparent damages and informing the Director IITM Pune. Measuring the insulation resistance value and improving the same, if required by approved methods.

   Checking the control circuit for operation, interlock, indication with only control supply 'ON' and all control connections made.

   Checking the name-plate details of the feeders as per drawings. Checking the bimetal relay ranges for the motors and setting the relay at full load current stated on the motor name-plate. Dressing and clamping of cables inside the equipment. Cleaning the equipment with vacuum cleaner before energising.Pre-commissioning tests like continuity checking, megger, interlock checking, direction of rotation of motor, operation of motors from various control points. Painting the cable numbers on the respective compartments (near terminal block)

   Tightening the busbar / link connection and checking connections at terminal block. Draw out modules shall be taken out if required. Pasting the vendor wiring diagram reference on compartment door (inside).Checking the mechanical operation of all switches, circuit breaker and similar items and the door interlocking arrangement. Connecting the earth busbar of the equipment to the main earthing ring and painting the same green for easy identification.

   Checking the measuring and indicating instruments for operation. Plugging the unused cut-outs for cable glands in the equipment after completing the cable connections. Touch-up painting of panels, wherever required. Checking of all Components in Feeders with respect to vendor SLD and Bill of Material. Prior to Panel hand-over, all feeder Nos. & description shall be provided on new engraved name plates in place of old ones.

Transformers

Handling

When lifting a transformer by the lugs or shackles provided for this purpose, simultaneous use should be made of all such lugs and shackles in order to avoid any unbalance while lifting. Before lifting, complete transformer, it should be ensured that all cover bolts are tightened fully. In case where it is necessary to use jacks for lifting, projections provided for the purpose of jacking should be used. Jacks should never be used under valve or cooling tubes.

It may be necessary under certain circumstances to place jacks under stiffening curbs on the tank base. For transporting transformers from stores to site, the transformers shall be loaded on a suitable capacity truck or trailer.

The transformers shall be properly supported by steel ropes and stoppers on the trailer to avoid tilting of the transformers in transit due to jerks and vibrations. At no instance, a transformer shall be kept on bare ground. Where it is not possible to unload the transformer directly on a foundation, these shall be unloaded on a properly built wooden sleeper platform. A transformer shall never be left without putting stoppers to the wheels.

Damages of any nature shall be brought to the attention of AEPPL/Client before lifting material from stores failing which it will be to contractor's account.

Following checks are to be carried out:

All the accessories have been fixed properly and transformer body and neutral are properly earthed. The transformer dehydration is over and results are satisfactory and approved by the Engineer-in-Charge.

The oil level, in the transformer conservator tank and all the bushings is up to the marked point and the oil has been tested for dielectric strength.

The Silica gel is in reactivated condition; the breather pipe is clear from any blocking and contains oil up to the proper level.

The explosion vent diaphragm does not have any dents accumulation of any oil and air had been released.

The operation of off-load and on-load tap changers on all the tap positions is satisfactory. The mechanical parts of the on-load tap changer are lubricated. Break shoes are OK.

Motor IR value taken and tap position mechanical indicator on the transformer and tap position indicator meter on the control panel are reading the same tap positions. Tap changer limit switch are operating alright on the maximum and minimum tap position, on load tap changer contact pressure and resistance is as per manufacturer's recommendations. Oil level of tap changer tank is OK and oil has been tested for dielectric strength.

The Bucholz relay has been checked up for any friction in the movement and floats are free. All the other protective relays, alarm and annunciation relays have been tested.

All the metering equipment has been tested. Polarity test of transformer winding is alright. Phase sequence and connections have been checked for proper vector group.

The ratio test on all the tap positions is alright.

Gaps of arcing horns for the bushings are alright and earth connections for the surge diverters have been checked.

The winding & oil temp. Thermometer pockets contain oil.

The transformers fitted with fan for forced air cooling have been checked.

The simulation tests for all the alarm, annunciation and trip circuits have been checked and are alright.

The insulation resistance of all the control circuits and IR value of the transformer windings and all the incoming and outgoing cables have been checked and in order.

All the valves in the cooling system and valve between the Buchholz relay and the conservator tank are in open position.

The transformer has been cleaned from outside.

The earth leads have been removed if shorted for testing purposes.

All the tools and other materials have been removed from the transformer vicinity.

The setting of all the protective relays in at the desired value and DC trip supply is available.

The fire fighting equipment is ready.

CABLES

Cables shall comply with the latest editions of following standard, as applicable,

BIS : 1554 Part 1 PVC insulated electric cables (Heavy duty)

BIS: 7098 Part 2 Cross- Linked Polyethylene Insulated PVC sheathed cables

BIS : 8130 Conductors for insulated electric cables and flexible cables

1.1 KV grade cables: All LT power cables shall be 660/1100V grade, with aluminium conductor for size 10 Sq.MM and above. Power cables of sizes up to 6 Sq.mm. shall be with copper conductors

Construction

- Conductor – Shall be solid up to and including 6 Sq.mm. and stranded above 6 Sq.mm. Conductor shall be as below –
  a)Copper conductor – Stranded, class2, as per IS 8130

- AL conductor - Stranded, grade H4, class 2 as per IS 8130
- Insulation- Conductor insulation shall be of extruded PVC compound type
- Inner Sheath –extruded, black, PVC compound type ST-1
- Armour - made up of Al. strip / or single G.I. strip / G.I. wire
- Outer sheath- extruded, black, PVC compound type ST-1

22kV Earthed Grade XLPE cables

Cables shall have following construction:-

- Conductor – AL conductor - Stranded ,grade H4,class 2 as per IS 8130
- Conductor Screen – Extruded semi conducting compound in combination with non-magnetic metallic tape and XLPE compound insulated
- Inner Sheath – Extruded black PVC compound type ST-2
- Outer Sheath – Extruded black PVC compound type ST-2
- Armour - Steel strip Al / G.I.
- Cores shall be identified by Printed numerals of Phase.
- Voltage rating will be 22kV Earthed.

Tests

- All routine tests as per relevant IS shall be carried out on each size of cable required for the project.
- The manufacturer will furnish type test certificate.
- In addition to above mentioned test the cables shall be subjected to following tests:-
    - Water tightness test.
    - Saline bath test (in accordance with CEGB recommendations 628)
- Inspection of cables will be held at the manufacturer's works at following stages:
    - During manufacturing process while applying insulation.
    - Final inspection for carrying out tests.
- The copies of routine and type tests shall be submitted at least one week prior to final inspection.

Cable Drums

- Cables shall be supplied in non-returnable drums of sturdy construction. All ferrous and other metal of drums shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage.
- The length of cable on each drum shall be determined by the manufacturer considering the transport limitations from manufacturer's works to the site.
- The cut ends shall be sealed by means of non-hygroscopic sealing materials.
- The cable drum shall be marked with following information :-
    - Trade name
    - Cross sectional area of the cable with no of cores.
    - Voltage grade and type of cable.
    - Lengths of cable, weight of cable drum including cable.
    - Direction of rotation of drum by arrow marking.
    - IS certification mark.

  Manufacturer shall indicate the maximum length for each size of cable, which can be furnished on one drum. However, before packing the cables on drums, the successful manufacturer shall obtain purchasers' approval for the drum length.

Cable Accessories

Manufacturer shall include in his offer, the equipment and materials required for making cable splice and cable terminals. Full details of the splicing and terminating procedures shall be given by the manufacturer.

- The total creepage distance of the outdoor porcelain insulators of cable sealing ends shall be suitable for heavily polluted saline atmosphere and shall in any case not be less than 25 mm per KV of highest line to line voltage. The protected creepage distance shall be half of the total creepage distance. The insulators shall be washable under live conditions by hot line washing equipment.

Information to be given by manufacturer

In addition to the standard information, the manufacturer shall provide the following information with the offer.
Detailed drawings with dimensions of the cable and all accessories including
Cross sectional view of cable, indicating the material used in each type of construction. Splices, straight joints and trifurcating boxes.
Terminations, showing mounting arrangement
Complete specifications of covering used to protect sheath and reinforcing tapes from corrosion.

Describing information regarding cable and accessories and test of installations of similar cables now in service with description, cable performance, and outages suffered and cause of outages.

Recommended method for locating conductor faults, apparatus required for locating the faults and their price.

Transporting the cables from stores to place of installation. The drums under the custody of the contractor shall be neatly arranged in the yard near his site office.

The drum shall not be rolled for transportation more than 10m Truck / Trailer shall be used for transportation for distance more than 10m.

The cables shall be rolled out for equipment and cutting shall be as per site requirement. Cable jacks and cable rollers shall be used during laying of cable.
Electrical Contractor shall cut all cable length by actual measurement at site as per final route determined. Cable lengths indicated in Cable Schedules shall be used only to get an idea of length involved.

The cables shall be tested for insulation value before laying. Drum Schedule to be prepared by contractor.

The Cables shall be laid in trenches, trays, along walls or structural support as per the requirement. The cables shall be neatly laid and clamped. The crossing of cables shall be avoided. The arrangement of cables on the tray / trench shall be decided based on the cable schedule and layout drawings and shall be approved by the Institute.

Clamping of cable shall be done by 18 SWG thick aluminium clamps at an interval of 0.5 mtr. for vertical run and 1 mtr. for horizontal run. When cables are cleated on wall / structures, the spacer and saddle shall be used at 300 mm interval or less depending on the location and shall be approved by Institute.

The cable terminations shall be done as per standard practice and crimping type of terminations shall be considered.

The glanding shall be done with suitable arrangement for earthing the gland. Wires / sleeves required for effectively earthing the glands shall be included in the termination materials.

The unused cores of the multicore cables shall be properly taped.
The tag carrying the cable number shall be at interval of 20 mtr. for underground cable and 30 mtr for above ground cable and at all bends and route changes of the cable run. Material of tag will be aluminium for above ground cables and of lead for buried cables. Sample of tags shall be approved by Institute.

The cable numbers shall be painted near the terminal blocks in MCC / Distribution Boards / Switchboards.

For main power cables loops shall be provided near terminations.

All cables coming from floor / trench shall be taken through a G.I. Pipe. The length of the pipe shall be decided by the contractor and approved by the Institute.
The glands supplied by the contractor shall be suitable for cable sizes mentioned and if necessary reducers shall be provided by the contractor. The contractor shall indicate the requirement of reducers and supply the same after approval of rates by Director IITM Pune.

The contractor shall supply and install the ferrules for multicore cable connections. The ferrule markings shall be identical to the wires connected to the terminals.

The Lugs used shall be tinned Copper for Copper Cable and Aluminium Lugs for Aluminium Cable, crimping type of reputed make. The Lugs used for multistrand control cable shall be PVC sleeved crimping type copper lugs.

The connections between the junction boxes/control panels to components like pressure switches, limit switches shall be through flexible conduits. The length of each of the flexible conduit shall not exceed 120 cm.

The cables coming from switchboards to the cable tray shall be taken through branch trays and the cables shall be clamped neatly. The arrangement shall be approved by Institute.

Main cable runs are to be routed as shown on the contract drawings. Any modifications found necessary due to site conditions must be approved by Institute. Details of routes not shown on these drawings are to be determined on site by discussion with Client.

PVC insulated and / or served cables shall not run parallel within 100 mm of, or be installed above and in line with, any heated pipes or duct. Where crossing above heated pipes or ducts is unavoidable the cable must be kept at least 150 mm from the outer surface of such pipes or ducts or the insulation thereof.

On main horizontal cable runs where cables are supported, suitable mild steel saddles, cleats or clips shall be used. Between these fixing points cables shall be laid neatly in position on the intervening racks. On vertical cable runs and horizontal runs other than the main horizontal runs, cables shall be fixed at one metre intervals. Where different sized cables are together the maximum fixing intervals are to be those required for the smallest cable, unless the smaller cables are bunched with larger cables and supported by them throughout the complete multi-cable run.

NOTE: Where the contract drawings indicate that the cables are to be run or fixed other than in accordance with this specification, the drawings shall be deemed to be correct.
Cable run in RCC trenches are to be run on the floor along the sides on suitable brackets and located 75 mm minimum from floor of trench. Cable ducts in the ground shall be sealed against the ingress of water, foreign matter and vermin, at both ends by means of non-setting compound and / or suitable wood plugs fitted over the cable and into the duct. Where ducts are not in use they shall be sealed in a similar manner.
Cables laid direct in the ground shall be laid on a bedding of 150 mm of sand and covered by 150 mm layer of sand, on top of sand tiles / bricks covering to be done. The depth of laying shall be such as to provide 750 mm minimum cover for low voltage cables and 1000 mm cover for high voltage cables.

All non used open entries in equipment and open ends of conduit are to be sealed by means of conduit plugs (or blanking plates if entries are not of standard conduit sizes) at all time.

NOTE: This is particularly important where equipment is located in position, but electrical installation is incomplete.

Where cables pass through floors, they shall be protected by metal / PVC pipes or other suitable means. Holes in floors, walls, etc. will be made and reinstalled by the contractor unless otherwise stated.
All cables laid underground shall be protected with good quality brick and interlocked concrete tiles marked "Electric" or "Telephone" cables.

Cable joints shall be mechanically and electrically sound and except for buried cables they shall be accessible for inspection. Underground joints shall be specially protected with a double layer of bricks and cast iron joint markers (marked 'Cable-Joint'), shall be installed to indicate the position of the joint.
Where corrosion of armour or gland might occur, it shall be effectively protected by suitable means.

The contractor shall test all cables for proper insulation before they are transported for laying and shall furnish a certificate of acceptance to this effect. Any damage to the cable subsequently shall be made good by the contractor at his own cost. After the test of insulation, the cut ends of cables shall be sealed properly with waterproof material to prevent ingress of moisture.

Cable Marking
All Cables shall be externally marked at either end with the respective identification numbers by means of non-deteriorating material. Cable Markers shall be approved by Institute.

Where conductors are left to be terminated by another party or left to be connected later, they must be individually identified.

Heat Shrinkable Type H T Cable Termination Kits

Cable termination kits shall be outdoor or indoor type as specified in the BOQ.
These kits shall be of PVC heat shrinkable type only. Compound Filling type termination kits are not acceptable.

Cable termination kits shall be suitable for XLPE cable of given size.

Voltage grade Of the kit shall be considered as EARTHED type that is 33 kV (E)As per cable voltage grade.

Cable Glands

When preparing cables prior to fitting glands, the gland manufacturer's instruction for cable preparation shall be observed. In all cases where armoured cables are used care shall be taken to ensure that the lay of the armour is maintained after the gland is completely fitted.

Where compound boxes are used for terminating cables, the compound must penetrate fully and leave no air holes. Where hot pouring of compound is employed,

'topping up' must be carried out as soon as possible after the first filling. The pouring temperature of the compound must not be high enough to damage the cable insulation.
All terminations of paper insulated cable shall incorporate damp barriers in each conductor. The insulation shall be removed to leave approximately 15 mm to 20 mm of the conductor exposed, and the conductor shall be soldered at this point.

The preferred method of terminating conductors is by means of solder less compressed connectors. Deviations from the above shall be subject to approval of Institute.

Connectors shall be of the correct size for the conductor concerned and as manufactured by Dowell's or approved equivalent.

All connectors shall be marked with the size reference for identification with the correct compression tool. This reference shall be located on the palm of the connector and
shall be remote from the contact faces where possible.
The palm of the connector shall be of such shape and size that standard washers to relevant IS applicable to the size of stud for which the connector is designed shall lie flat on both faces of the connector palm when the holes in the washers and the palm are co-incident.

Compression tools shall be designed and supplied for specific use with the connectors used, and shall be regularly services by the maker.

LT PANELS
Construction

The switchboard shall be totally enclosed, metal clad, sheet steel fabricated, compartmentalized, dead front type, dust and vermin-proof, freestanding, floor mounting type. It shall be of unit construction suitable for splitting into sections for shipping to site and to be correctly re-erected on prepared foundations without skilled supervision. The individual shipping section length shall not preferably exceed 2 metres. Provisions shall be made for addition of future units on either ends of a switchgear line-up after its installation on site. End busbar fishplates shall be provided.

The switchgear shall be easily extensible on either side by the addition of vertical sections. It shall be possible to extend the switchgear, irrespective of the type of end panel and the design shall be such as to permit addition of extension panels of a type other than the type of end panel. Any adapter panels required shall be included in the basic price and indicated clearly in the technical particulars furnished.

The switchboard shall be fabricated preferably from cold rolled sheet steel of minimum thickness 14/16 gauge.

The height of the switchboard shall be constant throughout its length, but not exceeding 2400 mm.

Adequate lifting facilities such as hooks for ease of handling on site shall be provided. These hooks when removed shall not leave any openings in the switchgear.

Front access shall be available to all components in each cubicle, which require adjustment, maintenance or replacement. Checking and removal of components shall be possible without disturbing adjacent equipment. All auxiliary equipment shall be easily accessible. Setting of relays shall be possible without de-energizing other equipment.

Rear access shall be available to all cable glands and multicore terminal blocks by means of sheet steel hinged doors, designed to give the maximum possible access to the cable terminations. The cable alley door shall be provided with bolts, which can be opened with special keys by authorized persons.

Each unit of switchgear shall have necessary interior barriers to form separate compartments for buses, switching devices entering cable connection etc. All barriers shall be manufactured from non-inflammable material, preferably of sheet steel.

Each compartment shall be constructed and segregated to confine any damage caused by an internal fault to that compartment.

Adequate barriers shall permit personnel to work safely within an empty switching device compartment or one from which the switching device assembly has been temporarily removed with bus energized.

The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders.

The arrangement of the feeders shall ensure that operating handle of the switch / breaker shall be above 300 mm but below 1800 mm from ground level.

Removable type undrilled gland plates shall be provided on bottom of the panel. Gland plates shall be 3 mm thick sheet steel.

Suitable provision shall be made for clamping cables inside the switchboard.

The cable terminations inside the cable alley shall be completely shrouded so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.

All bezels, handles, screws, bolts, washers, hinges and other embellishments shall be of the best quality electro galvanized or passivated to withstand attack from corrosive atmosphere.

The fabricated parts shall undergo a treatment of degreasing, pickling and two coats of primer before being given the stoved enamel finish. The final finish shall be of colour shade 631 as per IS-5 or RAL-7032. Two coats of final paint shall be applied. Proper care shall be taken to grind the welded joints to give a smooth appearance after painting.

The external finish of the board shall be of the highest standard.

The external and internal surface of the board shall be stove enamelled finish unless otherwise specified.

Adequate packaging against damage and deterioration shall be provided for transportation to site and subsequent storage prior to re-assembly.

Horizontal busbar chambers shall be at the top of the board. Busbars shall be completely shrouded to prevent metal pieces falling on the busbar during maintenance.

The busbars shall be of aluminium with continuous rating as given in the SLD. All busbars and their main current carrying connections shall have preferably the same sectional area throughout their length. The busbars shall be colour coded.

The busbar sizes shall be determined taking into consideration the continuous rating without exceeding the final temperature of 45o C over maximum ambient temperature and the fault level specified. The busbars shall be supported by insulators on non-carbonizing material resistant to acid and alkali and having non-hygroscopic characteristics and braced to withstand the fault level specified.

Auxiliary busbars each of minimum size 18 sq mm copper shall be provided for following applications. Exact number of busbars shall depend on various control, metering and auxiliary power distribution requirements specified in specific requirements.

1. Panel / Motor space heater supply.
2. AC / DC control supply for breaker tripping closing and indication circuits.
3. AC / DC control supply for breaker spring charging motors.
4. AC control supply for motor starter control and indication circuits.
5. AC potential supply for KWH meters.

Earthing - Two earth terminals shall be provided on each switch cubicle, at the back, near the floor. An earth bar of at least 50 x 6 mm copper shall be fixed to these terminals. The earth bar shall be electrically continuous and shall run the full extent of each board. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and earth terminals of the unit. Suitable holes with bolts and lugs shall be provided at each end of earth bar of switchgear for connection to a main earthing grid of 50 x 6 mm GI bus. The earth bar shall be accessible in each cable entering compartment either directly or through a branch extension to ground the cable armour and shields.

Bus bars and connections shall be secured in such a manner that the insulators are not subjected to bending forces under short circuit conditions. The vertical dropper shall be sized to carry continuously at least the rated current of the connected switching devices. When multiple switching devices are combined in tiers for a vertical unit, the droppers shall be able to carry the total current resulting from the combination of all switching devices. The vertical busbars shall be completely shrouded with the cut-out for connection tappings.

In case of copper to aluminium connections, proper treatment shall be given to minimize the bimetallic effect. That is, all joint surfaces at aluminium to copper joints shall be silver / tin plated, alternatively Cu-Al. washers (bimetallic washers) may be used.

Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical bus bars and control terminals / wiring, etc., such that the same could be used for housing outgoing breakers in future without any modifications to the panel. All quotations must indicate the number of circuit breakers, which could be provided in unused space for each switchboard line up. Unit price for providing such outgoing circuit breakers shall be quoted which could be considered during placement of order.

The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders.

Incomer and Bus Coupler ACB shall be limited to one per panel.

Nameplate or polyester adhesive stickers shall be provided for each equipment (lamps, push buttons, switches, relays, auxiliary contactors, etc.) mounted on the switchboard. Special warning

plates one each on each front of a shipping section shall be provided on removable covers of doors giving access to cable terminals and busbars. Special warning labels shall be provided inside the switchboard also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

Engraved nameplates shall preferably be of 3 ply (Black-White Black) lamicoid sheets or anodized aluminium. Nameplates shall be fastened by screws and not by adhesives.

ACB feeders for outgoing shall be limited three per panel subject to Director IITM Pune approval on GA diagram.

SFU feeders for outgoing shall be limited to three per panel.

The feeders shall be arranged in the ascending order of alphabets followed by ascending order of equipment, e.g. A33801, M3402, and P211.

Manufacturer shall furnish the general arrangement drawing of switchboard along with the quotation. The General Arrangement drawing of switchboard shall be subject to Director IITM Pune approval.

Circuit Breakers

The circuit breaker shall be triple pole, air break, and draw out type with solid manually detachable type neutral. Unless otherwise stated elsewhere, the circuit breakers shall be draw out type.

The charging mechanism of the circuit breaker shall be manual / motor operated spring charged independent type. The close / trip control switch to be interlocked to trip before close. The closing and tripping circuits shall be self-opening on completion of their respective functions irrespective of the position of the control switch. Manual closing devices shall also be provided.

The circuit breaker shall be electrically and mechanically trip free. For all electrical circuit breakers anti-pumping device shall be incorporated.

The breaker shall be provided with minimum 6NO + 6NC auxiliary contacts. 20% auxiliary contacts (Min. 3 NO + 3 NC) shall be provided for Director IITM Pune exclusive use. All spare contacts shall be wired upto terminal blocks. Auxiliary contactor or relay shall be used to multiply contacts.

The auxiliary contact for the shunt trip shall be of advanced nature such that the auxiliary contact close before main contacts.

The main and secondary isolating contacts of the circuit breaker shall be of self-aligning type.

The main isolating contact shall have continuous rating equal to the rating of the breaker.

The secondary isolating contact shall be of wiping contact type.

The fixed portion of the circuit breaker shall have rail arrangement over which the chassis can move smoothly.

It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.

The breaker shall have 3 distinct positions, such as "SERVICE", "TEST" and "ISOLATED"

Proper mechanical indication shall be provided to locate these three positions without opening the compartment door.

It shall be possible to further withdraw the breaker from isolated position for inspection of the circuit breaker "withdrawn" position.

A stop block shall be provided on the slide rails to prevent the forward movement of the circuit breaker when it reaches the isolated position so that any accidental fall can be avoided. Provision shall be provided to padlock the breaker in all the three positions.

The following interlocks shall be provided on the circuit breaker:

1. It shall not be possible to withdraw the circuit breaker from the service position with the contacts of the breaker closed.

2. It shall not be possible to close the circuit breaker unless any one of the three positions is located, the service position, a definitely located test position, or isolated position.

3. It shall not be possible to open the compartment door when the circuit breaker is ON.

4. It shall not be possible to push breaker in if either set of safety shutter is not free and not in its normal closed position.

5. The circuit breaker can be padlocked in OFF position.

6. The castle interlocking shall be provided as per the SLD

- The circuit breaker shall be provided with mechanical ON/OFF, TRIP and SPRING CHARGED indication, mechanical trip push button, operating handle or `close' push button, in case of electrically operated circuit breaker and padlocking facility wherever specified.

- In case of electrically operated breaker, emergency operating handle shall be provided.

- It shall be possible to close the circuit breaker with the emergency operating handle without opening the compartment door.

- Wherever cutouts are provided for the control box, proper gaskets shall be provided. Provision shall be made for closing the cutout provided for the control boxes when the C.B. is taken out of the compartment.

- The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches `isolated' position the main isolating contacts are completely shrouded.

- The circuit breaker compartment shall be so designed that hot gases produced shall be lead away from the operator.
- The protective relays and instruments shall be mounted as near to the circuit breaker as possible. Separate compartment for the instruments and relays shall be provided.

- When the circuit breaker compartment door is open, it must not be possible to touch the live parts.

- All removable covers protecting live parts shall be clearly labelled with warning notices reading "LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER'.

- It shall be possible to readily remove the arc chutes for routine inspection of the contacts with the circuit breaker in the "withdrawn" position.

- All circuit breakers of same rating shall be identical in all respects and shall be interchangeable.

- All the non-conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding contacts shall be arranged to make before power plug in and interrupt after power draw out.

Switches –
The switches shall be quick-make, quick-break heavy-duty type.

The switches shall be able to make and break 300% of the rated current at 0.3 P.F. as required by IS-4047.

The operating handle shall be mounted on the door of the compartment housing the switches. The switches shall be provided with an interlocking arrangement such that when the switch is ON it shall not be possible to open the compartment door.

It shall also be ensured that closing of the switch when the compartment door is open shall not be possible.

- To facilitate closing of switch with door open during maintenance / testing, interlock defeat mechanism shall be provided.
- The castell interlock shall be provided, wherever specified in the SLD.
- In case of switch fuse feeders, the switch rating shall be equal or greater than the fuse rating.
- The switch shall be provided with padlocking facility in OFF position.
- All removable covers protecting live parts shall be clearly labelled with warning notices reading "LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER".
- Rating of the switches shall be as given in the SLD.

HRC Fuses

- Fuses provided shall have rupturing capacity greater than the fault level specified.
- Fuses shall be of link type and shall conform to the relevant Indian Standards. They shall be of class 3 AC duty.
- Fuses for motor feeders shall be decided taking into consideration bimetal relay characteristics provided.
- Rating of the fuses shall be as given in the SLD.
- Delayed action fuses shall be preferred for motor feeders.
- Indication shall be provided in the fuses to indicate the fuse has operated. Operating indicator shall be visible without removal of fuses from service. Removal of fuses, however, must be possible, although full voltage may exist at the terminals. Fuses shall be pressure fitted type.
- Fuse handle shall be supplied along with switchboard.

Contactors

The air break contactors shall be of triple pole type. Contactor shall have at least 2NO + 2NC contacts for Director IITM Pune use. The auxiliary contacts shall be wired to the terminals. The contactor coil shall be suitable for control voltage of 230V AC. The coils shall have grade 'E' insulation and shall be suitable for use in the ambient temperature. The design of the contactor shall ensure easy access to auxiliary contacts and coil. Mechanical ON-OFF indication shall be provided for the contactors. Wherever mechanical indications are not provided, indicating lamps shall be provided for ON indication of the contactor. The contactor shall pick up at 85% of the control voltage and shall not drop out for voltage upto 45%. The control voltage for motor starter circuit shall be 240V, single phase, 50 Hz, unless otherwise specified.

Relays

The relays shall conform to the requirements of IS-3231 and IS-4483.

All relays specified shall be flush mounted in dust proof cases and shall match the appearance of the instruments mounted on the same panel.

Protective relays shall be of the easy withdraw able type. Trip circuits shall be automatically broken and current transformer secondary circuits shorted, when a relay is withdrawn from its case. A marking strip shall be provided in front of each terminal block and a diagram plate at the back of each case to identify connections.

- Relays contacts shall withstand repeated operation and shall make or break the maximum currents in their circuits without deterioration. All spare contacts shall also be wired upto the external terminals.
- Relay coils shall carry their normal currents indefinitely and such currents as can occur under fault conditions. Relay mechanisms shall not be affected by vibration or magnetic fields, which may occur in normal operation.
- All relays in tripping circuits shall have mechanically operated flag indications. Indicators shall be capable of being reset without opening the relay case. It shall not be possible to operate

any relay by hand or to alter its setting without opening the case. For relays with combined functions such as inverse time and instantaneous trip, separate indications of each function as specified shall be provided.

- Master tripping relay (Lock-out Relay) shall be of the hand reset type and shall have a reasonable number of spare contacts, both normally open and normally closed, in addition to those required by the protection and tripping scheme.
- Provision shall be made for insertion of test plug at the front for testing and calibration using external source of power without disconnecting permanent wiring. Test plugs shall permit the shorting of any current transformer circuit.
- Relay covers shall be of non-ignitable materials. Relays on which the function of a contact may be changed from NC to NO and vice-versa by simply changing the contact arrangement are preferred.
- All relays pertaining to a feeder shall be accommodated in the same vertical section.

Bimetal Relay

Bimetal relays shall be heavy duty, (wherever mentioned) ambient temperature compensated type. The selection of bimetal relays shall be based on the absorbed horsepower of motor given in the data sheet. Proper co-ordination shall be ensured between bimetal relay and the back-up HRC fuse provided. The bimetal relay shall be of hand reset type preferably with facility to change to self-reset at site, if necessary. The bimetal relay shall be provided with changeover contact for alarm indication. It shall be possible to reset the relay only after opening the compartment door, if so specified. BMRs shall be with built in single phasing protection. Equipment like fans, blowers, etc., shall be provided with suitable saturable CT operated BMR. For saturable CT operated BMR, Single Phasing Protection Relay shall be separate, if specified.

SINGLE PHASING PREVENTER RELAY (SPPR)

If specified Single Phasing Protections shall be provided in all motor starter modules with contactor rating of 200 Amps and above. The Single Phasing Protection shall be of the current operated type and shall operate on the principle of sensing negative sequence of current.

In case of single phasing, the Single Phasing Protection shall operate after a time delay of 2 to 3 sec. The relay shall be of the hand reset type and visual indication of the relay operation shall be available.

The Single Phasing Protection shall be suitable for protection of the non-reversible and reversible motors.

Current transformer operated Single Phasing Protection Relay shall be provided for feeders, if specified.

Thermal overload relays shall be provided with minimum 1NO + 1NC contacts with a rating of 5 Amps at 240V, 1 phase, 50 Hz AC and 1.3 Amps at 110 V DC (inductive load).

Indicating Instruments & Meters

- All indicating instruments and meters shall be capable of carrying continuously their full load currents and full voltage across their pressure coils. They shall not be damaged by the passage of fault currents or the existence of over pressure on the primary side of their instrument transformers for the maximum permitted duration of fault conditions, which may occur during normal operation. All instruments and meters shall be back connected.
- For incoming feeders, measuring instruments shall be of 96 x 96 mm square pattern, flush mounting type, 72 x 72 mm instruments shall be used for outgoing feeders. Instruments shall be provided wherever indicated in specific requirements. All auxiliary equipment such as shunts, transducers, CTs, VTs that are required shall be included in the supply of the switchboard.
- All AC ammeters, voltmeters, KW meters shall be of moving iron type for AC and permanent magnet type for DC. Accuracy class shall be 1.0 for KW / KWH meters and 1.5 for ammeters and voltmeters as per IS: 1248. The range shall be as indicated in the SLD. Ammeters for motor feeders shall have non-linear compressed scale at the end to indicate motor starting current. Voltmeter shall be suitable for direct line connection.
- KWH meters and KVARH meters shall be of registering type and shall be installed inside unit but readable without opening doors. KWH meters shall be with maximum demand indicator in KVA.
- KW, KWH and power factor meters shall be suitable for 3 phases, 4 wire unbalanced system with voltage coil suitable for 230V AC. The current coils shall also be suitable as given in SLD.
- Instruments shall be mounted above 900 mm but below 2000 mm from the base channel of the switchboard.
- They shall be provided with zero adjusting devices for external operation.
- Indicating instruments and protective relay for respective feeder shall be located either in the same panel or in adjoining panel and shall be grouped together.

Current Transformer

- The Current Transformers shall be Resin cast bar primary / wound primary type. The burden ratio shall be minimum as indicated in Specific Requirements. However, current transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on drawings with their accuracy classification. Separate cores shall be used for metering and protection
- Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 5.0. However, accuracy class 3.0 is acceptable for ammeters only. If a metering load is fed from a protection CT, suitable 1/1 or 5/5 ratio saturable interposing CTs shall be used.
- The current transformers shall be capable to withstand dynamic and thermal stresses originated by the fault current.
- The CTs shall be suitably insulated and the mounting of the CTs shall facilitate easy maintenance.
- The CTs shall be mounted in stationary part of switchgear.
- The secondary of the CTs for metering when wired to terminals, shorting links shall be provided. Shorting links shall be of removable type of Wago make.
- For proper relaying, one side of current transformer secondary shall be grounded in the compartment with the meters or relays, which they serve, and each CT group shall be grounded with a separate identified lead, which may be disconnected for testing.

Potential Transformer

- The potential transformers wherever provided shall be epoxy cast resin type and shall have class of burden minimum as given in the SLD. However, potential transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on the drawing with their accuracy classification.
- The voltage transformers shall have an accuracy class 3.0 from 50% to 110% of normal voltage and class 1.0 from 80% to 120% of normal voltage with burdens varying between 25% to 100% of the rated value at 0.8 PF lagging.
- The primary of the voltage transformers shall be rated for 415 volts and the secondary for 110 volts.
- The PT shall be provided with HRC fuse on the primary side and secondary side.
- The PT shall be mounted in a separate compartment complete with its accessories.
- For proper relaying, one side of PT secondary shall be grounded at the transformer and the ground connection shall be identified and removable for testing.
- Test terminals shall be provided for PT circuits.

Timer

- For reacceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0 - 60 secs. The time settings, where specified shall be accurately set before dispatch of the switchboard.
- Timers for auto-transfer schemes shall be of static type with timing ranges suitable for the scheme employed.

Indicating Lamps

- Indicating lamps shall be filament type with series resistance. The domes of the fittings shall be heat resistant.
- The lamp shall be suitable for the voltage supply as given in SLD.
- It shall be possible to replace the indicating lamp without opening the compartment door.
- Screwed type lamps are preferred to bayonet cap lamps.

Control Switches

All circuit breaker operating switches shall be of the pistol grip type, spring return to neutral and lockable in that position.

They shall be arranged to close the breaker by being turned clockwise and to trip it by being turned anti-clockwise. The trip, neutral and close positions shall be clearly indicated. The movement shall be such that the switch cannot be operated inadvertently and that it is mechanically interlocked to trip before close. The operating switch shall be located preferably on the centre line at about 1.5 M from the floor level

Wiring Termination & Ferruling

All control conductors insulating material shall be of the PVC type.

Control, signaling, protection and metering wiring shall be by PVC insulated, 1.1 KV grade copper conductor wires of minimum 1.5 sq mm section, for CT secondary circuit wires of 2.5 sq mm copper conductor minimum shall be used.
Flexible conductor ends shall be fitted with suitable crimped thimble for efficient termination.
All control wires shall be properly bunched, cleated and supported on panel frames.
Where it is necessary to use a large number of conductors in one run, they shall be divided into two or more cable runs in enclosed channels.

Conductors shall only be carried over or bent around sharp corners or edges where this is unavoidable, in which case a suitable insulating strip shall be fixed to the sharp edge.

Sharp bends shall be avoided.

Conductors carried across a hinged portion of a chassis or door shall be flexible stranded copper conductors and the same shall be soldered crimped at ends before connections are made.

Suitable means of protection against abrasion shall be provided.

Sufficient slack shall be left at conductor ends to allow components to which the conductors are attached to be removed for inspection and servicing.

Conductors passing through holes in chassis or screens shall be fully protected by correctly fitted grommets or bushes.

Control and main wiring shall be kept separate as far as practically possible.

Colour coding for wiring shall be used and shall be indicated on the drawing.

Terminal strips for connecting entering control cables shall be Wago make plug in type of adequate size, shall be located conveniently for easy accessibility, without danger of contact with live part, ease of connection, and shall be separated by barriers from power circuits. At least 10% spare terminals shall be provided in terminal strips. Sufficient terminals shall be provided on each terminal strip to ensure that not more than one outgoing wire is connected per terminal.

The wire shall be identified by numbered ferrules at each end all in accordance with the connection diagram. All ferrules shall be made of non-deteriorating materials. The ferrules shall be universal triangular type so that they cannot move freely on the wire.

Glands

It shall be preferable to have all the glands on the removable bottom gland plate. Gland plate shall be 3 mm thick M.S. sheet. Suitable provision for cable clamping shall be given alley for bringing cables to the respective compartments.

Panel Space Heaters

Wherever specified in specific requirements all switchgear shall be provided with space heaters in each vertical units to prevent condensation and the same shall be equipped with differential thermostat to automatically cut in and cut off the heater, so as to maintain interior temperature 5 DEG C above the ambient and shall also have manual disconnect switch and fuse for protection.

Label Details

Labels of 3-ply laminate shall have black lettering on yellow background provided for following:

Main nameplate for the PCC as per description given in SLD in centre on top side on front of the PCC.Name plates for all incomers and outgoing feeders indicating description, rating, equipment no., feeder no., etc.

1. Nameplates for all door mounted components.
2. Name plates for panel numbers on front and rear.
3. Warning labels for interlocks.

- Danger labels shall be provided for interlocks.

1. Danger labels for the PCC as per statutory regulations.
2. Danger labels for busbar chamber.

3. Danger labels for cable alley housing live terminals.

- All components shall be provided with components identification stickers.
- Every component shall be provided with label on inside of the door indicating following information.
    - Switch / Breaker Rating
    - Fuse Rating
    - BMR Rating
    - Contactor Rating
    - CT Rating
    - Rating of other major components

    All nameplates shall be fastened by means of screws to the panel.

Limit of Supply

The supply of switchgear shall include the switchgear itself complete with all normal components and devices required for full and proper operation of the equipment even though such components or devices may not be shown in detail on drawings.
Switchgear shall be in working order provided with the following auxiliary components necessary for normal and safe maintenance and operation.

- Special tools - Complete set of special tools shall include all necessary devices for lifting, installing, withdrawing, testing and maintaining the circuit breakers, contactors, fuses, relays and other components of the switchgear.
- 2 Nos. handles for removing fuses shall be delivered with each switchgear.
- 6 Nos. lamp grips for removing and replacing of indicating lamps.
- 1 No. test plug for Relays.

Commissioning and Start Up Supervision

Commissioning and start-up supervision shall be provided by the manufacturer at site, and charges for the same shall be quoted separately

Switchgear and Equipment Certification

Manufacturer shall state in its bid whether proposed circuit breakers and switchgears have been tested by an independent recognized testing organization. Copy of such test certificates shall be attached to the bid.

Packing

The switchboard shall be shipped to site packed in wooden crates. They shall be wrapped in polyethylene sheets before being placed in crates to prevent damage to the finish. Crates shall have skid bottoms for handling.

- The packing cases shall be marked as per the details given in the purchase order.
- Each case shall have the reference to the vendor general arrangement drawing and shall normally indicate the sections of the switchgear.
- The packing cases shall contain one set of all the drawings for easy inspection at site.

Statutory Regulation

The switchgear shall be manufactured as per the requirements of Indian Electricity Rules. The switchgear shall be acceptable to the local statutory authorities such as Electrical Inspectorate and Fire Insurance Council. The switchgear shall have approval of Tariff Advisory Committee and relevant certificates shall be furnished in six sets for records.

Spares

Manufacturer shall quote for recommended spares for 2 years and for spare fuses

Testing

a) 415V switchgear shall be tested as per relevant Indian Standards and will include the following:

b) Visual and dimensional inspection as per general arrangement drawing.
c) Checking for provision of feeders as per general arrangement drawing.
d) Checking for provision of components as per bill of material.
e) Operation test.
f) IR measurement before and after HV test.
HV test.

The testing will be witnessed by Client's Engineer. Six copies of Test Certificates shall be furnished to Director IITM Pune for approval before dispatch.

Bus Bar

The busbars shall be of electrical grade aluminium flats / channels adequately sized to carry maximum current of maximum site temperature specified. The final temperature of busbars and connectors at joints between connector and busbar should not exceed 100o C when carrying rated currents. Also the final busbar temperature shall not exceed 250o C when short circuit current for specified duration flows through.

Busbar size per phase shall be suitable for maximum specified continuous rating at maximum specified site hygroscopic temperature.

Bimetallic strips covering full joint surface shall be provided wherever copper to aluminium connections are envisaged. Busbar clamps shall be provided to maintain the busbars in position. These clamps shall be made out of fully heat treated magnesium silicate aluminium alloy to IS: 5082. The clamp design shall be such that it holds the busbar firmly and also allow sliding movement of busbars without generating internal stresses to accommodate expansion during operation at rated current. For fixing the busbars to the busbar supports, cadmium plated bolts, nuts and washers shall be employed

Wherever required for long run of bus duct, expansion joints with flexible strips shall be provided to allow for expansion and contraction due to temperature variations arising out of normal continuous current flow and short circuit current flow for specified duration. Minimum one expansion joint shall be provided for each 3000 mm long straight length of bus duct.

Termination at the End of Bus Duct

The bus duct shall be provided with flexibles at both ends for connecting it with transformer at one end and 415V switchgear at other end.

The flexibles shall be made of thin copper strips. The ends of the flexibles shall be clamped by copper plate. The ends of flexibles shall be tin plated

Earth Bus

One earth bus of 50 mm x 8 mm aluminium shall run on the external side of the bus duct through the whole length of the bus duct and shall be positively connected to the body of the bus duct. At both ends of the earth bus provision shall be made to connect it to main / earthing system

LT CABLES
Construction

All LT power cables shall be 660/1100V grade, with aluminium conductor for size 70Sq.MM and above. Power cables of sizes up to 50 Sq.mm. shall be with copper conductors
The cables shall be suitable for laying in trays, trenches, ducts, conduits and underground, buried installation with uncontrolled backfill and possibility of flooding by water. For all cables, cable manufacturer shall provide information on correct voltage drop values when the current is less than the full current rating of the cable

1. PVC Cables
All power / control cables for use on medium voltage systems shall be heavy-duty type, 1100V grade with aluminium / copper conductor, PVC insulated, inner-sheathed, armoured and overall PVC sheathed.

The construction of the conductors shall be solid for aluminium / copper cables upto 6 sq.mm. For 10 sq.mm and above shall be stranded only. Conductors of nominal area less than 25 sq. mm shall be circular only. Conductors of nominal area 25 sq.mm and above may be circular or shaped.

The core insulation shall be with PVC compound applied over the conductor by extrusion and shall conform to the requirements of Type 'A' compound of IS: 5831. Control cables having 6 cores and above shall be identified with prominent and indelible Arabic numerals on the outer surface of the insulation.

The inner sheath shall be applied over the laid-up cores by extrusion/wrapping and shall be on PVC / un-vulcanised rubber. If PVC compound is used it shall conform to the requirements of Type ST1 PVC compound of IS: 5831.

For multicore cables, if the armouring is specified, the same shall be by single round galvanised steel wires where the calculated diameter below armouring does not exceed 13 mm and galvanised

steel wires / strips where this dimension is greater than 13 mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS: 3975 and IS: 2633. If armouring is specified for single core cables, the same shall be with hard drawn aluminium round wire of 2.5 mm diameter.

The outer sheath for the cables shall be applied by extrusion and shall be of PVC compound conforming to the requirements of type ST1 compound of IS: 5831. To protect the cables against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

1. XLPE Cables

Power cables shall be with Aluminium / Copper Conductor, XLPE insulated, armoured and overall PVC sheathed. All cables rated above 3.3 KV shall be provided with both conductor screening and insulation screening. The conductors shall be provided with non-metallic extruded semi conducting shielding. The insulation screening shall consist of non-metallic extruded semi-conducting compound in combination with a non-magnetic metallic screening of copper. The insulation screen shall be strippable without application of heat. The copper screen shall be capable of carrying the single line to ground fault current for duration of 1 second. For cables rated above 3.3 KV the conductor screen, XLPE insulation and insulation screen shall all be extruded in one operation by Triple Extrusion process to ensure perfect bonding between the layers. The core identification shall be coloured strips or by printed numerals.

- The construction of the conductors shall be stranded and compacted circular for all cables.
- The core insulation shall be with cross-linked polyethylene unfilled insulating compound. It shall be free from voids and shall withstand all mechanical and thermal stresses under steady state and transient operating conditions
- The inner sheath shall be applied over the laid up cores by extrusion and shall conform to the requirements of Type ST 2 compound of IS: 5831.
- For multicore cables, the armouring shall be by galvanised steel wires / strips. If armouring is specified for single core cables the same shall be with hard drawn aluminium round wire of 2.5 mm diameter.
- The outer sheath for the cables shall be supplied by extrusion over the armouring and shall be of PVC compound confirming to the requirements of Type ST 2 compound of IS: 5831. To protect the cable against rodent and termite attack, suitable chemicals shall be added into the PVC compound of the outer sheath.

Standards

The Cables shall conform to the requirements of the following, but not limited, to latest revision of relevant Indian Standards or equivalent British or any other International Standard Specification.

IS: 1554 - PVC insulated (heavy duty) electric (Part I) Cables - Part I for working voltages up to and including 1100V.

IS: 1753 - Aluminium conductors for insulated cables.

IS: 3961 - Recommended current ratings for (Part II) cables: Part-II PVC insulated and PVC sheathed heavy-duty cables.

IS: 3975 - Mild steel wires, formed wires and tapes for armouring of cables.

IS: 5831 - PVC insulation and sheath of electrical cables.

IS: 7098 - Cross-linked Polyethylene insulated (Part-II) PVC sheathed cables: Part-II for working voltages from 3.3 KV upto & including 33 KV.

IS: 8130 - Conductors for insulated electric cables and flexible cords.

IS: 9968 - Elastomer - insulated cables, for (Part I) working voltage upto and including 1100V.

Testing & Inspection

All the cables shall be tested and examined at the manufacturer's works. All the materials employed in the manufacture of the cables shall be subjected, both before and after manufacture of the cable, to examination, and testing by vendor.

All routine and acceptance tests in accordance with the relevant standards shall be conducted in presence of the Client.

Vendor shall furnish Test Certificates for all cables before dispatch for approval.
Vendor to confirm the availability of facilities at their works for the following tests and the standards to which they will conform to.

Accelerated water absorption test for insulation.

Dielectric retention test.

- Oxygen index test.
- Test for rodent and termite repulsion property.

Packing & Forwarding

1.The cables shall be supplied duly wound on non-returnable wooden drums. The drums shall be fully sealed to protect the cable from mechanical damage during transit. The wood used for construction of the drum shall be properly seasoned and free from defects. Wood preservatives shall be applied to the entire drum.

1. All cables shall be supplied in one length. If cable length exceeds standard drum length then the balance quantity shall be supplied in one length. If required by the Client, the vendor shall supply the cable in lengths as specified / informed to vendor during delivery.
2. On flange of the drum necessary information such as manufacturer's name, type / size / voltage grade and length of cable, drum No, year of manufacture shall be printed. An arrow shall be printed on the rim of the flange to show the direction of rotation of the drum.
3. Cables shall be supplied in drum lengths as follows:
   Medium voltage power cables upto and including 6 sq.mm. - 1000 M.

Medium Voltage power cables from 10 sq.mm. Upto and including 300 sq.mm - 500 M.

A tolerance of plus 5% shall be permissible for each drum.

4. The length of cable on each drum shall be determined by the manufacturer considering the transport limitations from manufacturer's works to the site.

Laying of Cables

Transporting the cables from stores to place of installation. The drums under the custody of the contractor shall be neatly arranged in the yard near his site office. The drum shall not be rolled for transportation more than 10m Truck / Trailer shall be used for transportation for distance more than 10m.

- The cables shall be rolled out for equipment and cutting shall be as per site requirement. Cable jacks and cable rollers shall be used during laying of cable.
- Electrical Contractor shall cut all cable length by actual measurement at site as per final route determined. Cable lengths indicated in Cable Schedules shall be used only to get an idea of length involved.
- The cables shall be tested for insulation value before laying. Drum Schedule to be prepared by contractor.

- The Cables shall be laid in trenches, trays, along walls or structural support as per the requirement. The cables shall be neatly laid and clamped. The crossing of cables shall be avoided. The arrangement of cables on the tray / trench shall be decided based on the cable schedule and layout drawings and shall be approved by the Institute.
- Clamping of cable shall be done by 18 SWG thick aluminium clamps at an interval of 0.5 mtr. for vertical run and 1 mtr. for horizontal run. When cables are cleated on wall / structures, the spacer and saddle shall be used at 300 mm interval or less depending on the location and shall be approved by Institute.
- The cable terminations shall be done as per standard practice and crimping type of terminations shall be considered.
- The glanding shall be done with suitable arrangement for earthing the gland. Wires / sleeves required for effectively earthing the glands shall be included in the termination materials.
- The unused cores of the multicore cables shall be properly taped.
- The tag carrying the cable number shall be at interval of 20 mtr for underground cable and 30 mtr for above ground cable and at all bends and route changes of the cable run. Material of tag will be aluminium for above ground cables and of lead for buried cables. Sample of tags shall be approved by Institute.
- The cable numbers shall be painted near the terminal blocks in MCC / Distribution Boards / Switchboards.
- For main power cables loops shall be provided near terminations.

- All cables coming from floor / trench shall be taken through a G.I. Pipe. The length of the pipe shall be decided by the contractor and approved by the Institute.
- The glands supplied by the contractor shall be suitable for cable sizes mentioned and if necessary reducers shall be provided by the contractor. The contractor shall indicate the requirement of reducers and supply the same after approval of rates by Director IITM Pune.
- The contractor shall supply and install the ferrules for multicore cable connections. The ferrule markings shall be identical to the wires connected to the terminals.
- The Lugs used shall be tinned Copper for Copper Cable and Aluminium Lugs for Aluminium Cable, crimping type of reputed make. The Lugs used for multistrand control cable shall be PVC sleeved crimping type copper lugs.
- The connections between the junction boxes/control panels to components like pressure switches, limit switches shall be through flexible conduits. The length of each of the flexible conduit shall not exceed 120 cm.
- The cables coming from switchboards to the cable tray shall be taken through branch trays and the cables shall be clamped neatly. The arrangement shall be approved by Institute.
- Main cable runs are to be routed as shown on the contract drawings. Any modifications found necessary due to site conditions must be approved by CONSULTANT. Details of routes not shown on these drawings are to be determined on site by discussion with Institute.
- PVC insulated and / or served cables shall not run parallel within 100 mm of, or be installed above and in line with, any heated pipes or duct. Where crossing above heated pipes or ducts is unavoidable the cable must be kept at least 150 mm from the outer surface of such pipes or ducts or the insulation thereof.
- On main horizontal cable runs where cables are supported, suitable mild steel saddles, cleats or clips shall be used. Between these fixing points cables shall be laid neatly in position on the intervening racks. On vertical cable runs and horizontal runs other than the main horizontal runs, cables shall be fixed at one meter intervals. Where different sized cables are together the maximum fixing intervals are to be those required for the smallest cable, unless the smaller cables are bunched with larger cables and supported by them throughout the complete multi-cable run.

NOTE: Where the contract drawings indicate that the cables are to be run or fixed other than in accordance with this specification, the drawings shall be deemed to be correct.

- Cable run in RCC trenches are to be run on the floor along the sides on suitable brackets and located 75 mm minimum from floor of trench. Cable ducts in the ground shall be sealed against the ingress of water, foreign matter and vermin, at both ends by means of non-setting compound and / or suitable wood plugs fitted over the cable and into the duct. Where ducts are not in use they shall be sealed in a similar manner.
- Cables laid direct in the ground shall be laid on a bedding of 150 mm of sand and covered by 150 mm layer of sand, on top of sand tiles / bricks covering to be done. The depth of laying shall be such as to provide 750 mm minimum cover for low voltage cables and 1000 mm cover for high voltage cables.
- All non used open entries in equipment and open ends of conduit are to be sealed by means of conduit plugs (or blanking plates if entries are not of standard conduit sizes) at all time.

NOTE: This is particularly important where equipment is located in position, but electrical installation is incomplete.

Where cables pass through floors, they shall be protected by metal / PVC pipes or other suitable means. Holes in floors, walls, etc. will be made and reinstalled by the contractor unless otherwise stated.

All cables laid underground shall be protected with good quality brick and interlocked concrete tiles marked "Electric" or "Telephone" cables.

Cable joints shall be mechanically and electrically sound and except for buried cables they shall be accessible for inspection. Underground joints shall be specially protected with a double layer of bricks and cast iron joint markers (marked 'Cable-Joint'), shall be installed to indicate the position of the joint.

Where corrosion of armour or gland might occur, it shall be effectively protected by suitable means

The contractor shall test all cables for proper insulation before they are transported for laying and shall furnish a certificate of acceptance to this effect. Any damage to the cable subsequently shall be made good by the contractor at his own cost. After the test of insulation, the cut ends of cables shall be sealed properly with waterproof material to prevent ingress of moisture.

Cable Marking
All Cables shall be externally marked at either end with the respective identification numbers by means of non-deteriorating material. Cable Markers shall be approved by Institute.
Where conductors are left to be terminated by another party or left to be connected later, they must be individually identified

CABLE GLANDS

- When preparing cables prior to fitting glands, the gland manufacturer's instruction for cable preparation shall be observed. In all cases where armoured cables are used care shall be taken to ensure that the lay of the armour is maintained after the gland is completely fitted.
- Where compound boxes are used for terminating cables, the compound must penetrate fully and leave no air holes. Where hot pouring of compound is employed, 'topping up' must

be carried out as soon as possible after the first filling. The pouring temperature of the compound must not be high enough to damage the cable insulation.

- All terminations of paper insulated cable shall incorporate damp barriers in each conductor. The insulation shall be removed to leave approximately 15 mm to 20 mm of the conductor exposed, and the conductor shall be soldered at this point.
- The preferred method of terminating conductors is by means of solder less compressed connectors. Deviations from the above shall be subject to approval of Institute
- Connectors shall be of the correct size for the conductor concerned and as manufactured by Dowels or approved equivalent
- All connectors shall be marked with the size reference for identification with the correct compression tool. This reference shall be located on the palm of the connector and shall be remote from the contact faces where possible.
- The palm of the connector shall be of such shape and size that standard washers to relevant IS applicable to the size of stud for which the connector is designed shall lie flat on both faces of the connector palm when the holes in the washers and the palm are co-incident.
- Compression tools shall be designed and supplied for specific use with the connectors used, and shall be regularly services by the maker.

DISTRIBUTION BOARDS (Wall Mounted)

The Board shall be installed on column / structure, as required with necessary frame work at an approximate elevation of 1200 mm from finished floor level.

Balance activity, same as mentioned

LIGHTING SYSTEM

The lighting fixtures in the open areas shall be fed from lighting panel and controlled from local switch. Lighting wiring between JB and lighting fixtures shall be done by PVC insulated 3-core (phase neutral and earth) unarmored cable. Lighting fittings in building shall be fed from lighting panels. Wiring in the building shall be done by means of 3-core Copper Conductor PVC insulated or copper conductor wires in conduit of 1' size / metsec channel, as specified. All joints of conductors in Switch boards / JB's / Fittings shall be made only by means of approved Mechanical connectors (nylon / PVC connectors). Bare or twist joints are not permitted anywhere in the wiring system. Cost towards mechanical connectors is deemed to have been included in wiring.

Methods, type, size, etc. mentioned in the BOQ shall supersede the above requirements.

Socket outlets in production areas shall be approximately 1200 mm above finished grade and 300 mm above FFL in office area. Lighting and power panel shall be mounted such that top of the panel is not more than 2000 mm above finished grade.

Fixtures shall be firmly supported from the structures, support clamps, etc. They may be bolted or welded to the steel work or metal inserts. In case of concrete structures, where metal

inserts are not available, fixtures will be fixed to or supported from concrete surfaces with the help of anchor fastener. In such cases special care shall be taken to see that anchoring is firm.

The lighting layouts furnished by Director IITM Pune shall indicate approximate locations of lighting fixtures. The electrical contractor shall determine, with approval of the Engineer-in-Charge or his authorized representative, the exact locations of each fixture in order to avoid interference with mechanical equipment or any structure and also with a view to obtain as uniform illumination as practicable, and to avoid objectionable shadows. Conduit / cable run shown on drawing are only indicative. These shall be laid out by the contractor to suit field conditions as per directions of the Engineer-in-Charge.

All hardware shall be galvanized or zinc passivated. Circuit cable shall be group cleated to structure by using galvanized strip clamps or run in cable trays wherever they are available. Spacers and cleats shall be of suitable size to accommodate the cables and shall be approved by Engineer-in-Charge before fixing at site. For isolated structures lighting cable may be taken in underground G.I. Pipes. G.I. Saddle to be used will be 22 gauge thick ribbed types and GI Spacer will be of 3 mm thick made out of 25 x 3 mm M.S. Flat.

Main runs of wiring from lighting panels and tapings to individual fixtures shall be in sizes specified on the SLD. Wiring for all outlet sockets shall be done with 3 cores of equal sizes for phase, neutral, & earth.

The cost for cable clamps, metal spacers, anchor bolts, etc. shall be deemed to have been included in the installation of cables

Contractor shall keep a close watch on the lighting MTO sheets issued to him. Any discrepancy noticed between the figure given in MTO and the actual requirement at site, shall be immediately brought to the notice of Engineer-in-Charge by the Contractor.

All fluorescent fixtures shall be with high power factor, low harmonic (THD< 10%), warm start electronic ballast. All other Ballasts shall be low loss Cu. Ballasts.

Fluorescent lamps unless otherwise specified shall be tri-phosphor colour 86 (cool day light). CFL lamps shall be "Bright white" unless otherwise specified.

MID / High bay fixtures and streetlights shall be integral and floodlights shall be non-integral unless otherwise specified.

All housings shall be cast aluminium only. Sheet metal housing is not acceptable for outdoors luminaries. All outdoor luminaries shall be rated at IP 65.

Fixtures construction shall be suitable for maintenance from bottom unless otherwise specified and shall be screw less press fit as far as possible. Lamp replacement shall be possible without removing fixtures.

Tie arrangement shall be provided for covers, louvers etc which need to be removed for lamp / ballast replacement.

CONDUIT SYSTEM

Surface or concealed conduit system of wiring shall be adopted as specified in the drawings. Suitable pull boxes or inspection type fittings will be used to facilitate drawing of wires. Conduit wiring shall be as per IS-732. Wherever specified, conduits and conduit accessories shall be galvanized and shall conform to IS-2667, 1988.

Only threaded type conduit fitting shall be used. Pin Grip type clamp type fittings are not acceptable. Conduit ends shall be free from sharp edges or burrs. The ends of all conduits shall be reamed and neatly bushed with Bakelite bushings.

In order to minimize condensation of sweating inside the conduit system, all outlets shall be properly drained and ventilated in such manner so as to prevent entry of insects.

The outer surface of the conduit pipes, including all accessories forming part of the conduit system shall be adequately protected against rust, particularly when such system is exposed to weather. In all cases bare threaded portion of conduit pipe shall not be allowed unless such bare threaded portion is treated with anti-corrosive preservative or covered with approved plastic compound.

Conduit connection to outlet boxes shall be by means of screwed hubs or check nuts on either side.

Conduit pipes shall be fixed by 22 gauge ribbed G.I. saddles on 25 x 3 mm G.I. saddle bars in an approved manner at intervals of not more than 50 cms. Saddle shall be fixed on either side of couplers, bends or similar fittings, at a distance of 30 mm from the centre of such fittings. The cost of saddle bars, saddles, clamps, etc. shall be deemed to have been included in the installation of conduits.

Where concealed wiring is to be adopted, conduits shall be laid in time before concreting of the slab. The contractor shall co-ordinate his work with other agencies involved in the civil works in such a way, that the work of these other agencies is not hampered or delayed because of any section on his part. Vertical conduit runs shall be made either through columns or chases prepared in the walls. Contractor shall fill these chases or any other openings made by him after completing the work and neatly finish the surface. During installation, care shall be taken to see that adequate covers are provided to prevent rusting of conduits.

If required, conduit runs may be concealed in the floor for low level receptacles and exhaust fans. As built conduit layout drawing shall be submitted by contractor.

Wiring for exhaust fans shall be terminated in ceiling roses / receptacles and the connection from ceiling rose / receptacles to the exhaust fan shall be by means of a flexible cord equivalent in size to the main run of wires.

Maximum permissible number of wires that can be passed through a conduit of particular size shall be as per Table indicated below.

After erection, the entire conduit systems shall be tested throughout for mechanical and electrical continuity and shall be permanently connected to earth by means of approved type earthing clamps, in accordance with Indian Electricity Rules.

Installation is inclusive of supply and fixing of all accessories like:

Elbows, grommeters, bends, T-offs, etc.

2" Deep 65 mm dia round conduit junction box (18 SWG) with acrylic cover and 30A rated completely shrouded PVC connectors in JB. The terminals shall be kept loose in Junction Box for easy maintenance and connection.

CABLE TRAYS

All cable Trays upto 300mm shall be perforated type & above 300mm ladder type trays shall be used.

The Trays shall be pre-fabricated hot-dipped galvanized. Cold galvanizing at site is acceptable only for touch-ups.

The Trays shall have suitable provision for clamping at an interval of 500 mm.

The Earthing Strip for the earthing ring shall be run along the side of the Tray.

The connection between individual equipment to the ring shall be by bracing or with lugs.

The bending of trays shall be smooth and the curvature sufficient for each bending of cables in it. Pre-fabricated accessories such as Tees, bends, risers, couplers, reducers, etc. shall be used at all junction & branches. Cutting & welding of trays at site is not permissible. Similarly, the trays shall not be welded on the supports but bolted only.

Electrical Cable Tray routing shall be co-ordinated by Electrical Contractor at site to check fouling with pipes, equipment, light fittings, HVAC, etc. before fixing the trays.

EARTHING

All Electrical Equipment must be efficiently double earthed in accordance with the requirement of IS-3043/IEEE 80 and relevant regulations of Electric Supply Authority.

The earth pits shall be as per IS with proper arrangement for testing.

All earthing conductors shall be hot dip galvanized / electrolytic grade base copper conductor. The main earthing rings shall be done as per practice laid in Indian Standard.

The earthing of individual electrical equipment by two distinct strips/conductors shall be done as per practice laid in Indian Standard.

The sizes and material of conductors for earthing various equipment shall be as per relevant Earthing Drawing / General Notes for Earthing and Earthing Schedule.

All electrical equipment shall be connected to the earth bus at two points except the lighting fittings and junction boxes.

Following earthing resistances shall be measured and recorded in the presence of Institute during the dry season.

Resistance of each earth electrode with electrode isolated from the system.

Combined earth resistance of the installation measured at the substation, switch room and any other point as directed by the Institute.

The method of testing shall be as per Clause No. 10.1 and 10.2 of IS-3043. The contractor shall prepare the test report on standard Format. The effective earth resistance of the system shall be <1ohm.

All hardware for bolted joints shall be galvanized and the size of the bolt shall not be more than quarter of the size of earth conductor.

Tinned copper lugs shall be provided where round earthing conductors are used.

The 415V neutral shall be solidly earthed by means of two separate and distinct connections to earth. Each connection shall be connected to an independent earth pit near the transformer. The earth pits shall be interconnected between themselves and the main earthing grid to form an earthing ring. The neutral earthing leads shall be kept away from the transformer tank.

All joints in the main earthing conductors shall be welded.
Terminal joints on the equipment shall be bolted.
The earthing conductors running underground shall be laid approximately 500 mm / 600 mm below the grade level.
Removable test links shall be provided near the earth pits to facilitate testing of earth pits.Where the earthing terminal diameter provided on equipment is larger than quarter of the size of the earth conductor, connection shall be made using a wider flag welded to the conductor.

The quality of galvanizing shall be subject to test in the presence of Institute.

Unless otherwise approved by Director IITM Pune, all equipment (Rotary/ Static) shall be earthed at two points.

The equipment to be earthed shall be connected to a common earth grid of power system.

The pipes shall be earthed, if resistance of earth exceeds 106 ohms.

For equipment earthing, suitable GI bolts with spring and plain washers to suit the thread of earth boss of equipment, etc. shall be provided by Electrical Contractor.

Materials for Earthing

The Sizes and Material of Conductors for earthing various Equipment shall be as per relevant Earthing Drawing / General Notes for Earthing and Earthing Schedule prepared for particular Project.

Earth Pits

The number of earth pits will depend upon soil resistivity and the voltage of the system. The location of the earth pit will be as shown in the drawing. The earth pit together with the electrode shall be constructed as per IS-3043-1987. The minimum distance between two earth pits shall not be less than twice the length of the electrode. A bolted assembly

link shall be provided in the connection between earth electrode and the main earth conductor. GI pipe for watering shall be included in the rate of earth pit.

Earth Bus and Earth Wires

The earth wire may be of solid bars or flats or stranded. Sufficient care should be taken to prevent corrosion and mechanical damage. Interconnections of earth continuity conductors and main and branch earth wires shall be made in one of the following manners:
Riveted connection

a) Welded connection (mainly applicable in the case of M.S.)
b) Brazed connection (for copper)
c) Bolted connection

Framework and other non-current carrying metal work associated with each system e.g. transformer, tanks, switchgear frame work, etc. shall be earthed. Extraneous metal framework not associated with the power system e.g. boundary fence, steel structure, sheaths of communication cables, etc. will have to be earthed.

Each incoming and outgoing cable shall be bonded to the switchboard earth so that the armour and sheathing with feeders and interconnection shall form an earth system. The complete earthing system inside a substation shall be given a coat of black asphaltic varnish, if insisted by Institute.

Following also shall be earthed:-

Metallic noncurrent carrying parts of all electrical equipments such as transformer, switchgear, panels, power sockets, lighting fixtures., shall be earthed at one point for and up to 230V and at two points for working voltage of 415 Volts.

- Steel structures / columns
- Cable trays, spheres, vessels and other process equipment.
- Fence and gate of electrical equipment (of transformer yard)
- Cable shields and Armour.
- Street light poles near to main earth grid shall be earthed by tapping from main earth grid. For remote located street light pole, individual earth electrodes shall be constructed.
- Earth strips from Lightning arrester shall be laid and connected to Earth stations directly. Strips shall be of specified size. These shall be connected with plant main grid, whenever specified only below ground.
- Equi-potential jumpers for any or all of the above equipment joints / sections intended for earthing.

Artificial Treatment of Soil

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then 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.

Earth Resistance

Earth resistance of main bus and in turn at connections to equipments shall be less than 1 ohm. For further Details please refer BOQ. Sizes mentioned in the layout drawing shall supersede the above.

Capacitor

The capacitor units shall be inspected and insulation value shall be checked and recorded
The aluminium link connections shall be checked and tightened.
The units shall be installed on framework near switchgear.
Before energizing the Capacitors, it shall be ensured by Contractor that Discharge Resistor is fitted across the Capacitor
The units shall be earthed with two distinctive earth strips.

UPS

This shall conform to the requirements of the following but not limited to, latest revision of all relevant Indian Standards or International Standards.

(a) IS: 3700 : Essential ratings and characteristics of semi-conductor devices.

(b) IS: 3715 : Letter symbols for semi-conductor devices.

(c) IS: 4411 : Code of designation of semi-conductor devices.

(d) IS: 5001 : Guide for preparation of drawings for semi-conductor devices.

(e) IS: 5469 : Code of practice for the use of semi-conductor junction devices.

DESCRIPTION & SYSTEM OPERATION

- The UPS shall consist of Rectifier / Charger, Battery, Inverter, Static Transfer Switch, Maintenance Bypass Switch, Synchronizing Equipment, Protective Device and other Accessories. An Isolation Transformer shall be provided on input side.
- The UPS shall provide continuous electric power within specified tolerance, without interruption, to the critical loads.
- Normally electric energy from normal plant power source shall be supplied to UPS System.
- The solid-state rectifier / charger shall convert incoming AC power to DC power. The rectifier / charger output shall be fed to solid-state inverter. The inverter shall convert the DC power into AC power, which shall supply the load. Upon failure of AC power, input power for inverter shall automatically be supplied from the battery with no interruption / disturbance in inverter output in excess of limits specified herein (in these specifications). At the same time, UPS shall energize an alarm circuit.
- The duration for which Battery shall supply A/C power to O/P shall be minimum 30 minutes.

- When A/C power is restored, the input power for the inverter and for recharging the battery shall automatically be supplied from rectifier / charger output without interruption/ disturbance in inverter output in excess of limits specified herein (in these specifications).

  If the battery is exhausted before A/C power is restored, the UPS shall shut down automatically.

- The solid-state circuitry used for both Rectifier & Inverter shall be IGBT technology.
- Intelligent RS-232 Communication shall be possible which will Provide UPS status indications, electrical parameters such as Input & Output Voltage, Load levels etc and unattended shutdown.
- User-friendly LCD Display to indicate all important UPS parameters such as Input Voltage, Output Voltage, Battery Level and Load Level shall be provided.
- The UPS Module Cabinet shall consist of a rectifier / charger, a three-phase inverter, static transfer switch, maintenance bypass switch, and associated transformers, logic, synchronizing equipment, protective devices, and accessories as required for proper operation.
- The rectifier / charger unit shall be solid state and shall provide direct current to the inverter unit and for battery charging.
- A dry type power transformer shall be used for the rectifier unit if specified in the attached SLD.
- It shall be copper wiring exclusively and have one 5% tap below rated voltage. The transformer's hottest spot winding temperature shall not exceed the temperature limit of the transformer insulation class of material when operating full load at maximum ambient temperature of the transformer location within the rectifier / charger unit.
- An input AC filter shall be incorporated into the rectifier / charger unit. The filter is not to be add-on in front of the rectifier / charger. This filter is to reduce the current harmonics feedback into the input AC line to no more than 10%. The filter is to also improve the input power factor so that it is no more lagging than 0.95.
- The rectifier / charger unit shall provide for input current limiting whereby the maximum input current shall be limited to 125% of the full input current rating. This current limit shall be in effect, no matter whether the load is connected to the UPS module or the static transfer switch. That is, if the static transfer switch is supplying full rated load, then the rectifier / charger must limit the battery recharging to 25%.
- Furthermore, if the load is connected to the maintenance bypass line, the rectifier / charger input current must automatically reduce to 25%.
- The rectifier / charger unit shall provide features whereby when the AC power is returned after the UPS has been operating on battery power or has been de-energized, the total initial power requirement at the input terminals will not exceed 20% of rated load, and the power will gradually increase to 100% of full rating over the 15 second time interval. The unit shall be provided with an internal switch so that walk-in time can be changed from 2 seconds to 15 seconds.
- IGBTs in the rectifier / charger shall be fused with fast acting fuses, so that loss of any one power semiconductor will not cause cascading failures. All fuses shall be provided with a blown fuse indicator with an alarm indicator on the control panel.
- The rectifier / charger unit shall have an output filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 2% RMS. The filter shall be adequate to insure that the DC output of the rectifier/ charger will meet the input requirements of the inverter.
- The rectifier unit shall be designed to boost charge the completely discharged batteries in 10 to 14 hours. The changeover between boost charger mode and float charge

mode shall be affected manually. Necessary alarms to indicate battery discharged and D.C. over voltage conditions shall be provided. Selector switch shall be provided for selecting the float charge or boost charge mode.

There shall be DC overvoltage protection so that if the DC voltage rises to the pre-set limit, the UPS module is to shut down automatically and the load is to be transferred to the static bypass line uninterrupted.

- To prevent battery damage from over-discharging at light load, the rectifier / charger is to automatically raise the shutdown voltage set point as the load is reduced. The shutdown set point is to increase linearly from minimum to 1.75 volts per cell as the discharge time increases from 15 minutes to one hour.

Inverter Unit

- Advanced PWM Inverter with Precision Control Circuitry using High Performance IGBT Power Stage. The output shall be Pure Sine-wave output with less than 3% THD. Exceptional reliability, superior performance, Quite operation with very high reliability and efficiency shall be the key characteristics
- The inverter unit shall be a solid state device capable of accepting the output of the rectifier / charger or the unregulated voltage of the battery and provide regulated rated AC output within specified limits.
- The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall be temperature compensated and be adjustable +5% of rated frequency. The oscillator shall hold the inverter output frequency to +0.1% for both steady state and transient conditions. Drift shall not exceed +0.1% during a 24 hour period. Total frequency deviation, including short time fluctuations and drift, shall not exceed +0.1% from the rated frequency.
- The inverter output shall stay synchronized with the static bypass line provided the static bypass line remains within +3 Hz of the nominal frequency. If the line frequency goes outside these limits, the inverter is to break sync with the line and run on its internal frequency. When the line frequency returns, within limits, the inverter output is to automatically re-synchronize with the line. The rate of change of frequency is not to exceed 0.1 Hz per second. The unit shall be provided with an internal switch so that the synchronizing frequency range can be changed from +3 Hz to +1 Hz or to +0.5 Hz.
- The inverter shall be able to sustain an overload across its output terminals up to 150% load, while supplying any load within its rating, without reducing the output voltage. Loads greater than 150% shall be transferred to the static bypass line.
- The inverter, with the static bypass line disabled, shall current limit at 150% rated current at reduced voltage for any loading over 150% rated load. The inverter shall be capable of at least 300% current for short circuit conditions. If the short circuit is sustained, the inverter shall shut down and disconnect automatically from the critical load bus.
- The inverter unit shall be designed to operate from the rectifier output without use of battery smoothing effect. With the battery connected to the UPS system, a filter shall

be provided at the input of inverter unit to reduce the A.C. Feedback from the inverter to the battery to a maximum of 2% of the battery AH capacity.

- The inverter unit shall be designed to operate with 93V to 145V DC or 186V to 290V DC at the terminals of inverter input filter. The output inverter voltage shall be stabilized to within +2% of the nominal output voltage with a load variation of 0 - 100% at 0.6 power factor (lagging).
- During step loading of 100%. The system voltage dip shall not exceed 15% and output voltage shall recover to within + 3% of the nominal output voltage within 10 cycles (200 m sec.)
- The inverter voltage regulator is to regulate each phase so that an unbalance loading will not cause the output voltage to go outside the specified voltage unbalance or phase displacement.
- An output AC filter shall be incorporated in the inverter unit. The filter shall reduce the inverter output voltage harmonics to 5% RMS total and single harmonics to 3% RMS for linear loads.
- Power semi-conductors in the inverter unit shall be fused with fast acting fuses, so that loss of any one power semiconductor will not cause cascading failures. All fuses shall be provided with a blown fuse indicator with an alarm indicator on the control panel.

Static Transfer Switch

- The Static Transfer Switch, using solid state devices, shall be provided to transfer the load between the UPS module and the static bypass line uninterrupted. Automatic static load transfers are to be initiated when a system overload is greater than specified here, a branch load circuit faults or a fault within the UPS module occurs.
- If the static transfer was caused by an overload or branch fault and this condition was rectified, then the static transfer switch is to automatically re-transfer the load to the UPS module.
- The static transfer switch shall be sized to provide 125% rated load continuously. The switch shall also have an overload rating of 2000% rated load for two cycles.
- Any time the load is on the static bypass line, the control panel shall indicate so. The audible alarm is to sound only after a ten-second delay. If the transfer was due to a momentary overload and automatically re-transferred back to the UPS module after the overload was removed, the alarm and indicator are to automatically reset.

Maintenance by Pass Switch

- A manually operated maintenance bypass switch is to be incorporated into the UPS module cabinet that will connect the load to the input AC power source bypassing the rectifier / charger, inverter, and static transfer switch.
- All energized terminals shall be shielded to ensure that maintenance personnel do not inadvertently come in contact with energized parts or terminals. A means to de-energize the static switch shall be provided when the UPS is in the maintenance bypass mode of operation.

- While the load is on the maintenance bypass line, it shall be possible to check out the operation of the rectifier / charger, inverter, and static transfer switch. It shall also be possible to check the battery operation.

Battery

A Battery system shall be furnished for the UPS with sufficient capacity to maintain UPS output at the specified load for a duration of minimum 30 minutes. The type of battery shall Maintenance-free, Valve-regulated type. A minimum of 10 years warranty for performance of declared parameters within permissible limits shall be provided.

Cabinet

All the cells making up the Battery shall be installed in a free-standing cabinet, that is, of the same constructions as the UPS module cabinet. The cabinets shall be of the same height and depth.

Each cell is to be held in place to prevent movement during seismic motion. Connectors are to be used so that the battery can be disconnected in no more than 42 volt sections.

Battery Disconnect Circuit Breaker

The UPS Module shall have a Battery Circuit Breaker. This circuit breaker is to be mounted in the battery cabinet. When open, there shall be no battery voltage present in the UPS module cabinet. The UPS module shall be automatically disconnected when the battery reaches the minimum discharge voltage level or when signaled by other control functions.

MIMIC Panel

The Mimic Panel is to depict a single line diagram of the UPS. Indicating Lights shall be integrated with the single line diagram to illustrate the status of the UPS power paths. The functions whose status is to be displayed shall include, but not be limited to, the following:

a) Input power available
b) Output power available
c) Normal operation
d) Bypass operation

INSTRUMENT INDICATION & ANNUNCIATION

Following Instruments shall be provided on the system

Charger Panel

a) AC Line Voltage (with a selector switch)
b) AC Line Current (with a selector switch)
c) Charger Output Voltage (each)

d) Charger Output Current

e) Battery Current (charging / discharging current)

Inverter Panel

a) DC Input Current

b) Standby Transformer Secondary Voltage

c) UPS Output Voltage

d) UPS Current

e) Power Factor Meter

f) Frequency Meter

Following indications lamps shall be provided.

Charger Panel

a) AC mains ON (3 Lamps)

b) Battery on Float

c) Battery on Boost

Inverter Panel

a) Battery Output ON

b) Inverter - I Feeding

c) Inverter - II Feeding (Only for redundant system)

d) Standby Supply ON

e) Load on Bypass

f) Mains Synchronized

Audio-Visual Alarm shall be provided for the following complete with 'ACCEPT', 'RESET' and 'TEST' facilities.

Charger Panel

a) Mains Under voltage / Single Phasing

b) Charger Failure / SCR Fuse Failure

c) Reverse Polarity on DC Bus

d) Cooling Fan Tripped (common for all fans)

e) Battery Discharged

f) DC Over-Voltage

g) Battery Earth Fault

Inverter Panel

a) DC Input Failure

b) Inverter - I Output Trouble

Construction

- Rectifier / Charger and Inverter sections shall be housed in separate panels and shall be complete with all interconnections. The panels shall be fabricated with 1.6/2 mm thick cold rolled sheet steel and structural steel. The panels shall be free-standing. Vermin proof fitted with suitable louvers for ventilation and cooling fan. Hinged doors shall be provided at the front and back where required, with dust tight gaskets. Interpanel sheet steel barriers shall be used. The enclosure shall be IP-51 (NEMA-IA).
- Power cables shall be with aluminium / copper conductor as specified in SLD. Control cables shall be with copper conductors. All Cable connections shall be from bottom and from the front of the panel. At the bottom of the panels, a removable bolted gland plate shall be provided with double compression type cable glands fitted to it for external cable connections. Clamp type terminals shall be used for connection of all wires upto 10 mm2 and terminals for larger size shall be bolted type suitable for cable lugs.
- Busbars shall be colour coded and live parts shall be properly shrouded to ensure complete safety to personnel intending routine inspection by opening the panel doors. All equipment inside the panel and on door shall have suitable nameplates and device number as per the schematic diagram.
- All fuses shall be link type with HRC links and mounted inside the panel. All power and control switches shall be mounted on the door operable externally and shall be rotary type. Space heaters and 100W incandescent lamps shall be provided in each panel. All instruments shall be switchboard type, back connected, 96 x 96 mm square of reputed make. Scale shall have a red mark indicating maximum permissible operating rating. Test terminals shall be provided on a separate rail for measuring and testing of equipment to check the performance.
- A suitably sized earth bus shall be provided at the bottom of the panels with provision for earth connection at both ends to purchaser's main earth grid. Suitable earthing of potential-free metallic parts of various equipment shall be done to ensure safety.
- All metal parts shall be treated so as to ensure efficient anti-corrosive protection. Hardware shall be zinc passivated or electro galvanised. Panel enclosure and structure supports shall be thoroughly cleaned and degreased to remove mill scale and rust, etc. External surface shall be prepared for final painting with Manufacturer’s standard colour code.

Equipment Details

All materials and parts comprising the UPS shall be new, of current manufacture, of a high grade and free from all defects and imperfections and shall not have been in prior service, except as required during factory testing.

All active electronic devices shall be solid state. All semiconductor devices shall be hermetically sealed. All relays shall be dust tight.

The maximum working voltage, current and di/dt of all solid state power components and electronic devices, shall not exceed 75% of the ratings established by their manufacturer. The

operating temperature of solid state component cases shall not be greater than 75% of their ratings. Electrolytic capacitors shall be computer grade and be operated at no more than 90% of their voltage rating.

Wiring

Access holes with cover plates are to be provided on top and bottom of the UPS and battery cabinets for inter-cabinet wiring and customer installation wiring.

Wiring practices, materials and coding shall be in accordance with the requirements of the National Electrical Code, OSHA and applicable local codes and standards.

All bolted connections of bus bars, lugs and cables shall be in accordance with requirements of the National Electric Code and other applicable standards. All electrical power connections are to be torque to the required value and marked.

Ventilation

Adequate ventilation shall be provided to insure that all components are operated within their environmental ratings. All fans are to be equipped with wind vane sensors connected to an alarm on the module control panel.

Temperature sensors shall be provided to monitor temperature of critical components. Upon detection of temperatures in excess of component manufacturer's recommended ambient working temperature, the sensors shall cause audible and visual alarms to be sounded on the module control panel.
Forced ventilation if provided by means of fans shall have 100% redundancy.
If redundancy is not provided then it shall be possible to run the system at rated load for half hour and at reduced load (about 75%) continuously without any damage to the system.

Spares

Vendor shall recommend and provide spare parts needed for start-up and two years operation. Recommended spares should take into account related factors like equipment reliability, effect of equipment downtime upon production and safety, cost of and availability of equipment service facilities.

All spare parts furnished by vendor shall be wrapped and packed so that they will be presented in original as new condition under the normal conditions of storage to be anticipated and shall be properly taped and coded so that later identification as to intended equipment usage will be facilitated. They shall be packaged separately, clearly marked as spare parts and shipped at the same time as the equipment. Packing list shall be furnished so that the parts can be handled without uncrating, if desired.

Inspection and Testing

The Battery shall be subject to inspection by Client's representative. Manufacturer shall furnish to inspectors all requested information concerning the supply.

Battery shall be tested as per relevant IS and test certificates shall be furnished before dispatch.

The UPS System will be tested in the presence of Client's representative. The following tests shall apply:

Full load heat run for eight hours (unit rate to be furnished separately).
Current forcing test.
Recording of time for mains to inverter changeover and vice-versa.
Recording of 1/2 load change transient.
Recording of full load change transient.
Functional Tests.

Detailed inspection will be performed to ascertain that the data sheet and other contractual aspect are complied with the earthing system must be inspected for robustness and continuity.

Lightning Protection

The plant and structures shall be protected against lightning in accordance with requirements of IS-2309.

Air terminal rods shall be provided at the top most points of all buildings and structures. Roof conductors shall be run at not more than 18 meters from each other on top of the buildings and interconnected at intervals of not more than 18 meters. Hot dip galvanized 25 x 3 mm G.I. strips shall be used for horizontal air termination. Whenever specified in the BOQ or layout drawing, early streamer type lightning protection of reputed make & type subject to Director IITM Pune approval shall be used. Installation procedures shall be approved by Director IITM Pune prior to the stand of work.

Down comers shall be installed at every 30 meters of the periphery of the buildings and structures and connected to separate earthing pits. Each down comer shall be provided with one earthing pit. Each down comer shall be provided with a test link for testing the installation. Portion at the conductor below ground shall be painted with bituminous paint.

The sizes and material of lightning conductors shall be as follows unless otherwise specified in Specific Requirements.

		Roof Conductors	down Comers
a)	Copper	25 x 3 mm	32 x 6 mm
b)	G I	25 x 3 mm	32 x 6 mm

The down comer shall be cleated to the wall or columns at intervals of 300 mm using G.I. clamps. All joints in the conductors shall be welded. Welding joints shall be painted with two coats of Bitumen.

Each air terminal rod shall have 150 mm dia GI or 75 mm dia copper sphere with 5 nos. 150 mm long conical GI / Copper spikes. The spikes shall be screwed and welded / brazed to the sphere. The whole assembly shall be fixed to a GI rod of not less than 50 mm nominal bore by means of flanged connections. The down comer shall be connected to the flange and welded / brazed. The top of the air terminal rod shall be two meters above top most point of structure.

Following also shall be earthed:-

Metallic noncurrent carrying parts of all electrical equipments such as transformer, switchgear, panels, power sockets, lighting fixtures., shall be earthed at one point for and up to 230V and at two points for working voltage of 415 Volts.

Steel structures / columns
Cable trays, spheres, vessels and other process equipment.
Fence and gate of electrical equipment (of transformer yard)
Cable shields and Armour.
Street light poles near to main earth grid shall be earthed by tapping from main earth grid. For remote located street light pole, individual earth electrodes shall be constructed.
Earth strips from Lightning arrester shall be laid and connected to Earth stations directly. Strips shall be of specified size. These shall be connected with plant main grid, whenever specified only below ground.
Equi-potential jumpers for any or all of the above equipment joints / sections intended for earthing.

SECTION-G
APPROVED LIST OF MATERIAL

Contractor shall supply material of Reputed Make. In case, it is not possible to supply Material of recommended make, equivalent make shall be as approved by AEPPL/Client. Contractor shall fill in this data sheet while submitting the tender.

Contractor shall supply material of Reputed Make which is approved by Maharashtra state Transmission Company (MSETCL) and Maharashtra state Electricity Board (MSEDCL)

SR. NO	ITEM DESCRITION	RECOMMENDED MAKES	PROVIDED BY BIDDER
1	22 kV H T XLPE CABLES	Universal / RPG./ Lapp/ KEI /Polycab/Finolex	
2	22 kV H T DO fuse	Atlas / Pactil/ Kiron	
3	A.C.S.R. conductor	Atlas / Sterlite / equivalent.	
4	Clamps, Termination Kits, Joints	Raychem/ M-SEAL/3M	
5	22 kV HT GOD	Atlas/ Pactil/ Kiron	
6	LT Cables	Universal/Lapp/Finolex /RPG/KEI/Polycab	
7	22 kV H.T. cable terminations	Raychem/ M-SEAL /3M	
8	22 kV Lightning Arrestors	CG/GE/Elpro	
9	ACB/VCB	ABB / Schneider NW / Siemens 3WL / L&T	
10	MCCBs	ABB / Schneider (NSX) / Siemens / L&T	
11	SDFs	ABB / Schneider MG / Siemens / L&T	
12	Timers, Temp Controllers etc	Solectron / L&T/ABB	
13	Contactors/Relays	ABB / Schneider MG / Siemens / L&T	
14	Capacitors Banks (APP/MD)	Subdohan / Epcos / ABB / Mehar	
15	Lighting Fixtures	Wipro/ Philips /Pier Light	
16	1/3 Phase/ Sockets	Legrand / L&T/ Hager/ABB/Schneider	
17	DBs	Hager/Legrand/MG/ABB/ Siemens/Schneider/L & T	
18	Load Managers	L & T/ Schneider (Conzerv,Secure,Socomec) / Siemens/ Rishabh	
19	FSU Unit with HRC Fuse	Siemens / ABB/ Merlin Gerin/L&T	
20	ELCB / RCCB /RCBO / MCB	Legrand / Merlin Gerin/ Siemens/Hager/ABB	
21	Ht/LT Panels	Suvarna/OVI /Zenith/CPRI Approved Vendors	

22	Starters	Siemens/ ABB/Merlin Gerin	
23	Protective Relays	Alstom/ Siemens/ABB/L & T/Areva	
24	RTPFC Relay	Sycon/Beluk/Ducati(RMI)/ABB	
25	Energy meter	L&T / Enercon / Krycard / AE / Socomec / Elmeasure / Conzerv	
26	Indicating meter(Digital)	Enercon /AE/ Socomec/Elmeasure	
27	Control fuses	EE/Siemens/ Merlin Gerin	
28	Indicating lamps (LED based)	ALTOS/Teknic/Raas, Siemens	
29	Push buttons	Siemens/BCH/ Teknic/	
30	Connectors	WAGO/Phoenix	
31	Current / Voltage transformers	Kappa/ SEGC/AE	
32	Double Compression Glands	Commet / Braco / Dowels / Siemens / Phoenix	
33	Lugs	Dowel / Jainson / Braco	
34	PVC conduit accessories	Precision/ Circle Arc/ Diamond/Finolex/trubore/Sudhakar/	
35	Wires	Finolex / Lapp / RPG / Universal / Polycab	
36	Switches & socket	ABB/Legrand Mosiac / Crabtree / Anchor Roma /	
37	MS Conduit & accessories	BEC/VIMCO/Bharat/Univercell	
38	Lighting poles	Valmont/Wipro/Bombay poles/Bajaj / Philips	
39	High Mast	Philips / Wipro /Valmont	
40	Ceiling fans	Usha, Orient, Crompton,	
41	Exhaust Fan (heavy duty)	Almonard/GEC/ Crompton	
42	Exhaust fans (light duty)	Siracco	
43	Electronic ballasts	Wipro/CG/ Intelux/ Philips / pier light	
44	Light fitting accessories	ATCO/ Vossolloh/ Wipro, Philips/Thorn/ Clipsal / pier light	
45	Incandescent Lamps	Philips/ Osram / Wipro	
46	UPS System	APC/Emerson/Eaton/Socomec/Numeric	
47	DG Engine	CAT/Cummins/Volvo/MTU/Mitsubishi/Kirloskar/Perkits/Doosan	
48	Alternator	Kirloskar/Stamford/Avk/Leroy Somer	
49	Lead Acid Battery(DG Duty)	Exide/Standard/Amara Raja	
50	SMF Batteries for UPS	Rocket/Amar Raja/HBL	
51	Distribution Transformer	Crompton/Universal/Kirloskar/Voltamp/Emco/Raychem	

52	Cable Trays	Ashlesha /Indiana/Profab/shruti	
53	Cable Tray Support	Hitech / Amtech /	
54	HT Panel(VCB)Vaccum Contactor	Areva/Siemens/ABB/CGL/L & T/ABB/Schneider	
55	Busduct LT	L & T/C & S/Siemens/Schneider/GE	
56	NGR	RSI Switchgear/National Switchgear	
57	SCADA	ABB/Siemens/Schneider/L & T/Rockwell	
58	PDU	Datson/APC/Delta/ocomec/Eaton	
59	CT's	Voltamp/Siemens/Kappa/Socomec	
60	Auxillary /Protection Relays	ABB/Areva/Siemens/L & T/Schneider	
61	ATS	Siemens/Eaton/Emerson(ASCO)	
62	Surge Protection devices	Eric/Nimbus/ Indelec	
63	Lightning Protection devices	Erico/CEC/Nimbus/Socomec/Indelec	
55	Early Streamer LA	Indelec	

SECTION-H
LIST OF IS STANDARD

IS 10028	Code of practice for installation and maintenance of transformers.
IS 1866	Code of practice for Maintenance of mineral insulating oil.
IS 335	New insulating oil for transformers and switchgears.
IS 2309	Protection of buildings and allied structures against lightning.
IS 3043	Code of practice for earthing.
IS 5216	Safety procedure and practices in Electrical work.
IS 3106	Code of practice for selection, installation and maintenance of fuses (Voltage not exceeding 650 Volts)
IS 1646	Code of practice for fire safety of buildings (general) Electrical installation.
IS 9921	Alternating Current Disconnectors above 1000 V.
IS 8623	Factory built assemblies of switchgear, and control gear for voltages up to and including 650 V
IS 2147	Degree of protection provided by enclosure for low voltage switchgear and control gear.
IS 2551	Danger notice plates.
IS 1248	Electrical indicating instruments.
IS 722	AC Electric meters.
IS 2705	Current Transformers.
IS 3156	Voltage transformers.

1. Various materials and electrical installation shall confirm to latest editions of the B.I.S./IEC as mentioned in materials and installation specifications column. Additionally and generally following Indian standards shall also be applicable. All other relevant Indian standards shall also be applicable whether specifically mentioned or not.

IS 8828	Miniature air break circuit breakers for AC circuits.
IS 10118	Installation and maintenance of switchgear.
IS 398 IEC 1089-1991	ACSR conductors
IS 7098	Cross linked polyethylene insulated PVC sheathed cables up to 33 KV
IS 12943	Brass glands for PVC cables
IEC 99-4	Gapless Surge Arrestors
IS-900	Code of practice for Installation and Maintenance of Induction Motors
IS-1255 - 1983	Codes of practice for Installation and Maintenance of Power Cables up to and including 33 KV Rating.
IS-732 - 1989	Code of practice for Electrical Wiring Installation. (System Voltage not exceeding 660 Volt).
IS-1913	General and Safety Requirements for Luminaries.
IS-1646	Code of Practice for Fire Safety of Building (General) Electrical Installation.
IS-2713	Specification for Tubular Poles for Overhead Power lines.
IS-6792	Method for determination of Electric Strength of Insulating Oils.
IS-2667	Specification for Fittings for Rigid Steel Conduits for Electrical Wiring.

BOQ

Sr. No.	Description	Unit	Qnty
	SECTION - I : LV Panels & Distribution Boards		
1.0	Supply ,Installation, testing and commissioning of L.T. panel boards Compartmental cubicle type, freestanding with appropriate cable entries, with **Cu** busbars & manufactured based on IS 8623, AEPPL specifications and single line diagrams. Scope shall include unloading, shifting, unpacking, Section assembly from storage place to desired Installation.All required protections will be as per SLD. **(Panels will be supplied by Contractor, M.S. steel angle support fabrication shall be considered separately.)(As per Main SLD No.ITM_137_PD_ELEC_SLD_001)**		
1.1	4000A Outdoor Isolation Panel Consisting of 4000A,ACB,Ics=Icu=60kA & 2 nos of 4000/5A,15VA,CL-PS & 5P20 Resp.,Bottom incoming & top Outgoing	Set	2
1.2	ATS Panel-01 Consisting of 4000A,ATS & 4000A,ACB,60kA,LSIG Protections	Set	1.00
1.3	ATS Panel-02 Consisting of 4000A,ATS & 4000A,ACB,60kA,LSIG Protections	Set	1.00
1.4	Main LT Panel - 01	Set	1.00
1.5	Main LT Panel – 02	Set	1.00
1.6	Utility Panel	Set	1.00
1.7	Chiller Panel-01	Set	1.00
1.8	Chiller Panel-02	Set	1.00
1.9	UPS OUTPUT Panel-A	Set	1.00
1.10	UPS OUTPUT Panel-B	Set	1.00
1.11	Power Distribution Board -01A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.12	Power Distribution Board -02A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.13	Power Distribution Board -**03A with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.14	Power Distribution Board -04A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.15	Power Distribution Board -01B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00

1.16	Power Distribution Board -02B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.17	Power Distribution Board -03B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.18	Power Distribution Board -04B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00
1.19	Variable Primary Pump Panel -01	Set	1.00
1.20	Variable Primary Pump Panel -02	Set	1.00
1.21	Server Area PAC DB-A	Set	1.00
1.22	Server Area PAC DB-B	Set	1.00
1.22	Other Area UPS PDB	Set	1.00
1.23	600 kVAR RTPFC-1 with 7% detuned reactor with Thyristor Switch	Set	1.00
1.24	600 kVAR RTPFC-2 with 7% detuned reactor with Thyristor Switch	Set	1.00
1.25	CDU Panel-01	Set	1.00
1.26	GF Cooling Panel-Wall Mounted Group type Construction	Set	1.00
1.27	Supply installation,testing & commissioning of 630A 3P,35kA Automatic, Transition,Overlaping Neutral with enclosure ATS Switch	Set	3.00
1.28	Supply installation,testing & commissioning of 100A 3P,25kA Automatic, Transition,Overlaping Neutral with enclosure Change Over Switch(COS)	Set	3.00
1.29	Supply installation,testing & commissioning of 70A 3P,25kA Automatic, Transition,Overlaping Neutral with enclosure COS	Set	4.00
2.00	Supply,Installation, Testing & Commissioning of Copper, indoor/ Outdoor Sandwitch type **busduct** as per location/ specification of busduct. Busduct shall include all horizontal / vertical lengths, bends, phase cross over chamber if necessary, flexible Al./Cu. jumper at Panel/ Trafo. end. Scope shall include unloading, unpacking, section assembly, shifting from storage place to desired location. **(M.S. steel support fabrication shall be considered separately.)(Actual lengths shall be measured at site prior to procurement.)**		
2.1	4000 Amps, 55kA TPN Aluminium, Sandwitch type Busduct Indoor/Outdoor as per datasheet.	Rmtr	50.00
2.2	PCC end tinned copper flexible	Set	4.00
3.0	Supply, Installation, Testing and Commissioning of double door prefabricated recessed type MCB DB with CRCA sheet fabrication with powder coated body concealed in wall or on support structure. Steel support fabrication shall be considered separately.		

3.1	Phase Segrigated 8 way TPN DB with 40A, TP MCB as Incomer & 40A, 30mA,DP, RCBO as subincomer 3 Nos & 24Nos. of 10-20A SP MCB as O/Gs.**(LDB 1)**	Set	2.00
3.2	Phase Segrigated 4 way TPN DB with 63A, TP MCB as Incomer & 63A, 30mA,DP, RCBO as subincomer 3 Nos & 12Nos. of 10-20A SP MCB as O/Gs.**(RPDB 1)**	Set	2.00
3.3	12 way VTPN DB with 100A TP MCCB as incomer & 2 Nos. of 63A TP MCB,5 Nos. of 16A TP MCB & 2 Nos of 32A TP MCBs, & 9 nos. 20A SP MCB as O/Gs. **(ACDB)**	Set	1.00
3.4	12 Way SPN DB with 25A,DP,30mA,RCCB as incomer & 10Nos 10A SP MCB as O/Gs.(Main **ELDB**)	Set	1.00
4.0	Pre-fabricated, **IP 42** enclosure with power sockets, necessary cable glands & spare knockout holes comprising of:-		
4.1	1 No. - 20A 1ø 3 pin Industrial socket + 20A SP MCB.	Set	10.00
5.0	Supply,Installation,Testing Commissioning of power sockets, necessary cable glands & spare knockout holes comprising of:-		
5.1	Pug & Sockets 32Amps 3Ph + N + G (IEC 309)	Set	215.00
5.2	Plug & Socket 16 Amps P + N + G (IEC309)	Set	35.00
	TOTAL : SECTION – I		
	SECTION II : L.V. Cables. (XLPE Insulated)		
1.0	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Note:-Actual cable lengths shall be measured at site prior to procurement.)**		
1.1	3.5C x 400 Sq.mm. A2XFY Cable.	Rmtr	11000.00
1.2	3.5C x 300 Sq.mm. A2XFY Cable.	Rmtr	1900.00
1.3	3.5C x 95 Sq.mm. A2XFY Cable.	Rmtr	70.00
1.4	3.5C x 50 Sq.mm. A2XFY Cable.	Rmtr	500.00
1.5	4C x 25 Sq.mm. A2XFY Cable.	Rmtr	130.00
1.6	4C x 16 Sq.mm. AYFY Cable.	Rmtr	700.00
1.7	4C x 16 Sq.mm. AYFY FRLS Cable.	Rmtr	300.00
1.8	4C x 10 Sq.mm. AYFY FRLS Cable.	Rmtr	300.00
1.9	4C x 6 Sq.mm. YWY FRLS Cable.	Rmtr	110.00
1.10	4C x 4 Sq.mm. YWY Cable.	Rmtr	700.00
1.11	4C x 2.5 Sq.mm. YWY Cable.	Rmtr	250.00
1.12	4C x 2.5 Sq.mm. YWY FRLS Cable.	Rmtr	600.00
1.13	3C x 2.5 Sq.mm. YWY Cable.	Rmtr	500.00

1.14	3C x 2.5 Sqmm YY FRLS Cable	Rmtr	800.00
1.15	5C x 6 Sqmm YY FRLS Cable	Rmtr	8500.00
1.16	1C x 300sqmm YY FRLS Cable	Rmtr	10000.00
1.17	1C x 70 Sqmm YY FRLS Cable	Rmtr	800.00
1.18	24C x 2.5 Sqmm YWY Cable	Rmtr	250.00
2.0	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
2.1	3.5C x 50 Sq.mm. A2XFY Cable.	Nos.	28.00
2.2	4C x 25 Sq.mm. A2XFY Cable.	Nos.	4.00
2.3	4C x 16 Sq.mm. AYFY Cable.	Nos.	24.00
2.4	4C x 16 Sq.mm. AYFY FRLS Cable.	Nos.	8.00
2.5	4C x 10 Sq.mm. AYFY FRLS Cable.	Nos.	18.00
2.6	4C x 6 Sq.mm. YWY FRLS Cable.	Nos.	4.00
2.7	4C x 4 Sq.mm. YWY Cable.	Nos.	4.00
2.8	4C x 2.5 Sq.mm. YWY Cable.	Nos.	4.00
2.9	4C x 2.5 Sq.mm. YWY FRLS Cable.	Nos.	28.00
2.10	3C x 2.5 Sq.mm. YY Cable.(PG Gland)	Nos.	50.00
2.11	5C x 6 Sqmm YY Cable (PG Gland)	Nos.	450.00
2.12	1C x 300sqmm YY Cable PG Gland Termination	Nos.	376.00
2.13	1C x 70 Sqmm YY Cable PG Gland Termination	Nos.	40.00
2.14	24C x 2.5 Sqmm YWY Cable	Nos.	4.00
3.0	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
3.1	3.5C x 400 Sq.mm. A2XFY Cable.	Nos.	148.00
3.2	3.5C x 300 Sq.mm. A2XFY Cable.	Nos.	88.00
3.3	3.5C x 95 Sq.mm. A2XFY Cable.	Nos.	2.00
	TOTAL : SECTION – II		
	SECTION III : Earthing		
1.0	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete**(Eqvt toSGI,JEF,Ashlok T 39)** with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder/compound, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling.	Nos.	32.00

2.0	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. or in ready made trenches or on ready tray with necessary clamps & bimetallic srips as per specification. (excavation required for this will be ensured separately.) Refer layout & tender spec for various applications		
2.1	75 x 10 mm. GI strip.	Rmtr	400.00
3.2	50 x 10 mm. Cu strip.	Rmtr	600.00
3.3	50 x 10 mm. GI strip.	Rmtr	500.00
3.4	50 x 6 mm. GI strip. (Main Grid+ Cable Tray)	Rmtr	500.00
3.5	32 x 6 mm. GI strip.	Rmtr	300.00
3.6	32 x 6 mm. Cu strip.	Rmtr	250.00
3.7	25 x 3 mm. Cu. Strip	Rmtr	2500.00
3.8	32 x 6 mm. GI strip. Supported on Porcelain insulator/ J bolt at every 1.5 mtr interval for building L.A.	Rmtr	200.00
3.9	8 SWG GI Wire.	Rmtr	500.00
3.10	1C X 10 Sqmm YY FRLS Cable	Rmtr	250.00
4	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" to cover protection radius of 65.0 mtr. With 3 mtr rod height & with stem and fixing arrangement. (Indelec). Required installation/ mounting details shall be submitted prior to installation.	Nos.	1.00
5	Supply, installation, testing of disconnecting link box for lightning down conductor at 1 mtr. from GL with SMC insulator and Gunmetal 50 x 6 mm disconnecting link.	Nos.	2.00
	TOTAL : SECTION III		
	SECTION IV : UPS		
1	Supply, Installation, testing and commissioning of 500 kVA UPS , consisting of following	Set	6
	Input 433V 3 Ph + N + E +/-10% 50Hz		
	Output 400V 3 Ph + N + E , -2% 50Hz		
	Unsymmetrical load with SMF battery backup for 15 min.		
	Racks & Intercell connectors suitable for batteries		
	UPS to battery DC cable to be consider		
	Installation & commissioning of Batteries & UPS (Lenghths as per actuals)		
2	Supply, Installation, testing and commissioning of 100 kVA UPS consisting of following	Set	2
	Input 433V 3 Ph + N + E +/-10% 50Hz		

	Output 400V 3 Ph + N + E , -2% 50Hz Unsymmetrical load with SMF battery backup for 15 min. Racks & Intercell connectors suitable for batteries UPS to battery DC cable to be consider Installation & commissioning of Batteries & UPS (Lenghths as per actuals)		
3	As above but 2 x 2.5 + 1 x 1.5 Sq.mm. wires. In provided floor Truff / PVC conduit	Rmtr	500.00
4	Providing & fixing 2 Nos. modular 5 A socket & switch (on UPS) and 1 no 5A & socket & switch (on Raw Power) with modular plate and box at one place for UPS & mains connections above table top.	Set	10.00
5	Supply & Installation of MS boxes in flooring made from 16 SWG M.S. sheet with Stainless steel cover of 14 SWG of following sizes		
5.1	Supply and installation of Surface / concealed 25mm dia **PVC Conduit** with spacer saddles for computer and telephone / speaker wiring concealed in office area walls & open other places with pull boxes etc.	Rmtr	200.00
5.2	Supply and installation of Surface / concealed 25mm dia **GI Conduit** with spacer saddles for transformer area wiring walls & open other places with pull boxes etc.	Rmtr	100.00
	TOTAL SECTION – IV		
	SECTION V : Point Wiring		
1.0	Surface / concealed point wiring for light / fan call bell / 5 A points with 2 x 2.5 + 1 x 1.5 Sq.mm. multistrand Cu. wires 1100 V gr. in suitable 25mm **PVC conduits** / flexible conduits wherever required as submains and 2 x 1.5 + 1 x 1.5 Sq.mm. **FRLS** wires for each point complete (submains will not be measured separately) with necessary modular switch board, switch plates and Blanking plates & accessories as required etc. to complete the task.. Primary Point shall mean first point wired from switchboard and Secondary point shall mean successive points next to Primary point. **(Areas : Office, canteen, Security cabin, Toilets,Production Shop)**		
	Note:- All conduits in area with false ceiling shall be concealed in wall below false ceiling,**point wiring height will be 3-4 mtr from FFL**		

1.1	Primary Light point wiring with necessary 5 A SP Switch , ceiling rose / Holders compete. (Maximum 2/3 points controlled by one Switch) as reqiured to complete the job.	Pt.	40.00
1.2	As above but Secondary Light point wiring.	Pt.	50.00
2.0	Fan point with modular 5 A SP Switch, 5 step Electronic fan Regulator, switch box plate & fan hook box etc. modular, fan box.	Pt.	20.00
3.0	**Supply, installation,** testing and commissioning of lighting fixtures/ fans/Ex. fans etc. including necessary electronic ballast, lamp, accessories, wiring connection, support arrangement like suspension chain, M.S. conduit drop with ball socket. down drops, etc. All FTL fixtures shall be with triphosphor source.		
3.1	2 X 28 Watt TL-5 Weather Proof Luminaire suitable for TL-D and TL5 Lamps. high grade Polycarbonate housing and cover.TCW450 2xTL5-28W EBT	Nos.	50.00
3.2	4 x 14 Watt high efficiency Surface mounted luminaire suitable for T5 lamp with dimmable balast. (Make:- Philips Cat no.- TPS814 4xTL'5'14W/EBP D8 (4xTL'5'14W) or equivalent.)	Nos.	60.00
3.3	1x 28 watt Saviour Slim Channel luminaire (Wipro WRF 20128 SGW)	Nos	10.00
4.0	Supply, installation testing of Ceiling/Exhaust fans with necessary acessories to complete the job.		
4.1	Supply, installation testing of 150mm exhaust fans with mounting frame & louvers.	Nos.	5.00
5.00	Supply, Installation of Junction Boxes made out of CRCA Sheet (16SWG) with 4way Terminal Strip and appropriate knock out for loop in loop out of cables. (For Lighting)	Nos.	150.00
6.00	Supply,Installation,Testing & Commissioning of Exit Signages		
6.1	Exit	No	10.00
6.2	Emergency Exit	No	5.00
	TOTAL SECTION – V		
	TOTAL : SECTION VI: Data & Telephone Provisions		
1.0	Supply, installation, testing & commissioning of jelly filled armoured twisted pair 0.51 mm Cu. telephone cable with PVC insulation in ready trenches / trays / pipes etc.		
1.1	20 Pair.	Rmt	100.00
1.2	2 Pair Unarm. Cable	Rmt	500.00
2.0	Supply and laying of CAT 6 cable for Data points in existing raceways.	Rmt	500.00

3.0	Supply and installation of 2 mm thickness Aluminium extruded raceway for under floor installation including necessary cutting of floor providing couplers and clamps for raceway fixing as details provided making good the surface of floor complete as per sizes provided.		
3.1	82mm X 38mm deep Al raceways.	Rmt	100.00
4.0	Supply, installation of following set of modular sockets with box, switch plates for telephone & data cables etc. as required as detailed below.		
4.1	1 No. RJ 45 data socket with modular box & cover plate.	No.	10.00
4.2	1 No. RJ 11 telephone socket with modular box & cover plate.	Nos.	10.00
	TOTAL : SECTION VI		
	SECTION VII - CABLE TRAYS & FABRICATIONS		
1.0	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)		
1.1	100mm, 50x50 perforated tray. (16 SWG)	Rmtr	50.00
1.2	150mm, 50x50 perforated tray. (16 SWG)	Rmtr	60.00
1.3	300 mm, 50x50 perforated tray. (14 SWG)	Rmtr	100.00
1.4	450 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	400.00
1.5	750 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	200.00
2	Cable Tray Covers suitable for following size trays		
2.1	100mm perforated tray.	Rmtr	60.00
2.2	150mm perforated tray.	Rmtr	25.00
2.3	300 mm perforated tray.	Rmtr	50.00
3.0	Supply, Fabrication, Installation of M.S. angle/ Channel/ Square tube of 3mm thick of 50x50mm size including base plates supports arrangement, fastners, hardware etc. as per requirement (Duly approved by AEPPL and Client) for trays, frames etc. including necessary painting with 2 coats of primer and 2 coats of enamel black paint.	Ton	5.00
	TOTAL : SECTION VII		
	SECTION VIII - ITEMS MAY BE EXECUTED		
	Distribution Boards & Industral Socket		
1	Supply, Installation, Testing and Commissioning of double door prefabricated recessed type MCB DB with CRCA sheet fabrication with powder coated body concealed in wall or on support structure. Steel support fabrication shall be considered separately.		

1.1	8 way TPN DB with 25A 4P 30mA RCBO as incomer & 18Nos. of 10-20A SP MCB as O/Gs.	Set	1.00
1.2	8 way VTPN DB with 63A TP MCCB as incomer & 4 Nos. of 10A TP MCB,2 Nos. of 25A TP MCB & 2 Nos of 16A TP MCBs as O/Gs.	Set	1.00
1.3	8 way VTPN DB with 63A TP MCCB as incomer & 6 Nos. of 10A TP MCB,2 Nos of 16A TP MCBs as O/Gs.	Set	1.00
1.4	4 way TPN DB with 63A, TPN RCBO 30 mA as incomer & 12Nos. of 20A SP MCB as O/Gs.	Set	1.00
2	Pre-fabricated, **IP 42** enclosure with power sockets, necessary cable glands & spare knockout holes comprising of:-		
2.1	1 Nos. - 63A 3ø 5 pin Industrial socket + 63A TP MCB.	Set	1.00
2.2	1 Nos. - 32A 3ø 5 pin Industrial socket + 32A TP MCB.	Set	1.00
	LT Cables & Termination		
3	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Note:-Actual cable lengths shall be measured at site prior to procurement.)**		
3.1	3.5C x 240 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.2	3.5C x 185 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.3	3.5C x 150 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.4	3.5C x 120 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.5	3.5C x 70 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.6	3.5C x 35 Sq.mm. A2XFY Cable.	Rmtr	1.00
3.7	4C x 10 Sq.mm. YWY Cable.	Rmtr	1.00
3.8	4C x 6 Sq.mm. YWY Cable.	Rmtr	1.00
3.9	4C x 1.5sqmm YWY Cable	Rmtr	1.00
3.10	3C x 6 Sq.mm. YWY Cable.	Rmtr	1.00
3.11	3C x 4 Sq.mm. YWY Cable.	Rmtr	1.00
3.12	1C x 6sqmm YY Cable including Termination	Rmtr	1.00
3.13	6C x 2.5 Sqmm YWY Cable	Rmtr	1.00
3.14	8C x 2.5 Sqmm YWY Cable	Rmtr	1.00
4	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
4.1	3.5C x 70 Sq.mm. A2XFY Cable.	Nos.	1.00
4.2	3.5C x 35 Sq.mm. A2XFY Cable.	Nos.	1.00
4.3	4C x 10 Sq.mm. YWY Cable.	Nos.	1.00
4.4	4C x 6 Sq.mm. YWY Cable.	Nos.	1.00

4.5	4C x 1.5 Sqmm. YWY Cable.	Nos.	1.00
4.6	3C x 6 Sq.mm. YWY Cable.	Nos.	1.00
4.7	3C x 4 Sq.mm. YWY Cable.	Nos.	1.00
4.8	3C x 2.5 Sq.mm. YWY Cable.	Nos.	1.00
4.9	1C x 6sqmm YY Cable PG Gland Termination	Nos.	1.00
4.10	6C x 2.5 Sqmm YWY Cable	Nos.	1.00
4.11	8C x 2.5 Sqmm YWY Cable	Nos.	1.00
5	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
5.1	3.5C x 240 Sq.mm. A2XFY Cable.	Nos.	1.00
5.2	3.5C x 185 Sq.mm. A2XFY Cable.	Nos.	1.00
5.3	3.5C x 150 Sq.mm. A2XFY Cable.	Nos.	1.00
5.4	3.5C x 120 Sq.mm. A2XFY Cable.	Nos.	1.00
	Spare ACB's and MCCB's		
6.0	Supply and Installation of Spare Switchgear for modification and alteration work in LT Panels.		
6.1	4000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.2	4000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.3	3200A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.4	3200A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.5	2500A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.6	2500A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.7	2000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.8	2000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.9	1600A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.10	1600A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0
6.11	1250A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.00
6.12	1250A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.00
6.13	1000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.00
6.14	1000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.00
6.15	630A,TPN. 55kA,Thermal Release, MCCB	Set	1.00
6.16	400A TPN. 55kA,Thermal Release, MCCB	Set	1.00
6.17	315A TPN. 55kA,Thermal Release, MCCB	Set	1.00
6.18	250A TPN. 55kA,Thermal Release, MCCB	Set	1.00
6.19	200A TPN. 55kA,Thermal Release, MCCB	Set	1.00
6.20	160ATPN. 55kA,Thermal Release, MCCB	Set	1.00
6.21	125ATPN. 55kA,Thermal Release, MCCB	Set	1.00
6.22	100A TPN. 55kA,Thermal Release, MCCB	Set	1.00
	Earthing System & L.A.		

7.0	Earthing station as per IS 3043 - 1987, using Pipe / plate electrode complete with watering pipe & suitable GI strip up to chamber, soil treatment with charcoal and salt / bentonite powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link etc. And all other work required to complete the task.		
7.1	Earthing station as per IS 3043 - 1987 as above using 600 x 600 x 3 mm. Cu. Plate as electrode and other items required to complete the task.	Nos.	1.00
7.2	As per IS 3043 - 1987 as above but bore type earthing with 3mtr. long 40 mm. dia. GI pipe as earth electrode treatment with bentonite / earth powder complete including required Boring, earth strip connection to GI pipe electrode shall be with 2nos. GI half round clamps duly welded and bolted at 2 distinct points treatment with bentonite / earth powder complete including required dia Boring.	Nos.	1.00
8	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. or in ready made trenches or on ready tray with necessary clamps & bimetallic srips as per specification. (excavation required for this will be ensured separately.) Refer layout & tender spec for various applications		
8.1	75 x 10 mm. Cu strip.	Rmtr	1.00
8.2	75 x 6 mm. GI strip.	Rmtr	1.00
8.3	50 x 6 mm. Cu strip.	Rmtr	1.00
8.4	32 x 6 mm. Cu strip.	Rmtr	1.00
8.5	25 x 6 mm. GI strip.	Rmtr	1.00
8.6	25 x 3 mm. GI. strip.	Rmtr	1.00
8.7	25 x 3 mm. GI strip. Supported on Porcelain insulator/ J bolt at every 1.5 mtr interval for building L.A.	Rmtr	1.00
8.8	4 SWG GI Wire.	Rmtr	1.00
8.9	12 SWG GI Wire.	Rmtr	1.00
8.10	10 SWG GI Wire.	Rmtr	1.00
9	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" Protection level III to cover protection radius of 75.0 mtr. With 5 mtr rod height & with stem and fixing arrangement. (Indelec or Eqvt.). Required installation/ mounting details shall be submitted prior to installation	Nos.	1.00

10	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" Protection Level III to cover protection radius of 95 mtr. With 5 mtr rod height & with stem and fixing arrangement. (Indelec). Required installation/ mounting details shall be submitted prior to installation.	Nos.	1.00
11	Supply, installation, testing & commissioning of 5 Spikes Copper Building lightening arrester to be installed on top most point of building with stem and fixing arrangement etc. complete.	Nos.	1.00
	Point Wiring & Light Fixtures		
12	Mains Circuit as required		
12.1	2 x 4.0 + 1 x 2.5 Sqmm FRLS Cu wires as above but in provided AL floor Truff / in PVC conduit.	Rmtr	1.00
12.2	Supply and installation of main for UPS power points in plant area with 2 x 4 + 1 x 2.5 Sq.mm. wires including 25mm PVC Conduits.	Rmtr	1.00
12.3	As above but 2 x 2.5 + 1 x 1.5 Cu wires in 25mm PVC conduit.	Rmtr	1.00
13	Supply & Installation of MS boxes in flooring made from 16 SWG M.S. sheet with Stainless steel cover of 14 SWG of following sizes		
13.1	300 x 300 x 50 mm. Floor boxes.	Nos.	1.00
13.2	150 x 150 x 50 mm. Floor boxes.	Nos.	1.00
14	**Supply, installation,** testing and commissioning of lighting fixtures/ fans/Ex. fans etc. including necessary electronic ballast, lamp, accessories, wiring connection, support arrangement like suspension chain, M.S. conduit drop with ball socket. down drops, etc. All FTL fixtures shall be with triphosphor source.		
14.1	1x 28 watt Decorative luminaire (Wipro WRF 81128 SG)	Nos	1.00
14.2	1x 18 watt Decorative luminaire (Wipro WRF 21118)	Nos	1.00
14.3	4 x 14 Watt STELLAR - Recess mounted special geometric MO luminaire(Wipro WVF 20414)	Nos.	1.00
14.4	2 x 18 Watt Low Depth Recessed downlighter(Wipro WCP 28218)	Nos	1.00
15.0	Supply, installation testing of Ceiling/Exhaust fans with necessary acessories to complete the job.		
15.1	Supply, installation testing of 1200mm Ceiling fans with 300mm down rod canopies but without regulator.	Nos.	1.00
15.2	Supply, installation testing of 1400mm Ceiling fans with 300mm down rod canopies but without regulator.	Nos.	1.00
16.0	Supply, installation testing of wall mounted fans with mounting frame & louvers.	Nos.	1.00

16.1	Supply, installation testing of 305mm exhaust fans with mounting frame & louvers.	Nos.	1.00
17	Supply,Installation,Testing & Commissioning of Exit Signages		
17.1	Emergency Exit Door	No	1.00
17.2	Emergency Exit Right from here	No	1.00
17.3	Emergency Exit Left from here	No	1.00
17.4	Staire case up or down	No	1.00
	Data & Telephone		
18.00	Supply & installation of Krone type telephone junction box fabricated and painted as per panel specifications.		
18.1	50 Pair Box.	No.	1.00
18.2	20 Pair Box.	No.	1.00
18.3	10 Pair Box.	No.	1.00
19.0	Supply, installation, testing & commissioning of jelly filled armoured twisted pair 0.51 mm Cu. telephone cable with PVC insulation in ready trenches / trays / pipes etc.		
19.1	50 Pair.	Rmt	1.00
19.2	10 Pair Unarm. cable.	Rmt	1.00
20.0	Supply & laying of CAT 5E cable for Data points in existing raceways or in pre laid FRPVC blank conduits.	Rmt	1.00
	Raceway & J.B.		
21	Supply and installation of 2 mm thickness Aluminium extruded raceway for under floor installation including necessary cutting of floor providing couplers and clamps for raceway fixing as details provided making good the surface of floor complete as per sizes provided.		
21.1	100mm X 45mm deep Al. raceways.	Rmt.	1.00
21.2	125mm X 25mm deep Al. raceways.	Rmt.	1.00
22.0	Supply and installation of good quality floor junction boxes of appropriate sizes for raceways with folded frames including counter sunk screw arrangements such that covers are in level with the floor level. The cover will be M.S, power coated & have 4 Nos. 25 / 32 mm Ø holes with rubber grommets at appropriate location.		
22.1	100mm X 100mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00
22.2	125mm X 125mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00
22.3	225mm X 225mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00
22.4	330mm X 330mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00

22.5	450mm X 450mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00
23.0	Supply, installation of following set of modular sockets with box, switch plates for telephone & data cables etc. as required as detailed below.		
23.1	2 Nos. RJ 45 socket for data with box & cover plate at one place.	No.	1.00
23.2	3 Nos. RJ 45 for 1 telephone and 2 data socket with boxes & cover plates at one place.	No.	1.00
	Cable Tray with Covers & Fabrication		
24	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)		
24.1	50mm, 50x50 perforated tray. (16 SWG)	Rmtr	1.00
24.2	200mm, 50x50 perforated tray. (16 SWG)	Rmtr	1.00
24.3	600 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	1.00
25	Cable Tray Covers suitable for following size trays		
25.1	50mm perforated tray.	Rmtr	1.00
25.2	200mm, perforated tray.	Rmtr	1.00
25.3	450 mm perforated tray.	Rmtr	1.00
26.0	Supply, Fabrication, Installation of M.S. square tube of 3mm thick of 40 x 40mm size. including painting with 2 coats of primer & 2 coats of final enamel black paint as specified. And all other items required to complete the task.	Rmtr	1.00
	TOTAL : SECTION VIII		

HT BOQ			
Sr. No.	**Description**	**Unit**	**Qnty**
	SECTION-I:-HT SYSTEM		

1	Supply,Erection, Testing and Commissioning of **22 kV / 0.433 kV, 2500 kVA, Dyn 11, 6.25% Impedance, Oil Insulated Transformer with OLTC and all accessories** complete on readymade plinth, Scope shall includes unloading shifting from stores to plinth and BDV test & topping up of fresh transformer oil as per requirement to complete the task.If required filteration of oil .	Set	2.00
2	Supply,Erection, Testing & Commissioning of Ring Main Unit(RMU) & HT Switchgear equipment including necessary support structure, hardware & testing of the equipment at site after Erection as per specification. All other work to complete the erection of equipment.		
2.1	Supplu,Installation,Testing & Commissioning of 22 kV, 630A, **26kA, Indoor Compact RMU type (Extendable)** including relay and control panel .Consisting of 1 I/C SF6 , 3 O/G SF6,and Metering module Feeders as per SLD.(HT Panel 1).	Set	1.00
2.2	Supply,Installation,Testing & Commissioning of 22 kV, 630A, 26kA VCB **HT PANEL** 22kV,630A,26kA as incomer & 2nos. 22kV, 630A, 26kA Vacuum Circuit Breaker as outgoing Panel **Extensible type** including Power Pack as per specifications , Data sheet and SLD.	Set	1.00
2.3	Removing Existing RMU 1 incoming & One out going including cable termination,handover to Client as desired location guide by Client	job	1.00
3	Supply,Testing, tagging, laying, & commissioning of following **22 kV grade XLPE HT cable** on readymade Trench/Excavation with (sand cushioning of 75mm, laying bricks on both sides of cable) & covering with RCC / PCC tiles or half round hume pipe of 200 mm dia. and refilling of cable trench, leveling of cable trench etc. as required. (Note: Quantity is tentative as Route is tentitively desided). (Only Hard rock excavation shall be measured separately).		
3.1	3C x 240sqmm Al.XLPE HT Cable	Rmtr	700.00
4	Supply, installation, testing & commissioning of heat shrink jointing for **22kV HT cables** of following sizes including necessary accessories, spider supports, plated hardware like lugs / ferrules, insulation tapes etc. complete. Standard make. Scope also includes making suitable cutouts in gland plate & sealing them after connections.		

4.1	Indoor End Termination.	Set	5.00
4.2	Outdoor End Termination.	Set	2.00
5	Providing Chainlink Fencing with 10SWG, 1.5" Chainlink jali with 50 x 50 x 6 mm M.S. Angle supports at proper intervals (@2.0m C/C). Fencing height should be 2.4M above Ground Level. The rate shall be inclusive of **2No. 3M wide**, double leaf gate made out of 40mm dia., 2mm thk. MS pipe with proper channel supports and **1Nos. of 1.0M wide** single leaf gate same as above gate etc. complete including painting with 2 coats of red oxide primer & 2 coats of silver paint. The rate shall be inclusive of the required civil work. **(Total perimeter of fencing -- 100M)**.	job	1.00
6	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete**(Eqvt to Ashlok T 39)** with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling.	Nos.	14.00
7	Statutary Approval from local EB	job	1.00
8	Supply, installation, material equipment required as per statutory provision & safety.		
8.1	22 kV grade Rubber matting 1000 mm width.	Mtr	4.00
8.2	22 kV class Hand gloves.	Pair	1.00
8.3	22 kV Danger boards of appropriate size & marking.	Nos	6.00
8.4	433 V Danger boards of appropriate size & marking.	Nos	12.00
8.5	1.1 kV grade Rubber matting 1000 mm width.	Mtr	30.00
8.6	First Aid Box	Nos	3.00
8.7	Laminated First aid chart with frame.	Nos	3.00
8.8	4.5 Kg fire extinguisher ABC type	Nos	5.00
8.9	9 Kg fire extinguisher ABC type	Nos	5.00
9.0	Fire Buckets with stand 04 Nos. of Buckets filled with Fine Sand	Nos	4.00
10.00	HT Cable Route Marker	Nos	50.00
	Total Of Section-I		
	SECTION-II ITEM MAY BE EXECUTED		

1	Supply, installation, testing & commissioning of heat shrink jointing for **22kV HT cables** of following sizes including necessary accessories, spider supports, plated hardware like lugs / ferrules, insulation tapes etc. complete. Standard make. Scope also includes making suitable cutouts in gland plate & sealing them after connections.		
1.1	Straight through Joints.	Set	1.00
2	Excavation of cable trenches upto a depth of 1000mm refilling and reinstating the trenches and removing excess soil after proper 4" sand bedding/ coushioning above & below cables with bricks as per specifications & IS standards.		
2.1	Excavation in soil, soft murm & Hard murm.	M3	1.00
2.2	Excavation in soft Rock.	M3	1.00
2.3	Excavation in Hard Rock.	M3	1.00
3	Supply, laying of following different types of Hume pipes/pipes in trenches for road crossing for electrical, telephone cables etc. complete as required including excavation of trench in all types of strata except hard rock and refilling, leveling of trench, shifting of extra earth or debris to dump yard complete as required.		
3.1	300 mm dia. RCC Pipe.	Mtr	1.00
3.2	200 mm dia. Half round RCC hume Pipe.	Mtr	1.00
	Total Of Section-II		

BILL OF QUANTITY -DG Set			
Sr. No.	**Description**	**Unit**	**Qty**
	SECTION-I		
1.0	Design, Supply, Installation, Testing & Commissioning at site 3-phase, 415V, 1500RPM, 50 HZ, Diesel generator set as per DG Technical Document, of **1 x 625 KVA** Prime Rating at 0.8 pf lagging diesel engine with **Radiator cooled** and alternator set mounted on common base frame in Outdoor Type Acoustically Treated Enclosure, with day tank of adequate capacity in liters for backup of 8-10hr running of DG set, battery, battery charger, return fuel color, anti vibration mounting pads including residential silencer, engine alternator safeties with accessories, **1No. of 1000A, 25kA, mp based, LSIG, MCCB Isolator inside acoustic enclosure** as per the attached SLD, engine control panel, ventilation system, inside conopy lighting, etc. as per specification complete as required. DG shall have appropriate Building Management System integration provisions / ports as well as hardwired alarm/ critical monitoring provisions with details of integrationDiesel engine shall conform to IS:10000 and alternator shall be self excited complete with AVR confirming to IS:4722.Offer Shall Include operation and maintenance contract for minimum of 5 years .Carrying out performance & guarantee test, making arrangements for loads etc. as required. Fuel & oil fill for testing, trial run till handover. All cost of fuel, Oil and operation shall be borne by the the bidder.	Set	**6**
2.0	Supply, Installation, Testing & Commissioning of Cu. Unarmoured cables of following size from Alternator to 1000A MCCB Isolator Panel inside DG Set.		
2.1	1C X 95 sq.mm. 2XY Cu. UnArm. Cable **(4 Runs/phase + 2 Runs - Neutral)**	Mtrs.	550
3.0	Cable Termination of above cable		
3.1	1C X 95 sq.mm. 2XY Cu. UnArm. Cable	Nos	72
4.0	Supply Installation testing Commissioning of Synchronisation cum AMF Panel as per SLD and Technical Document. Synchronizing panel should be incorporated with Auto Load sharing, Load Dependent "Start & Stop".	Set	1
5.0	**Design Supply, Installation, Commissioing of Exhaust System as per below mentioned**		
5.1	10"M.S.Pipe Class B from Exhaust Bellow to Silencer	Mtrs.	12
5.2	Supply of 10" MS Class B Exhaust pipe	Mtrs.	50
5.3	Aluminium Cladding for the Exhaust Pipe	Mtrs.	62
5.4	Cladding for the Residential Silencers	Nos	6
5.5	Bends & Flanges 250 mm Dia or required size.	Nos	6
5.7	Steel for Exhaust Support structure (for 6No. Of D.G.Sets)	Ton	4

6.00	SITC of GI ladder and Perforated Cable Trays of following sizes		
a	600mm x 75mm ladder tray.	Mtrs.	60
b	300mm x 50mm perforated tray.	Mtrs.	20
7.0	**FUEL PIPING**		
7.1	Supply ,Installation and Commissioning of ASTM Grade, seamless Pipe 40 mm (40NB)	Mtrs.	50
7.2	Supply ,Installation and Commissioning of ASTM Grade, seamless Pipe 25 mm (25NB)	Mtrs.	60
7.3	Ball Valve		
a	40NB	Nos	4
b	25NB	Nos	6
7.4	Non Return Valves		
a	40NB	Nos	2
7.5	Y Stainers	Nos	2
7.6	Solenoid Valves for 25NB tapping lines for auto operation of Fuel pumping system.	Set	6
7.7	Flow Meter	Nos	6
7.8	Hardware for fuel piping	Set	1
8.0	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete (Eqvt to Ashlok T 39) with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling.	Nos	26
9.0	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. in trenches or tray with necessary clamps & bimetallic srips as per specification. (excavation required for this to be ensured in the scope.) Refer layout & tender spec for various applications		
9.1	50 x 10 mm. GI strip.	Mtrs.	200
9.2	50 x 10 mm. Cu strip.	Mtrs.	150
10.0	Supply, Installation, Testing and Commissioning of Al./Cu. LT XLPE cable for Power/Control cabling as mentioned below. Schedule for the same shall be submitted by the DG Vendor prior execution of the job.		
10.1	3.5C X 400 sq.mm. A2XFY	Mtrs.	1950
10.2	24C X 2.5 sq.mm. 2XWY	Mtrs.	650
10.3	2C X 4 sq.mm. 2XWY	Mtrs.	500
10.4	6C X 2.5 sq.mm. 2XWY	Mtrs.	500
10.5	3C X 1.5 sq.mm. Cu. Sheilded Cable	Mtrs.	1500
10.6	2C X 2.5 sq.mm. 2XWY	Mtrs.	200
11.0	Cable Termination of above cables with glands and lugs.		
11.1	3.5C X 400 sq.mm. A2XFY	Nos	36
11.2	24C X 2.5 sq.mm. 2XWY	Nos	6
11.3	2C X 4 sq.mm. 2XWY	Nos	6
11.4	6C X 2.5 sq.mm. 2XWY	Nos	6
11.5	3C X 1.5 sq.mm. Cu. Sheilded Cable	Nos	18
11.6	2C X 2.5 sq.mm. 2XWY	Nos	2
13.0	**Approvals**		

13.1	Approvals and registration from Statutory Authorities like pollution control board, electrical inspector etc. necessory to complete the job.	Job	1
14	Under Ground Diesel Storage Tank (UG Tank)		
15.1	Supply , Installation Testing and commissioning of Under ground Diesel Storage Tank of Capacity 50 KL **including Approval from CCOE**, NOC from various authorities, MPCB, Fire authority approval and any other statutary bodies approval. Necessory civil work along with fencing and gate. In the area of UG tank necessory flame proof light fitting along with lighting poles to be considered. Necessory Pumping arrangement (Electrical Driven) with one working and one stand by pumps, along with Diesel Piping to be considered. Fuel storage pumping system shall be designed to have a trouble-free automated system without manual intervention for auto-filling of Day Tanks for 6No. of DG sets. Level sensors, flow meters to be considered by bidders. Monitoring provision shall be included with Potential free contacts/option to connect Flow Meters inside fuel lines / Underground Level Sensor Provision on tanks etc which shall provide for smooth operation.	Job	1
	TOTAL Of SECTION-I		
	SECTION-II ITEM MAY BE EXECUTED		
1	**Design Supply, Installation, Commissioing of Exhaust System as per below mentioned**		
1.1	Supply, Installation and Commissioning of Single self supported standalone chimney as common exhaust outlet for 3Nos. Of DG Sets with all related & required accessories, support structure, LA, Aviation lamp etc.	Job	1
2	SITC of GI ladder and Perforated Cable Trays of following sizes		
2.1	750mm x 75mm ladder tray.	Mtrs.	1
3	Supply , Installation , Testing and Commissioing external Fuel Tank of suitable capacity 990 lts as per CPCB norms.	Job	1
4	Supply, Installation, Testing and Commissioning of Earthing station as per IS 3043 using Pipe / plate electrode complete with 50mm dia. watering pipe & suitable GI/Cu strip up to chamber, soil treatment with charcoal and salt / bentonite powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including rate of excavation for earth pit, refilling and any other item required to complete the task.		
4.1	Earthing station as above but using 600 x 600 x 6 mm. GI. Plate as electrode complete.	Nos	1
4.2	Earthing station as above but using 600 x 600 x 3 mm. Cu. Plate as electrode complete.	Nos	1

5	Supply, Installation, Testing and Commissioning of Al./Cu. LT XLPE cable for Power/Control cabling as mentioned below. Schedule for the same shall be submitted by the DG Vendor prior execution of the job.		
5.1	10C X 2.5 sq.mm. 2XWY	Mtrs.	1
5.2	4C X 25 sq.mm.	Mtrs.	1
5.3	3C X 4 sq.mm. 2XWY	Mtrs.	1
6	Cable Termination of above cables with glands and lugs.		
6.4	10C X 2.5 sq.mm. 2XWY	Nos	1
6.5	4C X 25 sq.mm.	Nos	1
6.6	3C X 4 sq.mm. 2XWY	Nos	1
	TOTAL Of SECTION-II		

LIST OF DRAWINGS

1. Lighting Layout for Ground Floor.
2. Lighting Layout for First floor.
3. Power Cable Tray Layout for Ground Floor.
4. Cable Tray Layout for First Floor.
5. HT & LT Panel SLD.
6. PDU Panel SLD.
7. External Equipment Layout
8. Cable Tray Section Layout
9. Earthing Layout 1st Floor
10. Equipment Layout
11. Equipment Section Layout

SPECIAL CONDITIONS AND TECHNICAL

SPECIFICATION FOR HVAC

DESIGN DATA

1. Site Parameters

Geographical Location: Pashan Pune

10 Kms From Pune (approx), Maharashtra, India.

Altitude : 560 m above MSL

Latitude : 18.34 °N

Daily Temperature Range : 31 Deg F

1. Outside Design Conditions:

Summer	D.B.Temperature	:	104 Deg. F
	W.B. Temperature	:	76.0 Deg. F
Monsoon	D.B.Temperature	:	83 Deg.F
	W.B. Temperature	:	79 Deg.F

2. Inside Design Conditions:

Server Room	24+/- 2 Deg C
Electrical Panel Room	24+/- 2 Deg C
Battery Room	24+/- 2 Deg C

The contractor shall visit and study the site on his own cost with prior permission from the client/owner. The submitted details shall guarantee the inside design conditions as specified. Any other information required by the contractor for verification shall be provided to him by the consulting engineer / the client.

TECHNICAL SPECIFICATIONS

1.0 Scope of Work

These specifications together cover supply, erection, testing and commissioning of Air Conditioning and Mechanical Ventilation system for IITM DATA CENTER at Pune.

Supply, Installation, testing & commissioning of Air-cooled Chillers, Pumps, Fan Coil Units, Piping with Insulation, Valves, BMS integration & accessories, Ventilation Fans, Ducting including end connection of Air Cooled Chiller & Precision Air Handling Unit with DX system complete in all respects and as per specifications and drawings, in which Connecting chilled water piping upto chiller Unit barrel nozzles including final end connections. Coordinate with the chiller/Precision Air Handling Unit Supplier to ensure stress free and satisfactory piping connections with adequate supports and carryout all miscellaneous fabrication/welding works like installation of thermowells/ pockets for all sensors/instruments as required and to the satisfaction of the chiller/Precision Air Handling Unit Supplier. Also to do flushing and cleaning works of chilled water system piping after suitably protecting the chiller. Clean the system strainers and complete the dosing process. Test the water quality and ensure acceptability with backup test certification so that the commissioning process can be done successfully at the following site.

Item wise Technical Specification is given here after in respective chapters.

CHILLER SPECIFICATIONS

CONTENTS

GENERAL

General Information

Each unit will be completely factory-packaged including evaporator, condenser, subcooler, oil separator, compressor, motor, lubrication system, micro-computer control center, and all interconnecting unit piping and wiring. The chiller shall also give Lon works / Bacnet protocol card / outlet to enable its connection to the BMS System. The chiller will be painted prior to shipment.

Water side shall be designed for 300 psig working pressure. Power shall be supplied to the compressor motor at 400 volts – 3 phase - 50 Hertz and controls at 215 volts – 1-phase - 50 Hertz. The chiller shall use R-134A./R-407C refrigerant gas. The power shall be provided at at one point only. The further distribution for multi compressors / condensers fan and any other devise shall be taken care by the supplier.

The supplier shall submit the computer software generated test parameters sheets of the testing before the despatch of the chillers at the points and conditions specified in tender agreement. The testing will be done in presence of clients representative at the test facility location at tender specified ambient temperature. The test parameters achieved during the witness testing at the testing facility at the specified ambient and at specified points ,in the presence of clients representative shall comply with the technical specification submitted by supplier without any negative tolerance in capacity of the chiller and positive tolerance in Power Consumption Values.

The initial charge of refrigerant and oil will be supplied for each unit including anti vibration mounts for base frame & flexible bellows for chiller inlet & outlet connections.

COMPRESSORS

The compressor will be a rotary screw type. The compressor housing will be of cast iron, precision machined to provide minimal clearance for the rotors. The rotors will be manufactured from forged steel and use asymmetric profiles. The compressor will incorporate a complete anti-friction bearing design to reduce power and increase reliability.

Capacity control will be achieved by use of a slide Valve to provide fully modulating control from 100% to 10% of full load. The slide valve will be actuated by oil pressure, controlled by external solenoid valves through the micro-computer control centre.

Screw compressors shall have low starting torque (start unloaded). The compressor shall be equipped with a sight glass to view oil level and an oil adjustment port. The compressor shall be internally lubricated with a highly refined, low foaming, and white mineral oil. The Screw compressor shall be provided with a crankcase heater to prevent refrigerant migration.

MOTOR DRIVELINE

The motor shall be, continuous duty, squirrel cage induction type, and will have an open drip-proof enclosure.

Motor full-load amperes at design conditions will not exceed motor nameplate (FLA). Motor will be designed for use with the type starter specified. Motor will be factory - mounted and directly connected to the compressor to provide compressor/motor alignment.

The compressor motor shall be semi-hermetic, refrigerant gas cooled with all phase inherent protection and shall be suitable for 380-420 Volts, 3 Phase, 50 Hz operation. Compressor motor shall be of the close-coupled open type or hermetic type. The motor shall be two pole, continuous duty, squirrel cage induction type. Motor full load ampere at the design conditions shall not exceed motor name plate amperage.

The motor shall be liquid refrigerant cooled and shall have high temperature cut-out protection at each phase of the starter windings

LUBRICATION SYSTEM

An adequate supply of oil will be available to the compressor at all times. During operation, oil will be delivered by positive system pressure differential or full-time operation of an oil pump.

EVAPORATOR

Evaporator will be of the shell-and-tube, flooded or DX type designed for 300 psig working pressure on the refrigerant side, and will be tested in accordance with ASME code or equivalent. The shell will be fabricated from rolled carbon steel plate 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 refrigerant side will be designed, tested and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII - Division 1 or equivalent. Tubes shall be 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. A liquid level sight glass will be located on the side of the shell to aid in determining proper

refrigerant charge. The evaporator will have a refrigerant relief device to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration or equivalent.
The evaporator tubes shall be internally coated with anti corrosive coat.

The test pressure shall not be less than 1.5 times that of the actual working pressure or rated working pressure whichever is the higher. The cooler shall be insulated with 50mm high quality polyurethane foam having thermal conductivity not exceeding 0.22 W/mK at 20 °C mean temperature. The insulation of the cooler water boxes shall be of detachable arrangement to allow access to the tubes for maintenance

CONDENSER

Condenser will be of the air cooled type complete with finned tube design, designed for 300 psig working pressure on the refrigerant side, and be tested in accordance with ASME code or equivalent. The tube material shall be copper & aluminium fins. A refrigerant sub cooler will be provided for improved cycle efficiency. The refrigerant side will be designed, tested and stamped in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII - Division 1 or equivalent. The condenser fans shall be silent design with motor capable of outdoor application (IP-55). The condenser will have refrigerant relief devices to meet the requirements of the ASHRAE 15 Safety Code for Mechanical Refrigeration or equivalent.

REFRIGERANT SYSTEM

Refrigerant flow to the evaporator will be metered by a single fixed orifice with a solenoid bypass to accommodate varying head conditions.

The condenser tubes will be capable of storing the entire system refrigerant charge during servicing. Isolation from the rest of the system will be by manually operated isolation valves located at the inlet and outlet of the condenser. Additional valves will be provided to facilitate removal of refrigerant charge from the system.

GRAPHICAL CONTROL PANEL

General

The chiller shall be controlled by a stand-alone microprocessor based control centre. the chiller control panel shall provide control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.

Control panel

The control panel shall include a 10.4 in. diagonal colour liquid crystal display (LCD) surrounded by "soft " keys which are redefined based on the screen displayed at that time. This shall be mounted in the middle of a keypad interface and installed in a locked enclosure. The screen shall detail all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage shall be available in other languages as an option with English always available. Data shall be displayed in either English or Metric units. Smart Freeze Point Protection shall run the chiller at 36.00 °F leaving chilled water temperature, and not have nuisance trips on low water temperature. The sophisticated program and sensor shall monitor the chiller water temperature to prevent freeze up. When needed Hot Gas Bypass is available as an option. The panel shall display countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point shall have a pop-up screen with

the allowable ranges, so that the chiller can not be programmed to operate outside of its design limits.

The chiller control panel shall also provide

System operating information including: Return and leaving chilled water temperature

i. Entering and leaving condenser air temperature
ii. Evaporator and condenser saturation temperature
iii. Oil pressure at compressor and oil filter differential
iv. Percent motor current
v. Compressor discharge temperature
vi. Oil temperature
vii. Percent slide valve position
viii. Operating hours
ix. Number of unit starts

Digital programming of set points through the universal keypad including:

i. Leaving chilled water temperature
ii. Percent current limit
iii. Pull-down demand limiting
iv. Six-week schedule for starting and stopping the chiller, pumps etc.,
v. Remote reset temperature range

Status messages indicating:

i. System ready to start
ii. System running
iii. System coast down
iv. System safety shutdown-manual restart
v. System cycling shutdown-auto restart
vi. System prelube
vii. Start inhibit

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, orange for cycling faults, yellow for warnings, and green for normal messages.

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:

i. Evaporator – low pressure
ii. evaporator – low pressure – smart freeze
iii. evaporator – transducer or leaving liquid probe
iv. evaporator – transducer or temperature sensor
v. condenser – high pressure contacts open
vi. Condenser – high pressure
vii. Condenser – pressure transducer out of range
viii. Auxiliary safety – contacts closed
ix. Discharge – high temperature
x. Discharge – low temperature
xi. Oil – high temperature
xii. Oil – low differential pressure
xiii. Oil – low differential seal pressure
xiv. Oil or condenser transducer error
xv. Oil – clogged filter
xvi. Oil – high pressure

xvii. Oil – separator – low level

xviii. Control panel – power failure

xix. Watchdog – software reboot

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. Cycling shutdowns with a fixed speed drive shall include:

i. Multiunit cycling – contacts open

ii. System cycling - contacts open

iii. Control panel - power failure

iv. Leaving chilled liquid - low temperature

v. Leaving chilled liquid - flow switch open

vi. Condenser – flow switch open

vii. Motor controller – contacts open

viii. Motor controller – loss of current

ix. Power fault

x. Control panel - schedule

Security access to prevent unauthorized change of set points, to allow local or remote control of the chiller, and to allow manual operation of the prerotation vanes and oil pump. Access shall be through ID and password recognition, which is defined by three different levels of user competence: view, operator, and service.

Trending data with the ability to customize points of once every second to once every hour. The panel shall trend up to 6 different parameters from a list of over 140, without the need of an external monitoring system.

The operating program stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge. Programmed set points shall be retained in lithium battery-backed RTC memory for a minimum of 1 years with power removed from the system.

A fused connection through a transformer in the compressor motor starter to provide individual over-current protected power for all controls.

A numbered terminal strip for all required field interlock wiring.

An RS-232 port to output all system operating data, shutdown / cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be preprogrammed to print from 1minute to 1day.

The capability to interface with a building automation system to provide:

i. Remote chiller start and stop

ii. Remote leaving chiller liquid temperature adjust

iii. Remote current limit set point adjust

iv. Remote ready to start contacts

v. Safety shutdown contacts

vi. Cycling shutdown contacts

vii. Run contacts

COMPRESSOR MOTOR STARTER

Star Delta Closed starter with NEMA 1 enclosure suitable for pad mounting. A 14-guage (minimum) steel terminal box with gasketed front access cover will be provided for field connected conduit. The chiller graphic control panel shall provide Overload/over current protection. Jumpers shall be furnished for three lead types of starting. Motor terminal lugs shall be not furnished.

MISCELLANEOUS ITEMS

Ant vibration mounts, steel & spring loaded with serrated rubber pads for field mounting under unit feet for vibration isolation shall be supplied by the contractor.

The Screw liquid Chillers shall be complete with Compressors, Air Cooled Condensers, Shell & Tube or DX type Evaporators (Chillers), electrical control panel with starters, interconnecting cabling etc. The machine shall be capable of delivering 175 TR (Actual Capacity for City of Pune ambient condition 40 Deg. C) for the following conditions chilled water outlet temperature - 07 Deg.C, chilled water inlet temperature - 12 Deg.C, Ambient Temperature – For the City Of Pune. The Chiller shall be capable of Operation on 415 V, 50 Hz, 3 Phase, complete with electrical Panel, having a microprocessor control, having following features, Single Phasing Prevention, Under & Over Voltage Protection, Phase Reversal Protection, Independent Set Points for each refrigeration Circuit, HP/LP Trip signal indication & interlocking, Condenser Fan Motor Over Load Protection, Interlocking for chilled water flow switch, Runtime equalization for multiple compressors. (The equipment shall have high efficiency lowest IKW / TR). The chillers shall have stepless capacity control 10% to 100% (Vanes / slide valve). The Chiller shall be complete with Lon Works / Bacnet protocol output card, to enable BMS integration.

INSTALLATION

The installation of the machine shall be carried out with proper foundation and proper supporting. The contractor shall prepare all the necessary drawings with norms, design, specification given by Institute and shall be approved by the Institute before carrying out the installation work.

CHILLER PERFORMANCE TESTS

- To ensure quality, guaranteed efficiency and performance in compliance with the specified conditions, at least one unit of each model of the package liquid chiller shall be fully tested.

- The tests shall be conducted at the manufacturer's factory or workshop where proper testing facilities are available and the test results shall be submitted to the Institute Engineer upon delivery of chiller. The design ambient condition should be simulated during the chiller performance test.

- The contractor shall be responsible for the arrangement of the tests and all expenses Incurred for two Engineers

- After assembly and pressure testing the chiller shall be tested on the following (in

accordance with ARI whenever applicable)

- Full load capacity.
- Quick Start with in 2minuts (start to start).
- Capacity control range as specified and stability of operation at minimum load.
- Efficiency at full load and partial load. Readings of chiller performance at 100% 80% 70% 60% 50% and minimum loadings are required.
- Safety device activation.
- Pressure drop across evaporator and condenser.
- Noise levels at various points.
- Vibration levels at various points.
- The contractor shall submit the test schedule at least one (1) month before the proposed date of testing.

Harmonic Filtration :-

The chillers/chiller switch board shall be equipped with harmonic filtration to filter any harmonics generated from the chiller plant.

Chiller Acoustical Performance:

Sound pressure levels for the complete unit are not to exceed specified levels. Manufacturer shall provide necessary Acoustic treatment to the Chiller as require. Sound data to be measured in accordance with ARI Standard 575-79. Data is in dB, reference 0.0002 dyne/cm2, measured along a perimeter of 1 meter from machine and at a height of 4.5 meter above floor. Data is at highest levels recorded in 3 operating position: 100% load, 83% load, 50% load and 33% load.

Provide full Acoustic Attenuation Kits fitted to all Chillers including sound Attenuators and acoustic shrouds to compressors

Insulation:

Cooler shall be insulated with 30mm flexible Armaflex II or equal closed cell foam insulation. (K = 0.28 fps units). Suction line, suction elbow and motor housing (for hermetic motors) to be similarly insulated All insulation shall be applied with adhesive. All joints filled Insulated surfaces shall be finished with factory applied pained to match the equipment

Start-up and Installation:

Manufacturer shall furnish a factory trained service technician without additional charge. The service technician shall perform the leak testing, evacuation, and dehydration using a high quality vacuum pump furnished by the manufacturer. The standard triple evacuation procedure shall be used to insure complete removal of all water and non-condensable particles. Unit shall be evacuated to at least 500 microns and shall hold vacuum for a period of 12 hours with a maximum increase of 100 microns. Service technician shall submit a certified report to the consulting engineer on the above evacuation procedure.

Units that are factory charged or shipped with a refrigerant holding charge will not require field evacuation and dehydration. Charging and start-up of the system shall proceed once the consulting engineer has approved the certified field evacuation and dehydration report.

Manufacturer shall provide instruction of the owner's personnel on the operation and maintenance of the unit. Manufacturer shall provide operating instructions and part lists.

A satisfactory operation test shall be conducted in the presence of the construction manager. Power and water required for operation and testing will be furnished without cost to the works contractor. Each chiller shall be disassemble and reassembled if required for access in the building. The clear opening available will be determined by the works contractors accepting the tender form. Any damage to the units during shipment and installation shall be made good.

The liquid chillers and their components shall be given the following tests and such ther tests as the Client considers necessary to bring the equipment into running order.

Evacuation of Liquid Chillers :

The refrigeration system shall be evacuated by means of a suitable vacuum pump to a pressure of not greater than 0.7kPa (0.1 psi) after which it shall be closed off and left to stand for 24 hours.

(b) Chiller capacity

An approximate check of total refrigeration capacity of the chiller machines shall be carried out if climatic conditions. Permit.

(c) Commissioning Tests.

- While the manufacturer's technician is on site the contractor shall arrange the commissioning tests to be carried out and witnessed by the Institute Representative. The commissioning tests shall involve a complete check of the operation of all parts and safety controls associated with the chilled water machines, including associated pumps, auto start/stop controls, electrical supply and starter and any associated alarm control system.

- The commissioning check of the chiller shall include check of evacuation, refrigerant and oil charge, electrical starter and associated control functions, motor windings, thermistor strips, bearings, water flow quantities, flow switch functions, purge unit functions, pompous unit functions, electrical wiring interlocks, refrigeration HP/LP controls, refrigeration low temperature thermostat, low oil pressure cut-out, oil level safety cut-out, high discharge temperature safety cut-out, leaving water thermostat and control, load limit controller, functions, recycle timer/programmer functions, and then a check of running pressures, temperatures, fluid levels, amps, motor overload trip settings to establish that proper operation is achieved.

TECHNICAL REQUIREMENTS

Sl. No.	General Description		Requirement
1	Number Required	:	**3 Nos**
2	Location	:	Chiller Yard
3	Duty		Chilled water
3.1	Application		24X7 (365 days)
4	Capacity Required At Specified Design Conditions Per Chilling Package		**As per Annexure-I**
5	Refrigerant		R 134a
6	Maximum IKW/TR at Full Load		<1.26 at 40 Deg.C (NGT)
7	Maximum Noise Level At A Distance Of 1.5 Meters		85 dB(A)
8	COMPRESSOR		
8.1	Type of Compressor		Semi-Hermetic / Hermetic
8.2	Condensing Temperature		Max. 55 Deg C
8.3	Compressor Motor KW		-
8.4	Type of Starter		Star-Delta-Closed transition
8.5	Type of capacity control		Slide (Stepless) Valve
8.6	Quick start feature		Less than 2 Minutes (<2Min.)
9	Range of capacity variation		10 – 100% (Continuous modulation)
10	Microprocessor based controller panel with built-in safety controls (BAS compatible)		As described in the specification.
12	CHILLER		
12.1	No. of Chillers per machine		One – Shell and tube type
12.2	Type of Chiller		DX or Flooded
12.3	Liquid to be cooled		Water
12.4	Chilled water inlet temperature		**69.8 Deg.F**
12.5	Chilled water outlet temperature		**57.2 Deg.F**
12.6	Chilled water flow per chilling package		2.0 USGPM/TR
12.7	Fouling factor : Water side		As per ARI 550/590(1998) 0.0005-0.0001

Sl. No.	General Description		Requirement
12.9	Maximum water side pressure drop		
13	**AIR COOLED CONDENSER**		
13.1	Type of Condenser		Outdoor Air cooled type
13.2	Ambient Air Temperature		40 deg C(Ref. Basis of Design)
13.3	Type of fan and material of blade		Propeller – Poly propylene blade
13.4	Fan arrangement		Shaft vertical Air delivery upwards
13.5	Type of Fan Motor		Suitable for outdoor service – IP-55
13.6	Fin concentration – fins / mtr		Not less than 512
13.7	Material of tubes		Copper
13.8	Material of fins		Aluminium
14	Delivery of Chillers at Site		**8-10 Weeks**

DATA SHEET – A

DATA TO BE FURNISHED BY TENDERER ALONG WITH OFFER

Sl. No.	ITEM DESCRIPTION	UNIT	*CONTRACTOR'S INPUT*
1.	Chiller type	-	
2.	Quantity – Working / Stand by	No	
3.	Tag Numbers	-	
4.	Location	-	
5.	Place of manufacture		
6.	Model number and make		
7.	Minimum Refrigeration capacity	TR	
8.	Type of Compressor and speed	RPM	
9.	Minumum chilled water flow rate	USGPM	
10.	Maximum chilled water pressure drop	Ft	

DATA SHEET – A

DATA TO BE FURNISHED BY TENDERER ALONG WITH OFFER

Sl. No.	ITEM DESCRIPTION	UNIT	*CONTRACTOR'S INPUT*
11.	Entering chilled water temperature	ºC	
12.	Leaving chilled water temperature	ºC	
13.	Fouling factor for chiller		
14.	IKW / TR at full load based on 5.6 ºC leaving chilled water temperature		
15.	Ambient air Temp.	ºC	
16.	Leaving air Temp.	ºC	
17.	Condensing Temp.	ºC	
18.	Total air flow rate	CFM	
19.	No. of fans & motor power	KW	
20.	Type of starter		
21.	Motor Voltage		
22.	Type of capacity control		
23.	Noise level at 1.86m distance	Db (A)	
24.	Equipment size	(L x B x H)	
25.	Equipment operating weight	Kg	
26.	Full refrigerant charge	Kg	
27.	KW rating (total) of package	KW	
28.	Rated full load amps	RLA	
29.	Maximum inrush current	A	

DATA SHEET – A

DATA TO BE FURNISHED BY TENDERER ALONG WITH OFFER

Sl. No.	ITEM DESCRIPTION	UNIT	*CONTRACTOR'S INPUT*
30.	Computerized printout (certified) from chiller Sub-contractor indicating power consumption in IKW / TR at full load and various part load conditions as per ARI format.		
31.	Catalogues furnishing detailed technical data for compressor, chiller, condenser, micro-processor or micro-computer control panel etc.		
32.	ARI certification	Yes / No	
33.	Minimum tube removal space required on either end of condenser	mm	
34.	Minimum service space required		
A	Front	mm	
B	Back	mm	
C	Sides	mm	
35.	Type of Vibration Isolators		
36.	Minimum overhead clearance required for installation and service	mm	

Annexure-II*

OPERATING PARAMETERS (IKW / TR) as per variant ambient temperatures:

Load	Outdoor DBT							
	15^0C	18^0C	20^0C	25^0C	30^0C	35^0C	38^0C	40^0C
100%								
90%								
80%								
70%								
60%								
50%								
40%								
30%								
20%								
10%								

Note: * Mandatory

DATA TO BE FURNISHED BY THE CONTRACTOR AFTER THE AWARD OF CONTRACT

Quality Assurance Plan (QAP).

Dimensioned general arrangement drawing showing all accessories, mounting details, nozzle locations, etc. for the Air-cooled screw chiller package. Overall space and head room requirement with details of handling during erection, operation and maintenance. Foundation drawing with static and dynamic loading data, pocket details, foundation outline, etc. Cross-sectional drawings of all items with part list and materials of construction. Power wiring and control wiring diagrams.

Operation and maintenance manual.

Note: Victaulic Coupling shall be provided for Air cooled Chillers.

DATA SHEET - B

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

(AIR COOLED CHILLERS)

No	Description	Unit	Time			Date			Remarks
1.	COMPRESSOR		10.00	12.00	14.00	16.00	18.00	20.00	
a.	Suction pressure	Kg/cm²							
b.	Discharge pressure	Kg/cm²							
c.	Oil pressure	Kg/cm²							
d.	Suction temperature	ºC							
e.	Condensing temperature	ºC							
f.	Starting current	Amps							
g.	Consumed current	Amps							
2.	CONDENSER								
a.	Pressure at inlet	Kg/cm²							
b.	Pressure at outlet	Kg/cm²							
3.	COOLER								
a.	Water temperature at inlet	ºC							
b.	Water temperature at outlet	ºC							
c.	Pressure at inlet	Kg/cm²							
d.	Pressure at outlet	Kg/cm²							
4.	SAFETY CHECKS								

DATA SHEET - B

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

(AIR COOLED CHILLERS)

No	Description	Unit	Time			Date			Remarks
a.	High oil pressure	N: Kg/cm² A: Kg/cm²							
b.	High compressor discharge pressure	N: Kg/cm² A: Kg/cm²							
c.	Low evaporator pressure	N: Kg/cm² A: Kg/cm²							
d.	Low chilled water outlet temperature	N: ºC A: ºC							
e.	Low Oil temperature	N: ºC A: ºC							
f.	Chilled water flow	No							
g.	Power fault								
h.	No. of compressors in operation								
i.	Total hours of operation								
j.	Hours since last start								
k.	Any fault history								
l.	No Refrigerant Leaks								

DATA SHEET - B

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

(AIR COOLED CHILLERS)

No	Description	Unit	Time			Date			Remarks
m.	Purge Cycle normal								
n.	Waste Oil, Refrigerant properly disposed of and spare refrigerant properly stored								
o.	Any condensation problems								

MODE OF MEASUREMENT:

- Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipments. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.
- Package chilling unit The entire chilling unit with all accessories, starters, controls, control panels, control wiring, vibration mounts, local control stations, discharge side plenum for direct throw units, floor mounting MS angle iron base, protection grill for condensing unit, suspension arrangement, refrigerant piping, refrigerant charge oil, insulation, erection, commissioning and testing shall be regarded as one unit for the purpose of measurement and payment.

Annual contract Comprehensive AMC for Chillers:

Introduction:

This Annual Contract is for maintenance of Chiller system. This contract is for 3 years period from the date of completion of warranty period of 36 Months of HVAC System installed. The AMC will be a Part of Main contract of 'HVAC Works' Tender & Firm have to give year- wise rates for 3 years period for AMC contract separately.

(1) The HVAC contractor have to provide AMC after completion of Main Contract work and issue of Completion Certificate (C C). The Annual service contract will be operative in following three conditions:

- Period after completion certificate issued and all equipments & Systems are under ' Defect Liability Period (DLP)' and Premises has not been occupied/allotted to any occupier.
- In this condition the Annual Service Contractor will check and clean all valves, pipelines, equipments & will operate equipments for periodic checking etc. i.e. proper upkeep of HVAC equipments & its Accessories under the contract & installed for smooth working of HVAC System .
- Period after completion certificate issued, DLP over but building not occupied:
- In this case also all the works mentioned in para 'a' above will have to be done.Period after completion certificate issued and the equipments are either under DLP or not but building occupied/ allotted to occupy
- Comprehensive AMC portion of Chillers System required to quote against A-1 of Rate summary sheet will be operative depending up on situation/Site requirement and main tender DLP condition and separate agreement will be prepared for this.

2.) ANNUAL MAINTENANCE CONTRACT

A-1

	1st Year	2nd year	3rd year	4th year	5th year	6th year
Comprehensive AMC of Chillers	DLP					

Note:* Mandatory

CENTRIFUGAL PUMPS

CONTENTS

GENERAL

Scope

This specification covers the supply, installation, testing & commissioning of End Suction back pull out type single stage centrifugal pump.

Codes and Standards

The design, materials, construction, manufacture, inspection and performance testing of horizontal centrifugal pumps shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Nothing in this specification shall be construed to relieve the CONTRACTOR of this responsibility. The equipment supplied shall comply with the latest applicable Indian, American, British or equivalent standards.

Design Requirements

The total head capacity curve shall preferably be continuously rising towards the shut off. In case of unstable (drooping) characteristic the duty point shall be well away from the unstable region. The shut off head shall be at least 110% of the total head.

The required NPSH at duty point shall be at least 1.0 M less than the available NPSH.

Pumps shall run smooth without undue noise and vibration. The noise level shall be limited to 75 dBA at a distance of 1.8 M. Vibration shall limited to class IIC of BS 4675 Part –I. The power rating of the pump motor shall be the larger of the following:

i. The maximum power required by the pump from zero discharge to zero head.

ii. 110% of the power required at the duty point.

Pumps of a particular category shall be identical and shall be suitable for parallel operation with equal load division. Components of identical pumps shall be interchangeable.

FEATURES OF CONSTRUCTION

Casing

The casing shall be of heavy close grained cast iron, to withstand high tensile strength with smooth waterways and fitted with bronze wear ring. It shall be of vertically split design with streamlined volute and integral suction vertical position to facilitate piping. Casing shall have tapped openings for priming, vent. drain and gauge connections.

Impellers

The impellers on end suction pumps shall be semi-open type carefully balanced for smooth operation. The impeller is hydraulically as well as dynamically balanced. Balancing openings shall be provided near hub of the impeller to reduce pressure on the stuffing box to approximately suction pressure. The impeller shall be secured to the shaft by feather and nut.

Wearing Rings

Wearing rings are provided to maintain close running clearance and to minimize pressure leakage between suction and discharge chambers of the casing. The casing bearing rings shall protect the casing against wear and shall be locked in pump casing to prevent rotation.

Pump shall be provided with renewable type casing ring. Pump having capacity 2,000 cu.m/hr and above shall be provided with impeller ring in addition to casing ring. The hardness of impeller ring shall be 50 BHN higher than that of casing ring.

Shaft

The shaft shall be of high strength steel with optimum diameter to provide maximum strength with minimum shaft deflection. Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing box.

Stuffing box shall be of such design that it can be repacked without removing any part other than the gland and lantern ring.

Shaft Seal

The pump shall have mechanical shaft seals of extra hard carbon ceramic type.

Bearings

The bearings shall be precision ball bearings. The bearings shall be located and positioned on to shaft by means of lock nut.

The outdoor bearing shall be double row bearings, to take the radial and thrust loads. The inboard bearing shall be single row bearing taking the shaft radial load and shall be free to move axially in the bearing housing to compensate for shaft expansion due to temperature changes. Labyrinth deflectors shall be provided to exclude dirt and moisture from the bearing housing. Facilities shall be provided for grease lubrication. Grease reliefs shall be provided to prevent over-lubrication.

Bearing shall be grease lubricated and shall have a minimum life of 40,000 hours of working.

Coupling

Pump shall be furnished complete with flexible coupling. Back-pull out pump shall be provided with spacer type coupling.

Coupling guard made of expanded metal and bolted to the base plate shall be furnished for all coupled pumps.

All accessories required for proper and safe operation shall be furnished with pumps.

All incidental piping (including valves) required for sealing, lubrication and cooling for stuffing box packing and / or bearing of pump shall be furnished by the Contractor.

Alignment

The pump and motor shall be aligned by the pump manufacturer.

The pump manufacturer shall provide certification to the effect that the pump and motor coupling has been carried out by them and checked by them.

On completion of the installation, grouting and connection of all piping, the pump and motor shall be rechecked for alignment by means of accepted methods, by the pump manufacturer/sole agent.

TESTS AND INSPECTION

A standard hydrostatic test shall be conducted on the pump casing with water at 1.5 times the maximum discharge head or twice the rated discharge head., whichever is higher. While arriving at the above pressure, the maximum suction head shall be taken into account.

The hydrostatic tests on the casing shall be conducted for a minimum duration of 30 minutes.

PERFORMANCE TEST

Standard Running Test

The pumps shall be tested as per IS 5120, at rated speed at SUB-CONTRACTOR's works to measure capacity, total head, efficiency and power. The negative tolerance on efficiency shall be limited to 2.5% (not 5 % as indicated in IS 5120. These tests shall form the basis for acceptance of pumps except for vibration and noise. The pumps shall be tested over the range covering from shut-off head to the maximum flow. The duration of the test shall be minimum one hour. Minimum five readings approximately equidistant shall be taken for plotting the performance curves.

NPSH Tests

NPSH tests shall be conducted with water as the medium.

Mechanical Balancing

In addition to static balancing, impeller and balancing drum shall be balanced dynamically at or near the operating speed.

Field Testing

After installation, the pumps shall be subjected to testing at site also. If the field performance is found not to meet the requirements regarding vibration and noise as specified, the equipment shall be rectified or replaced by the CONTRACTOR, at no extra cost to the CLIENT.

TENDER DRAWINGS

The following drawings shall be submitted by the CONTRACTOR along with their Bids.

i. Preliminary outline dimensional drawing of pump and motor (Suction and discharge connections and foundation details shall also be indicated).

ii. Performance curves (capacity Vs total head, efficiency, NPSH and KW requirement) ranging from zero to maximum capacity.

iii. Pump Catalogues.

PAINTING

All ferrous surfaces shall be painted with one coat of red oxide primer paint followed by finish paint. However the components of the pumps shall not be painted before inspection.

PUMP HEAD CALCULATION

It is very important that contractor shall submit actual pump head calculation based on site installation conditions taking into account pressure drop in installed (to be installed) chillers, piping and fitting. This actual pump head calculation shall be submitted for engineers approval before ordering equipment and motor. Required pump motor capacity will be provided based on actual head calculation without any extra cost.

PRIMARY VARIABLE SPEED PUMPING SYSTEM :-

REFERENCES

A. Hydraulic Institute

B. ANSI - American National Standards Institute

C. NEMA - National Electrical Manufacturers Association

D. UL - Underwriters Laboratories. Inc.

E. ETL - Electrical Testing Laboratories

F. CSA - Canadian Standards Association

G. NEC - National Electrical Code

H. ISO - International Standards Organization

I. IEC - International Electro-technical Commission

QUALITY ASSURANCE

a) A system integrator/representative/agent not actively engaged in the design and manufacturing of centrifugal pumps shall not be considered as the pump manufacturer. The pump manufacturer shall assume "Unit Responsibility" for the complete VSPS system. Unit responsibility is defined as the responsibility to interface and commission all system components supplied to meet tender requirement

b) The pump manufacturer shall have a minimum of 20 years experience in the design and construction of Variable Speed Pumping Systems (VSPS)

c) The pump manufacturer who is the supplier of VSPS system must have relevant expertise in all aspects of pre-sales activities like system design, application engineers and post sales activities like installation, commissioning and after sales-service. VSPS supplier must have commissioned minimum 200 such projects of variable speed pumping systems in India

d) The manufacturer should have ISO (International Standards Organization) per ISO 9001:2000. Proof of this certification shall be furnished during the time of submittal

e) Bidders shall comply with all sections of this specification relating to variable speed pumping system. Any deviation from this specification shall be mentioned clearly in writing. If no deviations for the specifications are noted, it is construed that the supplier shall bound by these specifications.

Pump Logic Controller Package ;

Components of Pump Logic Control Panel

a) To supply and install Variable Primary Flow controller VPC-3000 as per the design

b) The control system should include the Pump logic controller, Variable frequency drive(s) and Differential pressure transmitters as indicated in the design

c) Pump logic control panel should house dedicated Pump Logic Controller, Variable frequency drive(s) and associated switchgears

d) Pump logic controller, Variable frequency drive(s), Differential pressure transmitters, Flow transmitters, Temperature transmitters and related equipment shall be installed by the mechanical contractor as shown in the design

e) Input power wiring to the pump logic control panel and the output wiring to the motors shall be the scope of electrical contractor and to be done as indicated in the electrical drawings submitted for the specific project

f) Low voltage wiring for the Building Management System to be done by the BMS contractor from the pump logic control panel to the IBMS system

Pump Logic Controller

a) Pump Logic Controller shall be listed by and bear the label of Underwriter's Laboratory Inc (UL). The controller shall be specifically designed for Variable Primary Flow pumping applications

b) Pump logic controller in built in Variable frequency drives are not accepted. Logic controller should be external to the drives used in the system

c) Pump logic Controller shall have programs to safeguard the system against the following conditions System Hunting End of curve protection

d) Pump Logic Controller shall be capable of receiving multiple analog input signals from zone differential pressure transmitters as indicated in the design. Pump Logic Controller will then select the analogue signal that has deviated most from its set point. The selected signal will then be used as the process input value for the hydraulic stabilization function.

e) Pump Logic Controller shall be capable of controlling up to six pumps in parallel

f) Pump Logic Controller shall be capable of accepting an additional analog input signal from a flow sensor. This input shall be used for the end of curve protection

g) The hydraulic stabilization program shall utilize a proportional integral control function. The proportional-integral values shall be user adjustable in the Pump logic Controller over a finite range

h) Pump logic Controller shall be self-prompting and all alarm messages shall be displayed in plain English. The operator panel shall have the following features:

    i. Multi fault Display

ii. Red fault light with related alarm message on default

iii. screen with representation of the fault

iv. Soft touch membrane keypad switches

i) Pump logic Controller shall have a display screen size of minimum 3" graphical display with backlight. Current status of settings and measured values are to be displayed in the default screen Pump logic Controller shall have optional password protection to safeguard the settings against unwanted / unauthorized changes

j) Display should have key driven function for the operation easiness

k) The following communication features shall be provided to the BMS

i. Remote start/stop of the VSPS through potential free

ii. contact from BMS

iii. Individual pump start/stop/trip status from VSPS through

iv. potential free contact to BMS

l) The following communication features shall be provided to BMS

i. system via RS-485 port utilizing Modbus protocol

ii. Individual analog input

iii. Individual pump/VFD on/off status

iv. System percent reference

v. System start/stop command

vi. System operating mode

vii. Individual pump kW consumption

viii. Individual pump operating hours

ix. Individual pump running speed in Hz/percentage reference

x. System flow, when optional flow sensor is provided

m) Pump logic controller shall be of Grundfos – VPC 3000 or approved equal housed in a NEMA 1 enclosure

Variable Frequency Drive:

a. The variable frequency drive(s) shall be pulse width modulation (PWM) type, microprocessor controlled design.

b. VFD, including all factory-installed options, is tested to UL standard 508. VFD shall also meet C-UL and be CE marked and built to ISO 9001:2000 standards.

c. VFD shall comply EMC directives as per IEC 61800-3:2004, category C1 with 50 meter motor cable (for power less than or equal to 90 Kw) & category C2 with 50 meter motor cable (for power more than 90 Kw).

d. VFD shall be housed in IP55 enclosures for indoor applications. Wall mounted/VFDs with plastic enclosures shall not be acceptable. For out door applications, VFDs shall be housed in IP 54 enclosure.

e. VFD shall employ an advanced sine wave approximation and voltage vector control to allow operation at rated motor shaft output speed with no derating. 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.

f. VFD shall have balanced DC link chokes to minimize power line harmonics. VFDs without a DC link choke shall provide a 3% impedance line reactor

g. Automatic motor adaptation (AMA) algorithm shall be available in the VFD. This feature shall allow for automatic adaptation of drive to meet the characteristics of the motor to have increased efficiency leading to additional energy savings. AMA feature should be able to configure without disconnecting the motor from the VFD

h. Output power switching shall be done without interlocks or damage to VFD

i. The following user adjustable parameters shall be provided in the VFD
    i. Acceleration time
    ii. Deceleration time
    iii. Minimum frequency
    iv. Maximum frequency

j. VFD shall be compatible for ModBUS protocol as standard

k. VFD shall have Automatic Energy Optimization (AEO) function. this feature shall reduce voltages when the drive is lightly loaded to provide a 3% to 10% additional energy savings

l. VFD shall be suitable for elevations to 1000 meters above sea level without derating. Maximum operating ambient temperature shall not be less than 40 deg Celsius. VFD shall be suitable for operation in environments up to 95% non-condensing relative humidity.

m. VFD shall be capable of displaying the following data in plain English via 40 character alphanumeric display:
    i. Frequency
    ii. Voltage
    iii. Current
    iv. Kw per hour consumption
    v. Running hours
    vi. Run mode (remote/local)
    vii. Active power
    viii. RPM

n. VFD(s) shall be warranted for a period of 18 months

Differential Pressure Transmitters

- Differential pressure transmitters shall be field mounted and shall transmit an isolated 4-20mA DC signal indicative of process variable to the pump logic controller via standard three wire 24 DC system with Emission/Immunity confirming to EN61000-6-2/3. Unit shall have stainless steel wetted parts with two 7/16" process connections. It shall be protected against radio frequency
- interference and shall have water tight, IP 55 electrical enclosure. Sensor should be capable of withstanding a burst pressure of 25 bar. Accuracy shall be within 2.5% BFSL (Best Fit Straight Line).

Sequence of operation

a) The system shall consist of Pump Logic Controller, multiple pump/VFD sets, with manual and automatic alternation and pump staging

b) The pumping system shall start upon the start command from the BMS when the pump logic controller is in "Remote" mode

c) If the Pump logic Controller pump logic controller is not in "Remote" mode, the system is started via the "Control Unit" at the panel

d) System starts in auto mode, with one pump running in minimum rpm as per the sequence :

First instance,

a) Duty pump modulates its speed based on the load side DP value (of the most deviated zone)If the DP set point could not be satisfied by duty pump at its 100% speed,

b) pump logic controller sends a request to Chiller plant manager (CPM) /Building automation system (BAS) for next chiller to stage in.

c) On receiving the next chiller stage in signal from CPM/BAS,corresponding hiller isolation valve is opened

d) On receiving the valve open feedback signal from the dry contact of the valve, next pump is started by pump logic controller

e) In parallel, Chiller plant manager/BAS commands the active chiller to unload

f) Second duty pump starts with minimum speed and both the duty pumps modulate equally at same speed based on the DP set point

Second Instance,

a) Upon reaching the safe minimum flow condition, pumps speed is limited by safe flow level

b) pump logic controller sends a request signal to Chiller plant manager/BAS to destage a chiller in the plant

c) Upon receiving the destage signal from the CPM / BAS, pump logic controller closes isolation valve of the corresponding chiller and stops the one of the duty pump.

Third Instance:

a) During plant minimum load with one chiller under operation, if the DP set point further reduces, duty pump speed is limited by the chiller safe minimum flow

b) At this condition, minimum flow bypass valve opens up proportionally to bypass the excess flow back to the plant so as to maintain the load side DP to meet the set point as set in pump logic controller

c) Pump logic controller should be equipped with PID algorithms to take care of tuning of the system in order to counter, rate of flow change issues at the chillers

d) Pump logic Controller shall continuously scan the field DPT signals and compare with the set point to control the most deviated zone

e) VPC-3000 will monitor flow through chiller evaporator coils either through flow transmitter installed inline with the evaporator coils of chillers or DP measurement with a DPT fixed across the chiller evaporator coil tube

f) In the event of duty pump/VFD fault, Pump logic Controller automatically initiates a timed sequence to start the standby pump/VFD set in the variable speed mode. The standby variable speed pump shall be controlled by the Pump logic Controller

g) VFD fault indication shall be continuously displayed on the display screen until the fault is rectified and the controller has been manually reset

h) In the event of failure of zone differential pressure transmitter, its process variable signal shall be removed from the scan/compare sequence. Alternative zone differential pressure transmitter if available, shall remain in the scan/compare sequence

i) When any fault arises a plain English warning message shall be displayed on the Control Unit of Pump logic Controller screen

Installation:

a) To install the equipment supplied as per manufacturers operating & Installation manuals

b) Concrete pedestal, expansion joints at pipelines, anti vibration pads/mounts as required to be provided by the mechanical contractor as per the drawings provided by the supplier

c) Power wiring as required, shall be provided at site by the electrical contractor as per the electrical drawings submitted

d) Control wiring of the field instruments like DP transmitters, flow transmitters, temperature transmitters shall be responsibility of the contractor. It has to be done as per the instructions/recommendations given by the equipment supplier

Commissioning

a) System manufacturer or trained representative shall provide the commissioning support for the VSPS system at site, once installed

b) Commissioning support to include verification of installation, including pumps & field instrumentation

c) Commissioning is termed to be incomplete until the system manufacturer or trained representative demonstrates to the owner / end user / their representative the sequence of operation as stated above

d) Same should be signed off in writing by all the parties concerned vide system handing over document

e) System manufacturer or their trained representative shall provide on-site training for operators on the operation & maintenance aspect of the system

DATA SHEETS

Data Sheet- A

Technical Requirements

1	**DESIGN FEATURES**	**UNITS**	
1.1	Pump designation		Chilled water pumps
1.2	Minimum design capacity	US GPM	
1.3	Total head	Ft	
14.	Location		Terrace Level
1.5	Maximum rated speed (at 50 Hz.)	RPM	
1.6	Liquid handled		Water
1.7	Number required		-- working Plus -- standby
2.0	**FEATURES OF CONSTRUCTION**		
2.1	Type of pump		Monoblock
2.2	Impeller		Open/Enclosed/Non clog
2.3	Volute		Single
2.4	Shaft		Coupled
2.5	Drive Transmission		Direct
2.6	Seal		Mechanical seal
2.7	Coupling		Flexible
2.9	Prime Mover		AC Electric motor

3.0	**MATERIALS OF CONSTRUCTION**		
3.1	Impeller		Bronze *
3.2	Casing		Cast Iron GR FG 200*
3.3	Shaft		EN – 8 Steel *
3.4	Shaft Sleeve		EN-8 Steel *
3.5	Impeller Ring		SS 304 *
3.6	Casing Ring		Cast Iron GR FG 200*
3.7	Stuffing Box Packing		Graphite-Asbestos*
3.8	Base Plate		Fabricated Steel / Cast Iron*
4.0	**ACCESSORIES**		
4.1	Companion Flanges		Yes
4.2	Foundation Bolts		Yes
4.3	Base Plate		Yes
5.0	**TESTING**		
5.1	Hydrostatic Test Casing Jackets / Cooling Passage		Witnessed
5.2	Performance Test Std. Running Test NPSH Test		Witnessed

Note : For components marked * material test certificates shall be furnished

Data Sheet- B Data

To Be Furnished By Tenderer Along With Offer (Chilled Water)

SL. NO.	DESCRIPTION	TENDERER TO FURNISH
1	Pump tag number	
2	Number working stand by	
3	Make	
4	Model	
5	Design Capacity	Cu.m/hr
6	Differential Head	MLC
7	Shut off head	MLC
8	Hydrostatic test pressure	Kg / cm^2(g)
9	Pump efficiency	%
10	Motor efficiency at duty point	%
11	Power input to motor at duty point	KW
11.1	Motor rating –BKW / KW	KW
12	Rated speed	Rpm
13	NPSH required	MLC
14	Materials of construction as per specification indicate deviations	
15	Suction Nozzle	

15.1	Orientation	
15.2	Size	Mm
16	Discharge Nozzle	
17	Impeller type	
18	Pump weight	Kg
19	Pump set weight	Kg
20	Moment of inertia of pump rotor	Kg – m^2

Data Sheet – C Data

To Be Furnished By The Contractor After Award Of Contract And `Before' Installation

i. **Quality Assurance Plan (QAP)**

ii. **Detailed dimensioned general arrangement drawing of pump and driver.**

iii. **Foundation drawing of pump and driver with static and dynamic loads, details of fixing, grouting and all relevant data required for design of foundation**

iv. **Cross-section drawing of the pump with complete part list, materials of construction and relevant standards for each part**

v. **Pump performance curves flow rate Vs head, BKW, efficiency, NPSHR from zero flow to maximum flow and torque-speed curve**

vi. **Scheme for pump sealing, lubrication and cooling**

vii. **Driver dimensional drawing**

viii. **Surface preparation and painting procedures**

ix. **Catalogues, data sheets and drawings for instruments**

x. **Installation, operation and maintenance manual**

xi. **Isolation pads and SS or Hot dip galvanised foundation bolts provided by the Contractor.**

xii. **Corc-rubber make metallic bellows shall be provided at suction and discharge.**

xiii. **Pressure gauges with needle valve provided at suction and discharge lines.**

xiv. **All accessories provided to complete the pump installation.**

Data Sheet – D

Checklist And Performance Test Data To Be Provided After Installation

Sr. No	Description	Unit	Time			Date			Remarks
			10.00	12.00	14.00	16.00	18.00	20.00	
1.	Suction pressure	Kg/cm^2							
2.	Discharge pressure	Kg/cm^2							
3.	Water flow rate	M^3/hr							
4.	Current	Amps							
5.	Bed plate levels and alignment checks								
6.	Hydraulic test for casing at 1.5 times design pressure								
7.	Noise level from pump	1.8m dB							
8.	Discharge Vs head	Mtr							
9.	Discharge Vs efficiency								
10.	Discharge Vs BkW								

Run Test shall be conducted on the following Pumps.

i. **Chilled Water pumps.**

ii. **Make up Water pumps.**

WATER DISTRIBUTION SYSTEM

CONTENTS

GENERAL

Scope

This section lays down the general requirements for Supply, Installation and testing of all Piping works like Chilled Water, Condenser water, Condensate drain piping and Refrigerant piping and related valves and accessories.

Codes and standards

The material construction, manufacture, inspection, testing and commissioning of water distribution piping shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. Nothing in these specifications shall construe to relieve the CONTRACTOR of his responsibility. The equipment supplied shall comply with the latest applicable Indian and / or British Standards. Other National Standards are acceptable, if they are established to be equal or superior**.**

Scope of supply and erection

The CONTRACTOR shall supply all piping material like pipes, fittings, flanges and other items as required.

Scope of erection to be performed by the CONTRACTOR is outlined below:

a) The CONTRACTOR shall unload from carriers at plant site, handle, check, receive, transport, store, erect and test all materials furnished by him and others in accordance with this specification and General Conditions of Contract. The CLIENT shall be informed of any loss of damage within seven days of receipt of material.
b) The CONTRACTOR shall also install small accessory piping and any specialities furnished for equipment such as relief valves, built-in bypass and other equipments of this type.
c) CONTRACTOR's work includes the final tube or pipe connection at pumps, including the final connection.
d) The CONTRACTOR shall install primary elements for flow measurements, control valves and on-line metering equipment.
e) The CONTRACTOR shall hydrostatically test the entire piping system including valves and specialities.
f) All piping shall be internally cleaned and flushed by the CONTRACTOR before and after erection in a manner suited to the service as directed by the CLIENT.
g) For hydrostatic testing and water flushing, the CONTRACTOR shall furnish necessary pumps, equipment and instruments, piping etc
h) The CONTRACTOR's scope under this includes the following:

    i) Welding materials and other consumable materials and backing rings etc., as required.
    ii) Jointing material as required for all screwed joints. Fasteners (bolts, nuts, studs washers etc.) and gaskets is required for all flanged joints.
    iii) Services of erection superintendents, erection superiors, fitters, riggers, other skilled and unskilled labour.
    i) Erection tools, tackles and materials including welding machines.

MATERIAL SPECIFICATION

The material specification for piping, valves & specialities shall be as explained in later sections.

Colour code shall be used to identify pipe material. The CONTRACTOR shall be able to identify on request all random piping prior to any field fabrication.

The CONTRACTOR shall furnish six (6) copies of certificates for piping for –

a) Dimensions and
b) Hydrostatic test

FABRICATION

Wherever welded construction is specified, unless otherwise stated, branch connection may be made by Standard practice on the main header provided the CONTRACTOR establishes the adequacy. Reinforcing plate shall be used for all branch connections to provide compensation for the material removed in the main line. Branch connection in galvanised piping shall be made by using suitable reducing tees.

Wherever space permits, the CONTRACTOR may use pipe bends (3D) for pipe sizes 50 mm nominal size and under. The CONTRACTOR shall ensure that undue thinning of pipe wall does not occur due to bending.

CLEANING OF PIPING

All piping shall be wire brushed and purged with air blast to remove all rust and mill scale from inner surface. The method of cleaning shall be such that no material is left on the inner or outer surfaces, which will effect the serviceability of the pipe.

PROTECTION DURING TRANSIT

Effective precautions such as capping and sealing shall be taken to protect all pipe ends against ingress of dirt and damage during transit or storage.

SHOP AND FIELD HYDROSTRATIC TESTS

All pipes and fittings shall be tested hydrostatically at the ships where manufactured to test pressures which are given in the applicable codes mentioned. All piping systems shall be tested hydrostatically by the CONTRACTOR after erection.

The chilled water and condensate drain piping shall be suitably insulated as per specification.

Automatic air vents shall be installed at all high sections of piping as well as in the AHU room piping.

The discharge from these air vents shall be piped via copper tubes of appropriate size to the nearest waste drain pipe.

WATER TREATMENT

Contractor to Investigate the requirement for the quality of the water for the chiller and the available water quality at site and propose accordingly.

Chemical Dosing System (Sodium Hypochloride) shall be provided for chilled water network. The dosing system shall include all the necessary components / items inclusive of dosing pots,

pumps and chemicals required. Contractor to arrange the chemicals required for next 12 months operation.

The air-conditioning system shall not be put into operation until the water treatment system is insulated and ready for use. The contractor shall be held responsible for any fouling or drainage due to the absence of water treatment.

GUARANTEE

The CONTRACTOR shall guarantee all material, fabrication and workmanship, erection, installation and proper functioning of all the piping and also tightness of all joints, for a period of ten year from the date of commissioning.

The CONTRACTOR shall employ both in shop and field, qualified personnel and welders qualified recently to the satisfaction of the CLIENT.

If any shop fabrication part fails to meet the field tests in such a manner that the CLIENT's Inspection believes that the defect is minor, it will be remedied in the field by the CONTRACTOR at no cost to the CLIENT. In the event the CLIENT rejects defective part as not being capable of remedy in the field, the CONTRACTOR may at the CLIENT's discretion be required to transport new parts, from his shop at his own expense.

WATER PIPING

All condenser, chilled water and condensate drain piping upto 250 mm dia shall be of Polyethylene High Density (PE 100) from +GF+ piping of PN-16. All pipe joints shall be welded or provided with necessary ***Victaulic*** fittings only. Pipe flanges shall conform to IS:1536 whereas the threads shall conform to IS:554.

The screwed flanges shall also conform to IS:6392 and shall be screwed to the pipes. Gasket of 3 mm thick 3 ply rubber shall be used.

PRESSURE GUAGES & THERMOMETERS

Bourdon type pressure gauges with aluminium casing with a minimum 100 mm dial and appropriate range complete with needle valves shall be provided at the inlet and outlets of heat exchangers, and pumpsets.

Thermometers shall be of dial type mounted on a board with separable copper well. The case shall be of cast aluminium, weather & water proof type. Thermo well shall be provided at the inlet and outlet of all heat exchangers.

EXPANSION TANKS

Close expansion tank should be provided with water capacity to suffice the capacity of volume of water contraction & expansion during operation & rest state of the HVAC system. Tank should be a closed vessel with rubber bladder/diaphragm to maintain the operating pressure inside the pipelines. Standby and working booster pump should be provided with selector switch for pump starting, pressure differential transmitter , pressure gauge & non return valve at discharge outlet of the pump. Contractor to investigate the expansion tank size.

TESTING

All piping shall be tested to hydrostatic test pressure of at least 1 ½ times the maximum operating pressure but not less than 7 Kg/Sqm for a period of not less than 24 hours. All leaks

and defects in joints and piping during the test shall be rectified and got approved. No pipe shall be welded with water inside the pipes. Piping repaired subsequent to the above pressure shall be retested in the same manner. Systems may be tested in sections and such sections shall be capped securely. Entire system shall then be retested. Noiseless circulation of water in the circuit should be achieved. If improper circulation due to air lock is found, it is the responsibility of the air-

Air conditioning contractor to carry out all the rectification including opening and refinishing of floor, wall etc., Pressure gauges should be valve off during pressure testing. The air-conditioning contractor shall provide all materials, tools and instruments, services and labour required to perform the test and to remove the water resulting from cleaning and after testing. The water required for the testing shall be arranged by the contractor on his own cost. Additional claims for water testing shall not be entertained at any stage of the project.

The Institute shall be informed well in advance by the air-conditioning contractor of his intention to test a section or sections of piping and all such tests shall be witnessed by the authorized representatives of Institute. Test certificates duly signed by the contractor and the authorized representatives of Institute shall be submitted by the contractor after completing the tests.

No insulation shall be applied to pipes unless the pressure testing is completed to the satisfaction of the Institute. Insulation shall be done as per the tender specifications.

After completion of the installation, the pipe lines are to be flushed thoroughly to blow out the entire dirt and muck. Commissioning strainers shall be used before all equipments. The system then shall be balanced to deliver the water quantities as specified. Balancing report after certification shall be submitted with completion drawings and documents.

Direction of flow shall be marked on pipelines in bold markings.

Provide automatic air vents at highest points. The body shall be of cast iron and the float and leverage shall be of stainless steel. The operating pressure shall be 150 psig. Air vents, purge and drain valves are considered to be a part of the piping and no extra cost will be paid for the same.

Provide expansion joints to prevent bending, bowing of pipes resulting in unusual stresses. The expansion joint shall be complete with anchor bases, inner liners, tie rods, outer jackets and flanges. The expansion joints shall be of stainless steel.

Provide flanged rubber bellows at pump, chiller inlets and outlets that are assumed to be a part of the equipments.

VALVES

Gate and globe valves

Gate and globe valves up to 50 mm size shall be gun metal construction. Valves above 50 mm dia shall have cast iron body and bronze/gun metal spindle valve seat. The valves shall have non rising spindle.

Butterfly valves

The butterfly valve shall be supplied along with flow control lever. The valves shall be compact in size and shall conform to BS 5155, MSS SP 67 and API 609. The valves shall be light in weight and easy to install. The body shall of close grain cast iron conforming to IS:210 and the seating shall be of Resilient black, Nitrile rubber / EPDM moulded on to the body. The disk shall be of SG iron nylon coated, whereas the shaft shall be of stainless steel A ISI 431 treated permanently for lubrication. The shaft seals shall be of Nitrile 'O' rings and rubber seals.

Valves shall be suitable for a working pressure of 16.5 KSC. Care should be taken during installation to see that the disk is not damaged during installation due to the flanges being incorrectly spaced. Provide gear operated valves for sizes having 300 mm and above. For smaller sizes such as 40 mm and below diaphragm type valves are acceptable.

BALL VALVES

Ball Valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete with socket weld ends.

CHECK VALVES

Check valves for smaller sizes shall be of swing type of gun metal construction. Lift type check valves shall be used for horizontal lines. Wafer type plate check valves shall be used for bigger sizes as shown in the specifications. The check valves shall be suitable for 10.5 KSC test pressure.

STRAINERS

Strainers shall be preferably of approved 'Y' type or pot type as specified in the tender schedule with GI or fabricated steel bodies. Strainers up to 50 mm shall be of gun metal type. Strainers shall have a removable bronze screen with 3 mm perforations and permanent magnet. Strainers shall be provided with flanges. They shall be designed so as to enable blowing out accumulated dirt and facilitate removal and replacement of all screen without disconnection from the main pipe. Strainers shall be provided with isolating valves so that they may be cleaned without draining the entire system.

AUTO BALANCING VALVE

Balancing valve shall be installed in branch pipe and wherever shown on drawing. These valves shall be factory calibrated. Each valve shall limit flow rates to within ±5% accuracy, regardless of system pressure fluctuations.

Sufficient number of flanges and unions shall be provided as required to facilities maintenance work once the piping is installed. Piping shall be properly supported on or suspended from stands, clamps, roller hangers, etc., as required. The contractor shall adequately design all brackets, saddles, clamps and hangers and shall be responsible for their structural integrity. Each support shall be isolated from the support by means of anti-vibration springs or durable liner of neoprene rubber. Pipe supports shall be of steel and shall be painted with rust preventive paint and finish coated with synthetic enamel paint of approved colour. Only factory made supports with Galvanised fully threaded rods with bands are acceptable. The chilled water

pipes shall be isolated from the bands by a rubber sheet. Pipe supports on the terrace exposed to weather shall be hot dip galvanized.

The spacing of pipe supports shall not be more than that as specified below:

NOMINAL PIPE SIZE IN MM	SPACING IN M
Upto 25 mm	**1.5 m**
32 to 150 mm	**2.5 m**
above 150 mm	**3.0 m**

The GI support rods shall be 8 mm thick for pipes upto 50 mm dia, 10 mm for pipes from 65 mm to 125 mm dia and 12 mm for pipes 150 mm dia and above.

Extra supports shall be provided at bends and heavy fittings like valves to avoid undue stresses on the pipes.

Suitably designed blocks shall used for resting the pipe on the supports wherever required.

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 with a 12 mm thick rubber pad. Risers shall also have a suitable concrete pipe support at the lowest point.

Pipe sleeves of 50 mm larger diameter than the pipe shall be provided wherever pipes pass through the walls and the annular space filled with felt and finished with retaining rings. Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge sheet shall be provided between the insulation and clamps, saddle extending at least 10 mm on both sides of the clamps, saddles.

All welded bends shall be of 5 piece construction for pipe sizes 200 mm dia and for larger pipes at least 7 piece construction shall be provided.

Where pipes are laid underground, the top of the insulated pipes shall not be less than 750 mm from the ground. Pipes shall be placed over RCC / PCC sleepers as shown in the drawing. Buried pipes shall be covered by river sand cushion for a height not less than 150 mm from the top of the pipe. After pipes have been laid and top sand cushion provided, the trench shall be refilled with excavated soil and any extra soil shall be removed from the site of work by the contractor. RCC / PCC sleepers are in the scope of the air-conditioning contractor.

All piping work shall be carried out in a workman like manner causing minimum disturbance to the existing services. Piping installation shall be carried out with vibration elimination fittings wherever required. While installing the pipes, adequate clearance shall be provided for insulation wherever insulation is called for.

Drains shall be provided at all low points in the piping system and shall be of the following sizes:

MAIN LINE SIZE IN MM	DRAIN SIZE IN MM
Upto 300	**25**
Over 300	**40**

Drain shall be provided with gate valves of equal size but with rising spindle. Alternatively, ball valves shall be provided. Drain shall be piped through G.I medium class pipe to the nearest floor drain. Piping shall be pitched towards the drain points. Wherever specified, drain pipes for the ceiling suspended units and fan coil units shall be provided with water grade blue HDPE/PVC pipe with screwed joints. The joints shall be proper so that no water leaks over the false ceiling. The pipes shall be tested for leaks to a minimum pressure of 1 KSC before the false ceiling sheets are fixed.

Air vents shall be provided at all high points in the piping system for venting. Air vents shall be of gun metal construction and of automatic type. Similarly drain valves shall be provided at all dirty legs. The size of the valves shall be 25 mm size for pipes upto 100 mm and 40 mm for sizes larger than 100 mm. Drain shall be closed with dummy caps to prevent accidental opening.

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

Sl. No.	Description	Unit	Remarks
1.	Hydrostatic pressure conducted as per specification		
2.	Any leaks		
3.	Any defects in joints		
4.	Tested after rectifying defects		
5.	Test witnessed and certified		
6.	Any noise in piping system		
7.	Any water noise in coils		
8.	Any water noise in equipment		
9.	Proper flow achieved through AHU, Chiller, FCU		
10.	Piping insulation checked		
11.	All valves open		
12.	All motorised valves close / open		
13.	Expansion joints provided and checked		
14.	Pipe work cleaned		
15.	Water condition after pipe cleaning checked		
16.	Expansion tank Ball valve functional		
17.	All strainers clean		
18.	Pressure gauges working		

Sl. No.	Description	Unit	Remarks
19.	Thermometers working		
20.	Drain points provided at Low points		
21.	Air vents provided at High points		
22.	Pipe support and spacing checked		
23.	Pipe material checked		

Air Separators:

- Air separator working on basic centrifugal force and low velocity flow, complete with suitable diameter inlet and outlet connections, high capacity float type air vent, pressure reducing valve, cold water fill connection, drain valve, flanged connections etc. The air separator shall be suitable for 500 USGPM water flow. The pressure rating shall be 16 Kg/cm2.

PIPIE CLEANING AND CHEMICAL TREATMENT :-

General:
Description:

- Provide flushing, cleaning and chemical treatment program in accordance with the Contract Documents. Pipe cleaning and chemical water treatment is an integral part of the piping specifications and bill of quantities and will not be measured separately.

Work Included:

- Pipe Cleaning & chemical treatment.

Submittals:

- Submit shop drawings listing chemicals. Provide layouts of feeding equipment, details of testing equipment and describing treatment program, including calculations and quantities of chemicals to be used. Provide system schematics showing the following:

  Chilled Water:-
  volume
  circulation rates
  pressures
  temperature differentials
- Provide written report containing log and procedures of system cleaning, giving times,

dates, problems encountered and condition of water, witnessed by Contractor.

- Project Manager to receive 7 days advance notice of flushing.
- Submit written report containing result of tests and list of chemicals updated every 14 days during temporary use of treated system.
- Provide inspections and submit written reports on a twice monthly basis. Provide for one (1) year after acceptance of system. Take samples of water at each inspection, analyze, and certify. Submit the analysis made on the water to the Engineer and the Owner. Include in the analysis report, recommendations as to any changes in water treatment required. Provide an initial dosage of 1.5 gallons of an aqueous solution of sodium nitrite base corrosion inhibitor (NALCO 2536 or any approved make) for each 100 gallons of water in the system.
- Provide written maintenance instructions to be included in Maintenance and operating Manual.

Quality Assurance:

- The chemical pipe cleaning service supplier must be a recognized specialist, active in the field of industrial pipe cleaning for at least ten years, whose major business is in the field of pipe cleaning, and who has full time service personnel within the trading area of the job site. Laboratory facilities must be available.

  Cleaning and Treatment Standards

  - Closed Recirculating Water Systems:

System	Treatment and Chemical Conditions	Control Level
Chilled Water	Non-toxic organic corrosion and scale inhabitor	2000 ppm as total organic inhabitor
	Molybdate as Na2Mo04 or	200-300 ppm
	Nitrite as NO2	500-700
	pH	7.0-8.0

Products:

Pipe Cleaning:

- Furnish all required pipe cleaning chemicals, chemical feed equipment, materials, and labour necessary to clean the piping as herein specified. In addition, permanently install necessary chemical injection fittings complete with stop valves and coupon racks, etc.

- Provide a pre-startup non-foaming, liquid detergent dispersant cleaner for cleaning of all systems to remove oil and foreign matter from the piping and equipment prior to the final filling of the systems. Use a chemical that is not injurious to persons, piping, pipe joint

compounds, packing, coils, valves, pumps and their mechanical seals, tubes or other parts of the system.

- Furnish instructions dictating the quantities of the cleaner to use, methods and duration of the operation.

Execution:

General:

- Installation and startup shall be supervised by factory representatives of the equipment manufacturer and chemical manufacturer.

Preliminary Cleaning:

- Clean new piping internally by flushing prior to the application of pressure tests, and before the chemical cleanout procedures specified herein. Provide temporary strainers at the inlet to the chilled water Pumps before the start of cleaning procedures.

- Block off and isolate Chillers, circulating pumps, cooling coils, other equipment during the preliminary flushing and draining process.

- Provide temporary by passes to fully circulate through all branch piping.

Pipe Cleaning:

- All Piping Systems
- Provide temporary connections with valves to fill and drain the piping and equipment after completion of the chemical cleanout procedure. Provide temporary blind flanges and /or caps to isolate the piping and equipment.
- Provide temporary piping connections, valves, strainers, bypasses, and blank connections where required to clean out systems
- After each hydrostatic leak testing procedure is complete drain the system until empty. The piping systems are internally chemically treated and protected during the hydrostatic testing procedure as described in the Section entitled "Testing, Balancing and Adjusting".
  Thoroughly clean the piping and flush as follows:
- Cleaning will not take place more than 14 days prior to startup. Give the chemical manufacturer's representative at least 30 days notice prior to startup.
- Prior to the start of the chemical cleaning procedure submit three-two (2) foot lengths of the piping installed on this project to the chemical manufacturer for analysis of the interior coating on the piping. Refer to the Section entitled "Testing, Balancing and Adjusting" For additional requirements.
- Before the chemical cleaning procedure is begun, install in each closed re-circulating water system a temporary skid mounted portable side stream filtering system. The filtering assembly shall have 6" flanged connections and multiple cartridge filters capable of least 600 gpm, an integral Barco type flow venturi, and be pressure rated for the system to which it is connected. Install the filter cartridges and change out until the system is clean. Initially provide twenty (20) micron cartridges, the intermediate set five (5) microns, and the final set one (1) micron.

- Add chemical pipe cleaning compound as recommended by the chemical manufacturer's representative to the system simultaneously with the filling of the system.
- Circulate the cleaning compounds in the system for the time period specified by the chemical manufacturer.
- Drain the system until empty from its lowest point.
- Fill the system again with fresh water and flush thoroughly until clean water is obtained. (Maintain continuous blowdown and make-up as required during flushing operation). Use a one (1) micron cartridge type strainer element at end of drain hose to confirm that discharge water is free of foreign material.
- The cleaning and flushing procedure must be approved in writing by the chemical manufacturer. The chemical manufacturer's representative shall supervise and certify in writing the cleaning and flushing of the piping systems. The Contractor shall provide and install injection pumps, water meters, and coupon racks to control and monitor the cleaning process.

Filling of Water Systems:

- After completion of chemical cleanout, fill the water system with fresh water, air vent, and immediately provide treatment to passivate metal.
- Furnish the following chemicals as required for the system until the Owner has issued a "Certificate of Substantial Completion".
- pH Adjustment Chemicals: Provide suitable pH adjustment chemicals in 50 gallon drums to control pH at the 7.8-8.8 level.
- Corrosion Inhibitor: Provide thirty (30) gallon drums of liquid corrosion inhibitor. Provide non-polluting corrosion inhibitor which complies with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.
- Dispersant: "Provide thirty (30) gallon drums of dispersant. Provide non-polluting dispersant which compilers with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.
- Biocide: Provide thirty (30) gallon drums of biocide. Provide non-polluting biocide which complies with local regulations covering waste water discharge, and as permitted by the local authorities having jurisdiction.
- Recommend pH adjustment chemical, corrosion inhibitor, dispersant and biocide for the local water characteristics.

Chemical Dosing:

- Chemical cleaning with pre-engineered chemical systems shall be done to remove mill
- scale, dirt etc and provide a protective corrosion resistant layer on the inside surface of
- piping. The pipes will undergo repeated cleaning and flushing cycles till water is absolutely clean and the pipes fully treated. Then final multiple flushings as required for chilled water system shall be provided before starting of testing/commissioning. Chemical dosing system for chilled water system shall be provided to minimize corrosion, biofilm prevention, preventing scale deposition and to control the water quality/chemistry.
- Chemical pot feeder (CPF) shall consist of mild steel vessel with inlet and outlet valves, a drain valve and a filling valve, steel tundish, air release valve, wall mounting brackets and non-return valves.
- Chemical dosing system shall maintain the chiller water PH value 8.0 to 9.5, total
- dissolved solid less than 1500 ppm and sulphite concentration between 50 to 100 ppm.

- Water samples shall be taken at regular duration and tested at laboratory to check and
- control water quality. Subcontractor shall include free supply of the adequate quantity of chemicals for one year consumption after completion of Works.

Technical Service and Control:

- The Air Conditioning and Mechanical Ventilation contractor should ensure that for a period of one year completion of system commissioning the chemical treatment contractor shall be on call at no additional cost to the Owner to make on site inspections of equipment during scheduled or emergency outages in order to properly evaluate their effect on the water treatment program.
- Insulate water treatment piping and tanks containing chilled water, in accordance with insulation material as specified for the respective system.
- Wherever possible, all water treatment equipment is to be located in mechanical equipment rooms. Locate in suitably weather proofed enclosure on roof platform

MODE OF MEASUREMENT:

Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipments. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified else where in the specification.

Piping and Pipe insulation

All water pipes and other pipes be measured nett length and measured linear over all fittings such as bends junction etc., and given in running metres. The length shall be taken along -With centre lines of the pipes and fittings. The unit rate shall include fittings (Elbows, Tees, bends, Mitres, Reducers, flanges, Gaskets, Bolts, Nuts, CAPS, Blind flanges and end closures). The measurements will be based on the approved drawing I as built drawing and paid per unit running metre. Length of other fittings (valves and strainers), which are paid under appropriate item, shall not be re-measured under linear measurement. The bill of quantities specified does not include any wastages during fabrication and erection. These shall be included by the tenderer in the unit rate. Also the unit rate quoted shall include piping insulation for chilled water piping and other pipes, no separate payment will be made for piping insulation.

Expansion tank

Expansion tank with insulation and accessories as specified in the tender document will be regarded as one unit for the purpose of measurement and payment.

AIR DISTRIBUTION SYSTEM

1.0 SCOPE

This specification covers the general design, materials, construction features, manufacture, shop inspection and testing at manufacturer's works, delivery at site, installation, testing, commissioning and carrying out performance test at site of Air Distribution system.

2.0 CODES and STANDARDS

The design, materials, construction features, manufacturer, inspection, testing and performance of air distribution system shall comply with all currently applicable statues, regulations, codes and standards in the locality where the system is to be installed. Nothing in this specification shall be construed to relieve the Contractor of this responsibility. In particular, the air distribution system shall conform to the latest edition of following standards.

IS 277	Galvanised Steel Sheet (Plain and corrugated).
IS 655	Metal Air Ducts.
IS 737	Wrought Aluminium and Aluminium Alloy sheet and strip for general engineering purposes.
SMACNA	HVAC Duct construction standards – Metal and Flexible.
SMACNA	HVAC Air duct leakage test manual.
SMACNA	HVAC systems – Testing, adjusting and balancing.
UL 181	Factory – Made Air ducts and connectors.
UL 555	Fire Dampers.
ASHRAE 70	Method of testing for rating the performance of Air Outlets and inlets.

3.0 MATERIAL REQUIREMENT

Ducting shall be fabricated from Galvanised steel sheet (GSS) as specified.

a. GSS duct shall be of lock forming grade, zinc coated conforming to IS 277 coating grade 180 or better.

4.0 CONTRUCTION FEATURES

Fabrication details shall be generally in accordance with the details given here under.

4.1 RECTANGULAR DUCT

a. For Low Pressure System (upto Fan external static pressure of ± 75mm WC).

LARGER SIDE OF DUCT mm	THICKNESS OF SHEET mm/G		TYPE OF TRANSVERSE JOINT	TYPE OF REINFORCEMENT
	GSS / SS	AL		
Upto 250	0.63 / 24	0.80 / 22	25x25x3mm MS angle flanged joint	--
251 to 750	0.63 / 24	0.80 / 22	25x25x3mm MS angle flanged joint	25x25x3mm MS angle @1250 mm c/c.
751 to 1000	0.80 / 22	1.00 / 20	25x25x3mm MS angle flanged joint	40x40x3mm MS angle @ 1250 mm c/c.
1001 to 1500	0.80 / 22	1.00 / 20	40x40x3mm MS angle flanged joint	40x40x3mm MS angle @ 750 to 800 mm c/c.
1501 to 2100	1.00 / 20	1.25 / 18	40x40x3mm MS angle flanged joint	50x50x6mm MS angle @ 750 to 800 mm c/c.
2101 to 2400	1.25 / 18	1.50 / 16	65x650x6mm MS angle flanged joint	65x65x6mm MS angle @ 750 to 800 mm c/c.
Greater than 2401	1.25 / 18	1.50 / 16	50x50x3mm MS angle flanged joint with tie rod(s) of 10 mm dia.	50x50x3mm MS angle @ 750 to 800 mm c/c with the rod(s) of 10mm dia, evenly spaced along reinforcing angle, spacing not exceeding 1500 mm.

b. For High pressure system duct (Fan external static pressure of +76 to +250mm WC)

LARGER SIDE OF DUCT mm	THICKNESS OF SHEET mm/G		TYPE OF TRANSVERSE JOINT	TYPE OF REINFORCEMENT
	GSS / SS	AL		
Upto 600	0.80 / 22	1.00 / 20	40x40x3mm MS angle flanged joint	40x40x3mm MS angle @ 750 to 800 mm c/c.
601 to 1200	1.00 / 20	1.25 / 18	50x50x3mm MS angle flanged joint	50x50x3mm MS angle @ 600 mm c/c
1201 to 1500	1.25 / 18	1.50 / 16	50x50x3mm MS angle flanged joint	50x50x3mm MS angle @ 600 mm c/c
1501 to 2000	1.50/16	1.80 / 14	65x65x6mm MS angle flanged joint	50x50x3mm MS angle @ 600 mm c/c

Greater than 2001	1.50 / 16	1.80 / 14	50x50x3mm MS angle flanged joint with tie rod(s) of 10 mm diameter.	50x50x3mm MS angle @ 600 mm c/c with tie rod(s) of 10mm diameter, evenly spaced along reinforcing angle, spacing not exceeding 1500 mm.

c. Longitudinal seams shall be Pittsburgh lock type at corners as shown on sheet. Longitudinal joints shall not be provided for rectangular ducting at locations other than corners, except where larger side of duct exceeds 2500mm. Longitudinal joints of ducting having side larger than 2500mm other than corner shall be grooved or standing seam as shown.
If specified, sealing of the longitudinal seams shall be accompolished using Dow corning RTV 732 Silastic or equivalent.

d. All circumferential joints shall be MS angle flanged joints.

e. Flanges used for transverse joints shall be joined with each other with Galvanised Steel (GS) bolts, washers and nuts. The bolts shall be of minimum M8 size and the spacing between bolts shall be maximum 150 mm for low pressure system and 100 mm for high pressure system.

f. For transverse angle flanged joints, neoprene gasket (3mm uncompressed thickness and width equal to flange face) adhered to the flange face shall be used. The bolt holes in gasket shall be the same as bolt diameter and shall be punched prior to insertion of gaskets.

g. All flanges shall be applied with two coats of zinc-chromate, silver or zinc paint. (Red oxide is prohibited)

h. Angles shall have welded corners and shall be riveted to the ducts at 300mm centres. (maximum).

i. For SS ducts all related appurtenances such as transverse joint angles, reinforcement angles, fasteners, turning vanes, access doors, etc. shall be of the same material as of duct.

j. Ducts shall be fabricated using lock forming machine.

4.2 ROUND DUCT

a. Round duct thickness in mm/G for GSS/SS shall be as given below:

DUCT DIAMETER mm	UPTO 50 mmWC STATIC PRESSURE POSITIVE		51 to 250mmWC STATIC PRESSURE POSITIVE		UPTO 50 mmWC STATIC PRESSURE NEGATIVE	
	SPIRAL SEAM	LONGITUDI-NAL SEAM	SPIRAL SEAM	LONGITUDI-NAL SEAM	SPIRAL SEAM	LONGITUDI-NAL SEAM

Upto 200	0.42 / 28	0.42 / 28	0.51 / 26	0.63 / 24	0.42 / 28	0.63 / 24
201 to 350	0.42 / 28	0.51 / 26	0.51 / 26	0.63 / 24	0.51 / 26	0.63 / 24
351 to 650	0.51 / 26	0.63 / 24	0.63 / 24	0.80 / 22	0.63 / 24	0.80 / 22
651 to 900	0.63 / 24	0.80 / 22	0.80 / 22	1.00 / 20	0.80 / 22	1.00 / 20
901 to 1250	0.80 / 22	1.00 / 20	1.00 / 20	1.00 / 20	1.00 / 20	1.25 / 18
1251 to 1500	1.00 / 20	1.25 / 18	1.25 / 18	1.25 / 18	1.25 / 18	1.50 / 16
1501 to 2100	1.25 / 18	1.50 / 16	1.25 / 18	1.50 / 16	1.50 / 16	1.80 / 14

b. Round duct thickness in mm/G for aluminium sheet shall be as given below:

DUCT DIAMETER mm	**MAXIMUM 50 mmWC STATIC PRESSURE POSITIVE**		**MAXIMUM 50mmWC STATIC PRESSURE NEGATIVE**	
	SPIRAL SEAM	**LONGITUDINAL SEAM**	**SPIRAL SEAM**	**LONGITUDINAL SEAM**
Upto 200	0.63 / 24	0.80 / 22	0.63 / 24	1.00 / 20
201 to 350	0.63 / 24	0.80 / 22	0.80 / 22	1.00 / 20
351 to 650	0.80 / 22	1.00 / 20	1.00 / 20	1.25 / 18
651 to 900	1.00 / 20	1.25 / 18	1.25 / 18	1.50 / 16
901 to 1250	1.25 / 18	1.25 / 18	1.25 / 18	1.50 / 16
1251 to 1500	1.50 / 16	1.50 / 16	--	2.25 / 12
1501 to 2100	--	2.25 / 12	--	--

c. Round duct shall have longitudinal or spiral seam, as specified Data Sheet – A. Longitudinal and spiral seam shall be as shown on sheet.

d. Angle flanges shall be used for transverse joints and shall be joined with each other with GS nuts and bolts. Angle shall be minimum 25x25x3mm for ducts size upto 250mm and minimum 40x40x3mm for ducts size greater than 350mm.

e. For transverse angle flanged joints, neoprene gasket (3mm uncompressed thickness and width equal to flange face) adhered to the flange face shall be used. The bolt holes in gasket shall be the same as bolt diameter and shall be punched prior to insertion of gaskets.

f. All flanges shall be applied with 2 coats of zinc-chromate, silver or zinc paint. (Red oxide is prohibited.)

g. For SS ducts all related appurtenances such as transverse joint angles, reinforcement angles, fasteners, turning vanes, access doors, etc. shall be of the same material as of duct.

h. Ducts shall be fabricated using lock forming machine.

4.3 DUCT SUPPORTS and HANGERS

a. Rectangular duct shall be supported from ceiling using trapeze hangers. Ducts shall rest on supporting angle or channel and this supporting angle or channel shall be supported by CS rods or angles or channels on both sides of ducts with weld or bolts.

Supporting details for low-pressure system shall be as given below.

LARGER SIDE OF DUCT mm	**SUPPORTING ANGLE mm**	**VERTICAL ROD DIAMETER mm**	**MAXIMUM SPACING BETWEEN SUPPORTS mm**
Upto 900	40x40x6	10	3000
901 to 1500	50x50x6	10	3000
1501 to 2400	50x50x6	10	2400
2401 and above	65x65x6	12	2400

Supporting details for high pressure system shall be as given below:

LARGER SIDE OF DUCT mm	**SUPPORTING ANGLE mm**	**VERTICAL ROD DIAMETER mm**	**MAXIMUM SPACING BETWEEN SUPPORTS mm**
Upto 1250	50x50x6	15	2400
1251 to 2100	65x65x6	15	2400
2101 and above	Mc 75x6	15	2400

b. Round duct shall be supported using single or two hanger straps or rods. Straps and rods shall be of GSS.

Supporting details for round duct shall be as given below.

DUCT DIAMETER mm	**STRAP**			**ROD**	
	Nos.	**WIDTH mm**	**THICKNESS G**	**Nos.**	**DIAMETER mm**
Upto 600	1	25	22	1	7

601 to 900	1	25	20	1	10
901 to 1250	2	25	20	2	10
1251 t o1500	2	25	18	2	10
1501 to 2100	2	25	16	2	10

c. Zinc coated anchor fasteners or embedded plates shall be provided for upper attachments to the building. Anchor fasteners shall be provided by Contractor. Embedded plates shall be provided by Contractor. Contractor shall provide duct supports from angle cleats welded to the embedded plates. Anchor fasteners shall be loaded to maximum 20% of the maximum rated capacity specified by the manufacturer. Site Engineer shall approve all anchor fasteners used for supporting duct.

d. In case of insulated duct, anchor fasteners shall be selected based on actual total load.

e. Duct supports shall be qualified and sized for seismic forces, if specified in Data Sheet – A.

4.4 FLEXIBLE CONNECTIONS (Metal Duct connections to Supply / Exhaust Fan)

Where sheet metal duct connects to the intake or discharge of fan units, a flexible of fire retarding double layer heavy duty canvas of at least 150 mm width shall be provided. The material shall be attached to angle frames by means of steel and over the end of the flexible connection. The material shall be secured between the band and the angle frame by bolting. Sleeve shall be made smooth and the connecting duct work rigidly held by independent supports on both ends. The flexible connection shall be suitable for fan intake and outlet pressures.

4.5 TRANSFORMATION

Duct transformation shall be used to change the shape of duct and shall be made for easy and noiseless flow of air. Maximum slope of transformation shall be 1:4

4.6 BENDS, OFFSETS and BRANCH CONNECTIONS

All bends, offsets and branch connections shall be made for smooth and noise less flow of air and minimum pressure drop. In case of full radius elbow optimum ratio of centreline radius of elbow to duct dimension of 1.25 shall be considered. However, due to space constraint shorter radius constraint shorter radius elbow or square elbow with guide vanes may be provided. Contractor shall furnish the details of guide vanes i.e. number of vanes, location etc. in the drawing. The flow of air to the branch duct shall be regulated by a splitter damper or volume control damper.

4.7 SPLITTER DAMPERS and VOLUME CONTROL DAMPERS (VCDs)

a. Splitter dampers shall be fabricated of minimum 18G GSS and shall be of robust construction. The position of splitter damper shall be adjusted by use of the splitter rod.

b. VCD shall be fabricated of minimum 18G GSS and shall be of robust construction. VCD shall be single blade type for round duct and opposed blade type for rectangular duct. VCD shall have a locking device mounted outside the duct to hold the VCD in a fixed position without vibration. Fully open and fully closed position shall be marked for easier operation of VCD.

c. Motor operated VCD shall be provided, if specified. Actuator for dampers shall develop sufficient torque for easy operation of VCD.

d. VCD shall be provided with Teflon or brass bushing for blade shaft as specified in Data Sheet – A. Motor operated VCD shall be provided with Teflon bushing or sealed ball bearing for blade shaft as specified in Data Sheet – A. (Optional)

e. For SS duct, all splitter dampers and VCDs shall be fabricated from SS 304 sheet.

f. Volume control dampers shall be provided in every branch duct from individual main ducts. Volume control dampers shall also be provided in branch duct from main connecting to individual supply / exhaust air outlets, and inlets, fresh air intake duct, etc.

h. Flexible ducts

Insulated flexible ducts shall be provided to connect the supply air ducts to all air delivery devices such as grilles and diffusers. The length of the flexible duct shall not exceed 2.5 m. The airflow velocity through the flexible duct shall not be more than 3.0 m/s.
The flexible duct shall be made of triple lamination of aluminium foil, polyester and Metalised Polyester film permanently bonded to a coated spring steel wire helix. The exterior shall be wrapped with 25mm thick 32 kg / m^3 fibreglass insulation. The outer insulation jacket / vapour barrier shall be made of fibreglass reinforced Metalised Polyester film laminate. The fire rating of the flexible duct shall conform to BS 476 Parts 5, 6 and 7.

i. Very branch duct shall have test plugs.

j. Every duct tap-off from supply and return air duct shall be complete with opposed blade volume contract damper.

k. The duct leakage rate shall not exceed 1% of full flow and 25% of the ducts shall be tested at site for duct leakage.

l. CAULKING and DRAIN

Wherever duct passes through wall or slab, all the openings between masonry and duct work shall be neatly caulked or sealed by the Contractor to prevent movement of air from one space to the adjoining space. Where duct passes through the floor, a drain trap of 100mm width across the width of the duct and 50mm depth shall be provided with a suitable plug at the lowest point in the elbow.

4.9 ACCESS DOOR

Access door shall be provided in duct before and after equipment installed in duct and at all fire damper locations. All access doors shall be fabricated of the same material as the duct work and shall have minimum two hinges. Hinges shall be zinc plated and pins shall be of brass. Access doors shall be of minimum of 305 mm x 305 mm size. At least two heavy solid brass fasteners and a brass handle are required for each door. A continuous neoprene rubber gasket shall be adhered to the opening frame with adhesive.

4.10 DIFFUSERS AND GRILLES (AIR DIFFUSION EQUIPMENT)

a. The type and quantity of diffusers and grilles shall be provided, as specified in the drawing. The contractor shall ensure that the diffusers and grilles offered are of requisite capacity, throw and terminal velocity. Diffusers and grilles shall be fabricated from CS, factory coated with rust resistant primer or extruded aluminium section with powder coating or SS 304, as specified in the drawing.

   Whenever VCD is provided with diffusers or grilles it shall be located within the duct collar. Diffusers and grilles shall be of flush pattern,.
   Ceiling diffuser shall be equipped with fixed air distribution grids, removable key operated volume control dampers and anti-smudge rings. The extruded aluminium or SS 304 diffusers shall be provided with removable central core and concealed key operation for volume control damper.

b. Linear diffusers shall be of extruded aluminium or SS 304 construction.

c. Slot diffuser shall be of extruded aluminium or SS 304 construction multi-slot type with air pattern controller provided in each slot. Supply air slot diffusers shall be provided with hit and miss VCDs in each slot.

d. Grilles with VCD shall be single acting or double acting, as specified in the drawing. Grilles without VCD shall have fixed blades or adjustable blades, as specified in the drawing.

e. All diffusers, grilles and registers shall be of extruded aluminium construction, and epoxy powder coated.

   Aluminium registers, diffusers and grilles shall be approved by Architect. The shade of epoxy powder coating for grilles, registers and diffusers shall be approved by Architect.
   All ceiling diffusers shall be of the louver face type with removable core complete with opposed blade volume control dampers. The diffuser surface shall be completely flush with the false ceiling.
   Supply registers shall be of the rectangular universal type with adjustable horizontal and vertical vanes complete with opposed blade volume control dampers. Dampers shall be adjustable by a removable key or screwdriver from the face of the registers.
   Fresh air and discharge air grilles shall be of the fixed single louver type with opposed blade volume control dampers adjustable from the face of the grilles. All diffusers, registers and grilles shall be selected to account for the noise levels as specified for various area.

   For areas where square ceiling diffusers are used, they shall be of the louver face type with removable core complete with opposed blade volume control damper.
   Air terminals (square diffusers) for the VAV system(wherever applicable) shall be selected to be compatible with the characteristics of the VAV box i.e., the outlet must be capable of performing at full airflow as well as reduced air flow. Linear diffusers shall be used with VAV Boxes.
   Supply air register shall be of the rectangular universal type with adjustable horizontal and vertical vanes complete with opposed blade volume control dampers. Dampers shall be adjustable by a removable key or screw driver from the face of the register.
   Outdoor air grilles shall be of the fixed single louver type with opposed blade volume control dampers adjustable from the face of the grilles.

4.11 PLENUMS

Plenums shall be factory fabricated of 18G GSS for low-pressure system and 16G GSS for high-pressure system. Type of reinforcement and supporting details shall be as per clause 4.1 and 4.3. Plenums shall be constructed to withstand 133% of rated plenum pressure without structural failure. Wall and roof deflection at rates pressure shall not exceed 10mm per meter of width.

5.0 INSPECTION AND TESTING

a. The ducts, branches, elbows etc. shall be inspected and the joints and connection shall be checked before these are assembled in position. After assembly the system shall be checked for tightness, vibration and noise.

b. Changes in direction shall be made with elbows with an inside radius equal to the width of the duct, where possible, but where space does not permit this radius, sharper or right – angle bends within inside radius not less than 1 of the duct width which may be used with double thickness aerofoil turning vanes. The turning vanes shall have a flange covering the whole base and they shall be riveted to the duct at not more than 75 mm intervals. Insecurely fitted turning vanes shall be rejected. All changes in dimensions and shape of ducts shall be done in a gradual manner and to approval.

c. Ductwork shall be free from waves or buckles and the sheet metal is to be machine – bent to ensure neat and accurate fabrication. If double thickness aerofoil shape internal stiffeners are fitted, the original 'cross sectional area of duct shall be maintained.

d. Full sized standard sheets of the gauges specified are to be used and any patched or made-up pieces of duct work are liable to be rejected. Joints between flanged connections shall be fitted with neoprene rubber gaskets of 5 mm thick.

e. All duct work not insulated shall be painted externally with one coat of primer and two coats of anticorrosive paint.

f. All duct surfaces behind diffusers, registers and grilles shall be painted Matt black.

g. All toiler riser ductwork shall be of soldered or welded seams and joints throughout.

h. Duct joints and seams shall be made air tight by use of sealants acceptable to local authority. Test points shall be provide at the discharge of each air handling unit and at each individual zone of the duct work system. Test points shall consist of 25 mm diameter sockets fitted with sealing plugs which can be removed for the fitting of measuring devices. Test points shall be insulated as for the ductwork and shall be provided with identification labels.

i. Duct dimensions and drawings.
The contractor shall furnish duct layout drawings showing clear internal sizes for all air-conditioned as well as areas covered by MV.

j. Rectangular risers should be supported by angles or channels secured to the sides of the ducts with welds, bolts sheet metal screws or blind rivets. Riser support intervals should be one or two storey height.

k. In case embedded plates are provided contractor shall provide support from angle cleats welded to embedded plates.

l. Ducts shall have support on either side of elbow within two feet and for branch connection it shall be within four feet.

m. Turning Vanes

All curved elbows shall be provided with air turning vanes consists of curved metal blades or vanes arranged so as to permit the air to make abrupt turns without appreciable turbulence. All right angle elbows shall be provided with double thickness aerofoil turning vanes extending over at least 50 percent of the while curvature of the elbow. The turning vanes shall have a flange covering the whole base be rivetted to the duct at not more than 60 mm centres.

n. Sound Attenuators (Dissipative Type) to be provided on the discharge side of all AHU fans and ventilation fans and also in return air ducts connected to AHU rooms.

o. Sound attenuators shall consist of an outer casing, sound absorbing material and internal baffles, splitters and supports. Casings shall be of galvanised steel of not less than 20 g. thickness. Casings shall be tested to 150 mm wg. and shall show no leakage, or distortion in this condition. Duct sealing compound shall be furnished by the supplier for sealing all silencers on site, where necessary, as determined by the ENGINEER.

p. Sound absorbing material shall be high-density fibreglass held in place with at least 5% compression to prevent voids due to settling. Absorption material density shall be minimum 48 kg / cu.m fibreglass faced with minimum 26 g. perforated galvanised sheet metal of minimum 40% open area. Combustion rating for the silencer acoustic infill shall not be less than the following, when tested in accordance with ASTM E84:

Flame spread classification	-	25
Smoke development rating	-	0
Fuel contribution	-	20

q. The supplier shall supply certified test data on dynamic insertion loss and self-noise with an airflow of at least 7.62 m/sec. (1500 ft / min) face velocity. Ratings shall be determined in a duct-to-reverberant room test facility, which provide for airflow through the test silencers during rating.

6.0 BALANCING

a. The air distribution system shall be tested and balanced so that the requisite temperature and air flow are maintained throughout the space to be air-conditioned or ventilated.

b. During start-up phase, Contractor shall make all arrangement for drilling or plugging of all test opening or holes, adjustment of VCDs, adjusting of fan speed to obtain specified flows, obtaining actual motor ampere readings, and all related functions to ensure the proper operation of all systems.

c. Test holes for system commissioning shall be minimum 20mm diameter to accept a standard pitot tube of 8mm diameter and each hole shall be fitted with an effective removable type seal. Location of test holes shall be decided by Contractor in consultation with Contractor / Engineer.

d. All instruments required for testing and balancing of air distribution system shall be provided by the Contractor.

e. Complete air balance report shall be submitted for scrutiny and approval. Four copies of the approved balance report shall be provided with completion documents.

f. Splitter damper and VCD adjustments shall be permanently marked after air balancing is complete so that these can be restored to their correct position if disturbed at any time.

GLOCITY RECTANGULAR DUCT CONSTRUCTION
SURES FROM 50-150mm WG

REINFORCING

AT JOINTS

		STANDING SEAM		REINFORCED STANDING SEAM		FLANGED JOINT		POCKET LOCK	COMPANION FLANGE
UM HEIGHT	MINIMUM HEIGHT		MINIMUM HEIGHT	MIN ANGLE SIZE	MINIMUM HEIGHT		MINIMUM HEIGHT		MIN. ANGSIZE
	25		25	NONE REQUIRED	25		25		30x30x3
	25		25	NONE REQUIRED	25		25		30x30x3
	30		30	NONE REQUIRED	30		30		30x30x3
H TIE ROD TRE	40		40	NONE REQUIRED	40		40		30x30x3
H TIE ROD TRE	50 OR 40 WITH TIEROD AT CENTRE		40	40x40x3	50		-		30x30x3
H TIE ROD TRE	40 WITH TIEROD IN CENTRE		40	50x50x3	40 WITH TIE ROD IN CENTRE		-		40x40x3
2 TIE RODS	50 WITH TIEROD IN CENTRE		40	65x65x5	40 WITH TIE ROD		-		50x50x5 OR 30x30x3 WITH TIE ROD IN CENTRE
2 TIE RODS	50 WITH TIEROD IN CENTRE		40	65x65x5	40 WITH TIE ROD IN CENTRE		-		50X50X5 OR 30x30x3 WITH TIE ROD IN CENTRE

FIG.1-LOW PRESSURE-LOW VELOCITY SHEET METAL DUCTWORK CONSTRUCTION DETAILS

DIMENSION OF LONGEST SIDE OF DUCT IN mm	GALVANISED IRON SHEETMETAL THICKNESS IN mm	PLAIN 'S' SLIP(B) AIR FLOW DRIVE SLIP(A)	HEMMED 'S' SLIP(C) AIR FLOW BAR SLIP(E) STANDING SEAM(I)	REINFORCED BAR SLIP(G) * AIR FLOW	ANGLE SLIP(H) AIR FLOW ALTERNATE BAR SLIP(F) ANGLE RFD POCKET(L)	GASKET COMPANION ANGLES(M) ANGLE RFD STANDING SEAM(J)	REINFORCING ANGLE SIZE AND MAXIMUM LONGITUDINAL SPACING BETWEEN TRANSVERSE JOINT AND/OR INTERMEDIATE REINFORCING
THRU 300	0.71	A-B K	-	-	-	-	-
301 THRU 460	0.71	A-B K	-	-	-	-	-
461 THRU 760	0.71	K	C-E	-	-	-	25x25x3 AT 1.5m cc
761 THRU 1070	0.86	K	E-C-I	-	-	-	25x25x3 AT 1.5m cc
1071 THRU 1370	0.86	K	E	G	-	-	35x35x3 AT 1.5m cc
1371 THRU 1520	1.02	K	E	G	-	-	35x35x3 AT 0.8m cc
1521 THRU 2130	1.02	-	-	G	H F L	J	35x35x3 AT 0.8m cc
2131 THRU 2440	1.32	-	-	-	H L	M J	35x35x3 AT 0.8m cc
OVER 2440	1.32	-	-	-	H L	M J	50x50x6 AT 0.8m cc

NOTES:

H : (HEIGHT DIMENSION) UPTO 1070=25
H : (HEIGHT DIMENSION) 1090 TO 2440=40
H : (HEIGHT DIMENSION) OVER 2440=50
* : ROLLED FORMED SLIP SHALL BE 400 MAXIMUM AND 50 REINFORCING ANGLE ANGLE FASTENED TO SLIP WHEN "H" DIMENSION REQUIRES 50 HEIGHT

CHECKLIST AND PERFORMANCE TEST DATA TO BE PROVIDED AFTER INSTALLATION

No	Description	O.K	Needs Attention	Not Applicable	Remarks
11.	Duct Work clean				
12.	Sealed, No leaks, Tight connection .				
13.	Fire Dampers open				
14.	Access doors closed				
15.	Lined ducts				
16.	Flexible duct connected, No Tears				
17.	System balanced				
18. a b	Short circuiting or other Air Distribution problems Note locations.				
19.	VCD provided as per specification				
20.	VCD all open and adjusted				
21.	Supply / Return / Exhaust outlets / Inlets balanced				
22.	Noticeable flow of Air				
23.	Air balance report submitted with details				
24.	VAV Box a. Minimum stops - % b. Maximum opening - %				
25.	Controls working				
26.	Thermostats				

a.	Type				
b.	Properly located				
c.	Working				
d.	Set point - °C				
e.	Space temperature - °C				
27.	Duct insulation checked				
28.	Duct supports and hangers checked including spacing				
29.	Turning valnes provided in elbows.				
30.	Test witnessed and certified				

MODE OF MEASUREMENT:

1.0Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipments. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified elsewhere in the specification.

1.1 Air-distribution system

1.1.1 Ducting

The following procedure for measurement shall be followed for purpose of billing in case of items subject to variation in quantities.

Payment for ducting shall be on the basis of the external surface area of the ducting.

The rate per square meter of the external surface shall include flanges, gaskets for joints, bolts and nuts, duct supports and hangers. Vibration isolation pads or suspenders; flexible connections, inspection doors, dampers, turning vanes, straightening vanes and any other item which will be required to complete the duct installation except external insulation and finish thereon.

The external area shall be calculated by measuring the over-all width and depth (including the corner joints) in the center of the duct section and over-all length of each duct section from flange face to flange face in case of duct lengths with uniform cross section. Total area will be arrived at by adding up the areas of all duct sections.

In case of taper pieces average width and depth will be worked out as follows:

W1 = Width of small cross section

W2 = Width of large cross section

D1 = Depth of small cross section

D2 = Depth of large cross section

$$\text{Average Width} = \frac{W1 + W2}{2}$$

$$\text{Average Depth} = \frac{D1 + D2}{2}$$

Width and depth in the case of taper pieces shall be measured at the edge of the collar of the flange for duct / sections fitted with angle iron flanges; otherwise at the bottom of the flange where the flanges are of GSS. Face to face length for taper piece shall be the mean of the lengths measured face to face from the centre of width and depth flanges.

For special pieces like bends, branches, and tees, etc, the same principal of area measurement as for linear lengths shall be adopted, except for bends and elbows, the length of which shall be the average, of the lengths of inner and outer periphery along the curvature of angle of the piece.

Duct measurements for calculation of area shall be taken before application of insulation.

1.1.2 Supply air Diffusers

Each supply air diffuser including volume control dampers, flexible ducting, adopter box and accessories as specified will be regarded as one unit for the purpose of measurement and payment. The measurements will be based on the approved drawing *I* as built drawing and paid per unit. Flexible ducting and adopter box (connecting flexible ducting and supply air diffuser) are part of supply air diffuser. The unit rate quoted for supply air diffusers shall include the cost of adopter box and flexible ducting. No separate payment will be made for flexible ducting and adopter box.

1.1.3 Return air Diffusers

Each return air diffuser and accessories as specified will be regarded as one unit for the purpose of measurement and payment. The measurements will be based on the approved drawing *I* as built drawing and paid per unit.

1.1.4 Fire Dampers

Fire dampers shall be measured by their cross-sectional area perpendicular to air flow based on the approved drawing *I* as built drawing and paid. Quoted rates shall include necessary accessories and flanges for mounting, access door etc.

1.1.5 Fusible link and solenoid for operation of Fire Dampers

Each Solenoid and associated accessories will be regarded as one unit for the purpose of measurement and payment. Each Fusible link and associated accessories will be regarded as one unit for the purpose of measurement and payment. The measurements will be based on the approved drawing *I* as built drawing and paid per unit.

1.1.6 Linear Diffusers

Linear diffusers shall be measured by linear measurements only and not by cross- sectional areas and shall exclude flanges for mounting linear diffusers. The measurements will be based on the approved drawing *I* as built drawing and paid per unit length. The supply air plenum for linear diffusers shall be measured identical to ducting as described earlier. Frame work for linear diffusers shall be included in unit rates quoted.

1.1.7 Slot Diffusers

Slot diffusers shall be measured by linear measurements only, not by cross- sectional areas and shall exclude flanges for mounting slot diffusers. The measurements will be based on the approved drawing *I* as built drawing and paid per unit length. The supply air plenum for slot diffusers shall be measured identical to ducting as described earlier. Frame work for slot diffusers shall be included in unit rates quoted.

1.1.8 Supply and return air Grilles

Supply and Return air grille area shall be calculated by measuring width by height, excluding flanges. In case of supply air grilles, volume control dampers shall form part of supply air grilles and the unit rates quoted for supply air grilles shall include the cost of volume control dampers. Frame work for grilles shall be included in unit rates quoted. The measurements will be based on the approved drawing *I* as built drawing and paid per unit area.

1.1.9 Volume control damper (VCD) in Duct

VCD (manual or motorised) shall be measured by their cross-sectional area perpendicular to air flow based on the approved drawing *I* as built drawing and paid per unit area. Quoted rates shall include necessary collars and flanges for mounting etc. No special allowance shall be payable for extension of cross-section outside the air stream. Volume control dampers in supply and exhaust fan units are part of fan units and no separate payment will be made for the same.

1.1.10 Back draft damper

Back draft damper shall be measured by their cross-sectional area perpendicular to air flow based on the approved drawing *I* as built drawing and paid per unit area. Quoted rates shall include necessary collars and flanges for mounting etc. No special allowance shall be payable for extension of cross-section outside the air stream.

1.1.11 Variable Air Volume (VAV) unit

Each Variable Air Volume (VAV) box with dampers, accessories etc, will be regarded as one unit for the purpose of measurement and payment.

1.1.12 Sound Attenuators

Each Sound attenuator with accessories will be regarded as one unit for the purpose of measurement and payment. The measurements will be based on the approved drawing I as built drawing and paid per unit. Sound attenuators in supply and exhaust fan units are part of fan units and no separate payment will be made for the same.

1.1.13 Flexible Connection

Flexible Connections other than at equipment inlet and outlet shall be measured by their cross-sectional area perpendicular to air flow. Quoted rates shall include necessary mounting arrangement, flanges, nuts and bolts and treated for fire requisite length of canvas cloth. The measurements will be based on the approved drawing I as built drawing and paid per unit area.

1.1.14 Louvers

Louvers complete with bird screen etc., shall be measured from the approved drawings / as built drawing on the basis of core area (excluding margin flanges) and paid per unit area. Louvers in supply and exhaust fan units are part of fan units and no separate payment will be made for the same.

1.1.15 Strip Heater

Strip heaters if specified including accessories will be measured from the approved drawing I as built drawing in KW and paid per unit KW.

INSULATION SPECIFICATIONS

1 SCOPE

This specification covers the technical requirements and essential particulars for the supply, application and finishing of the composite thermal insulation for cold equipment, piping systems, air-conditioning ducts, etc. The scope of supply of the contractor shall include, but not be limited to, the following items:

(a) Insulation material as specified
(b) Finishing material as specified
(c) Auxiliary materials such as binding and lacing wires, wire netting, bands, screws, pop-rivets, etc. as required
(d) Angles, clamps, lugs, etc. for supporting insulation
(e) Weather hoods
(f) Any material as may be required for making the insulation complete

2.0 CODES AND STANDARDS

The following are some of the codes and standards relevant to this specification:

IS 277	Galvanised Steel Sheet (Plain and Corrugated)
IS 737	Wrought Aluminium and Aluminium alloy Sheet and Strip for General Engineering Purposes
IS 8183	Bonded Mineral Wool
IS 9842	Preformed Fibrous Pipe Insulation
IS 14164	Industrial Application and finishing of Thermal Insulation Materials at Temperatures above (-) 80^0 C and up to (+) 700^0 C
BS 5970	Thermal Insulation of Pipe work and Equipment (in the Temperature Range (-) 100^0 C to (+) 870^0 C

3.0 INSULATION WORK

1) The scope of this section comprises supply and application of insulation to sheet metal ducting, chilled water piping, condensate drain piping, refrigerant piping, insulation for air handling units, chillers, insulation for walls and ceiling and floor.
2) Nitrile Rubber Insulation of Class "O" Closed Cell, 32 mm thick for pipes above 100 mm Dia & insulation of 25 mm thick for pipes below 100 mm Dia. The pipe insulation shall be covered with 26 Gauge Aluminium Cladding with superior workmanship.
3) Duct insulation of Closed Cell Rubber Nitrile Class O Armaflex make. The insulation shall have factory pasted wrinkled Aluminium Foil finish.
4) All insulation on equipment and piping shall be applied only after the system has been pressure tested satisfactorily.
5) The Institute's authorized representatives reserve the right to peruse the weights, dimensions etc., of the insulation material supplied. Samples of all insulation material specified, in various forms shall be submitted by the successful contractor. The customers shall have the right to reject all supplies which do not conform to the specifications and to the samples so approved.

External (Thermal) insulation of air-conditioning ducts:

The entire supply air ducting for air-conditioning from AHU fan outlet to the terminal device (diffuser or grille) shall be insulated Closed Cell Rubber Nitrile Class O Armaflex make. The insulation shall have factory pasted wrinkled Aluminium Foil finish 19 mm. The thermal conductivity (K) value shall not be more than 0.033 W/m .k. at 10 deg C.
Internal (Acoustic) insulation of air-conditioning ducts :

Acoustic insulation shall be provided for the following:

(a) The first eight (8) metres of air-conditioning duct from AHU outlet.
(b) The return air transfer ducts in the AHU room wall, connecting the AHU room with the air-conditioned area.

The portion of supply air duct which is acoustically (internal) insulated need not be insulated thermally (external).
Insulation material shall be resin bonded rigid board fibreglass insulation of thickness 25 mm and density 48 kg / m^3 and faced with 26 G galvanised steel sheet (GSS) with minimum 40% open area.. The thermal conductivity (K) value shall not be more than 0.031 W/m K at 10 deg. C.
Mechanical fasteners shall be used to ensure adherence of duct insulation to surface of the ducts.

Chilled water piping and AHU and FCU condensate piping

All chilled water piping, hot water piping, condensate drain piping shall be insulated as indicated herein. Prior to application of insulation, all pipe work shall be cleaned on the surface with wire brush to remove dirt and dust.

The insulation for chilled water piping, pump, expansion tank etc., shall be carried out from Nitrile Rubber Insulation of Class "O" Closed Cell, 32 mm thick for pipes above 100 mm Dia & insulation of 25 mm thick for pipes below 100 mm Dia. The pipe insulation shall be covered with 26 Gauge Aluminium Cladding with superior workmanship.

The chilled water pipes in the plant and air handling unit rooms and as well as shaft risers and exposed roof, insulation shall be covered with 24G commercial grade aluminium sheet cladding. This basically includes entire chilled water piping network. The joints shall be formed with proper grooves and overlaps and secured in position with self tapping screws. For bends / elbows and such other fittings, the cladding shall be in multi-piece construction, the thickness of the sheet shall be 26G.

Arrows indicating direction of flow shall be clearly marked.

<u>Chilled Water Pipe Insulation (where above method is not feasible)</u>

The insulation for chilled water piping shall be carried out from flexible pipe sections sheets of closed cell elastomeric insulation having a 'K' valve of 0.037 W/mK at a mean temperature of 20ºC and a minimum density of 55 Kg./Cubm.

The thickness of insulation shall be 19 mm upto 100 mm dia and 25 mm for above 100 mm dia pipes.

5.0 DRAIN PIPE INSULATION

The material for insulation of drain pipes shall be pipe sections of flexible closed cell elastomeric insulation having a 'K' valve of 0.037 W/mK at a mean temperature of 20ºC and a minimum density of 55 Kg./cubm.

7.0 AHU ROOM INSULATION (IF ANY)

Acoustic insulation for the air handling unit rooms shall be done with 50 mm thick fibre glass as specified. Clean the surface to remove all dirt and dust. Apply two coats of hot air blown grade bitumen. Fix 50 x 50 mm GI channels on the wall / ceiling using rawl plugs to form a grid of 1000 mm x 500 mm. Friction fit the fibre glass in the 1m x 0.5 m. The fibre glass shall be wrapped inside RP tissue. Cover the insulation with 1 mm thick perforated aluminium sheet. The corners and junctions / terminations shall be covered with aluminium angles / flats.

8.0 PUMP / EQUIPMENT INSULATION

The specification of insulation as per piping shall be applicable for this section also.

9.0 GENERAL REQUIREMENTS

9.1 The application of insulation shall be made in a workmanlike manner. The insulation shall be applied to all surfaces when these are at ambient temperature. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied in a manner which shall avoid breaking or telescoping due to alternate periods of contraction and expansion. A single layer of insulation shall not be more than 50 mm thick.

9.2 Insulation shall be applied after all leak tests on equipment and piping are over and the section of the plant has been specifically released by the CLIENT for such work.

9.3 All surfaces to be insulated shall be clean and dry before the insulation is applied. The surface shall be cleaned of all foreign material such as scale, dirt, rust and paint, by the use of steel wire brushes and steel scrapers, where necessary. One coat of primer paint shall be applied and allowed to dry before application of insulation.

9.4 Where multi layer insulation is provided, insulation adhesive shall be used between two layers.

9.5 For aluminium sheet finishing material provided, all joints shall be sealed with bitumastic paint and made effectively weather and waterproof.

9.7 Approval of the Engineer shall be obtained for samples of materials. Necessary test certificates shall be furnished to Engineer, before despatching any material to site.

9.8 The following information shall be furnished by contractor after award of contract.

a) Detailed insulation application procedure with drawings
b) Test certificates for insulation materials

MODE OF MEASUREMENT:

1.0 Representatives from the Contractor and Engineer shall conduct a joint inspection of the Equipments. All the discrepancies observed either incomplete works or defective work shall be clearly indicated in the joint inspection report. The mode of measurements given below is for the purpose of measurement and payment and the scope of works shall be as specified else where in the specification.

1.1 Thermal insulation for Duct

Area of duct insulation finished as per specification shall be calculated on the basis of finished duct area before insulation based on the approved drawing *I* as built drawing and paid per unit area.

1.2 Acoustic insulation for Duct

Area of acoustic insulation finished as per specification shall be calculated on the basis of finished duct area before insulation based on the approved drawing *I* as built drawing and paid per unit area.

TESTING AND BALANCING

GENERAL

1.1. All testing and balancing shall be made in the presence of the Consulting Engineer or his representative or other inspecting authority. Give not less than 5 days prior notice, in writing, to these parties before making any tests. Check list format has been furnished in every section for all air conditioning & ventilation equipment. The duly filled the check list has to be submitted to the consulting engineer before starting the testing & balancing.

1.2 Supply all necessary skilled labor, helpers, equipment and materials for tests, operating and adjusting the systems and for fully instructing the Employer or his representatives in the operation of the system.

1.3. Protect valves and equipment from damage during tests. Include connection to previously tested sections, if the systems are tested in sections.

1.4. Prior to the balancing procedure, operate all systems for at least 16 consecutive hours or longer if required, to prove satisfactory automatic operation. If systems shutdown is experienced for any reason, repeat and test until 16 consecutive hours are achieved. Operate equipment as recommended by the equipment manufacturers and in such a manner as to avoid damage to the work of other trades.

1.5. Submit to the Consulting Engineers for review a log of all tests made which shall include time, temperature, pressure and other readings necessary to indicate that the systems have been operated and tested as required by the Specification.

1.6. Upon completion of testing and balancing submit six (6) copies of the recorded test data for the Consulting Engineers evaluation and approval.

1.7. Flow quantities for Air side, Chilled and Condenser Water Systems shall be verified by the Consulting Engineers and Clients representatives before the report is submitted.

2.0. TESTING OF MEDIUM & LOW PRESSURE DUCTS

2.1. The Medium and Low Pressure ducts shall be tested for air leaks.

3.0 TESTING OF PIPING

3.1. All pressure systems specified to be tested using water as the test medium shall be first checked by pre-testing the test section, or system, with compressed air at 2.5kg/sq.cm for a period of 3 minutes. Correct all leaks disclosed by the pre-set before proceeding with the specified testing using water as the test medium.

3.2. Test all piping as noted below with no leaks or no loss of pressure. Repair or replace Defective piping until tests are accomplished successfully.

SYSTEM	TEST PRESSURE	TEST MEDIUM	TEST DURATION
Chilled water piping	7 kg/sq.cm	Water	24 hours
Condenser water piping - NA	6 kg/sq.cm	Water	24 hours
Condensate drains	3m hd	Water	24 hours
Refrigerant piping	21 kg/sq.cm	Dry Nitrogen	4 hours

3.2. For refrigerant piping, proceed further as follows:

a. Test points of possible leakage to assure pressure tightness with halide testing device.

b. Evacuate system to 100 microns using high vacuum pumps.

c. With Vacuum pump stopped, system shall maintain vacuum for a period of 24 hours without losing vacuum of more than 50 microns.

d. Refrigerant shall be charged only after the pressure tightness has been proven.

4.0. TESTING OF ELECTRICAL WORK

4.1. Supply necessary meters, instruments, temporary wiring and labor to perform all required tests and adjustment of equipment and wiring installed and connected under this Sub Contract, including the electrical equipment supplied by others to determine proper polarity, phasing, freedom from earth faults and shorts and the proper operation of equipment, meters relays etc.

4.2. All materials and manner of installation shall be in strict accordance with the applicable requirements of the local Authorities. The installation must pass all inspections, and will be subject to the approval of such authorities and the Engineer.

4.3. Wherever any codes, laws, etc., require any work to be tested or approved the Contractor shall provide proper facilities for access and for inspection, all at his own expense.

4.4. Tests shall be made for continuity and identification of each conductor. Both ends of a given conductor shall be identified alike. Before circuit terminal connections are made, continuity and identification shall be checked by means of a D.C. test device using a bell or buzzer or battery powered phone to ring out the wires.

4.5. All earth tests shall be made with 100 volt merger test-type instrument.

4.6. Test each circuit for grounds and shorts by means of a merger insulation testing instrument which shall impress a voltage of not less than 100 volts D.C. upon the circuit under test. Any circuit showing an insulation resistance less than the minimum values given in the Wiring Rules shall be investigated and weak points corrected. All circuits under merger insulation test shall be connected to the respective final terminals and switches or breaker, in the 'OFF' position.

4.7. Correct or replace any nominal current carrying circuit which is defective or earthed. Also correct all trouble encountered by test and set breakers and relays as directed so that equipment will be in proper operating condition, before being placed in service.

4.8. Following establishing procedure, equipment will be energised after certification that the installation is satisfactory .Final operational tests shall determine that the wiring connections are correct.

5.0 PRE BALANCE CHECKS AND START UP

5.1. The Air and Water Systems will be checked out at specified below, and started up prior to balancing.

a) Complete "'water pressure and duct pressure testing for leakage.

b) Complete all 'Punch List' check items.

c) Install all dampers and other balancing devices as called for in the construction documents and verify the same are properly installed, indexed and in good working order.

d) Check all motor starters and verify that the heater sizing is correct, taking length of electrical feeders into consideration. Record amp readings on all motors.

e) Check out and align all equipment drives.

f) Set all fan sheaves to provide the indicated capacities at specified static pressures (RPM as specified).

g) Set all manual balancing dampers, valves and balancing valves at 100% open position. Verify that all fire dampers are open.

h) All adjustable pitch pulleys shall be removed from the motor shaft. The shaft and pulley threads shall be cleaned, lightly oiled, and pulley remounted, aligned and properly adjusted.

i) Clean interior of all plenums, casings and ducts and install all filters before starting systems.

j) Make sure all controls systems are calibrated and functioning properly.

k) Place all systems in automatic operation.

I) Operate systems for 16 consecutive hours without shutdown with all equipment in perfect working order. Manufacturers' representative must be present at initial start-up all equipment.

m) Check fan and pump bearings for grease.

n) Install clean prefilters and install high efficiency filters in all systems prior to starting air balance.

0) Provide availability of personnel from all the related mechanical and Controls contractors during balancing.

6.0 TEST REPORTING FORMS

6.1. General

Test forms used for testing and balancing shall be set up to include the following information. Each sheet shall have job name and address, name of air conditioning sub-contractor, architect and engineer instruments used to perform tests, and name of test technician or test engineer. All forms shall be submitted in typewritten form. A minimum of 6 copies shall submitted. Test sheets shall be similar to those shown in the section 4.13.

6.2. Diffusers, Grilles and Registers -Test Sheets

a) Fan Systems and/or zone number

b) Room number or area designation

c) Outlet code number which shall correspond to code number of outlet on air balance code drawing.

d) Size of Outlet -.

e) Type of Outlet -.

f) Manufacturer of Outlet

g) Manufacturer's effective area for each size

h) Required FPM and required CFM of each outlet

j) Available FPM and CFM of each outlet

6.3. **Air Handling Equipment Test Sheets** .

The test sheets shall provide details of the following items: (Refer Checklist in AHU Spec. Section)

System Fan Number	Fan RPM
Fan Manufacturer	Size of Sheave Driver
Total CFM	Size of Sheave Driven
Return Air CFM	Belt sizes and number
Outside Air CFM	Motor Manufacturer
Total Static Pressure	Motor Size, Voltage
Suction Static Pressure	Phase & RPM KW
Discharge Static Pressure	Amperage Nameplate Rating
Coil Pressure Drop	Final Operating Amperage
Filter Pressure Drop	Overload Setting

6.4. **Exhaust Fans , Fresh Air Fans and Pressurization Fans Test Sheets**

The test sheets shall provide details of the following items:.

System Fan Number	Amperage Nameplate Rating
Fan Manufacturer	Final Operating Amperage
Size and Model	Fan RPM
Motor HP, Voltage & Phase	Total Static Pressure, Overload Setting

6.5. **Test, Code Drawings**

Each Report shall contain a single line drawing of air distribution system with fan system and zone number indicated. Each and every outlet, supply, and return shall be indicated on this drawing by a number corresponding to the number on the outlet test sheet, enabling the Engineer to locate each outlet for this drawing.

Drawing shall be clear and neat and shall list name of job and location of same.

6.6. **Temperature Test Sheets**

Temperature test sheets shall list both specified and test conditions in opposite columns.

Items listed on this sheet shall be as follows:

a) Entering Air D.B. & W.B. Temperature

b) Leaving Air D.B. & W.B. Temperature

c) Entering Coil Water Temperature

d) Leaving Coil Water Temperature

e) Outside Air -D.B. & W.B. Temperature

f) Room temperature reading to be checked against thermostat setting

7.0. **AIR SIDE TESTING AND BALANCING**

7.1. The Air System shall be tested and balanced as under:

a) Test and adjust fan RPM to design requirements

b) Test and record motor full load amperes.

c) Make Pitot Tube traverse of main supply ducts and obtain design CFM at fans.

d) Test and record system static pressures, suction discharge and total.

e) Test and adjust system for design recirculated air.

f) Test and adjust system for design outside air.

g) Test and record entering air temperatures DB/WB.

h) Test and record leaving air temperature DB/WB

i) Adjust all main supply and return air ducts to proper design CFM.

j) Adjust all zones to proper design CFM (supply and return).

k) Test and adjust each diffuser, grille and register to within 10% of design requirements:

I) Each grille, diffuser, register shall be identified as to location and area.

m) Size, type and manufacturer of diffusers, grilles, registers, and all tested equipment shall be identified and listed. Manufacturer's ratings on all equipment shall be used to make required calculations.

n) Readings and tests of diffusers, grilles, and registers shall include required velocity and test resultant velocity. Required CFM and test resultant CFM after adjustments.

0) In co-operation with control manufacturer's representative, set adjustments of

automatically operated dampers to operate as specified, indicated and/or noted.

p) All diffusers, grilles, and registers shall be adjusted to minimise drafts in all areas.

q) **As part of the work of this contract, the Contractor shall make any changes in the pulleys and belts for correct balance as required at no additional cost to Owner**.

8.0. WATER SYSTEMS TESTING AND BALANCING

HVAC contractor shall engage the services of balancing valve supplier to provide complete water side balancing.

8.1. Pre Balancing Checks

The Air Balancing should have been completed before the Water balancing begins. The Contractor is to ensure that the following works are completed prior to commencement of water balancing.

a) Open all valves to full open position, including coil stop valves, bypass valves, and return line balancing cocks.

b) Remove all strainers and clean the same and replace in system.

c) Examine water in system and ensure water has been treated and is cleaned. This is to be verified by Owner's representative.

d) Check pump rotation

e) Check expansion tanks to determine they are not air bound and the system is completely full of water.

f) Check all air vents at high points of water systems and determine all are installed and operated freely. Bleed any air out of systems.

g) Set all temperature controls so all coils are calling for full cooling.

h) Check operation of all automatic valves.

i) Check and set operating temperatures of chillers to design requirements.

8.2. Initial Balancing

a) Set Chilled Water Pumps to proper gallons per minute delivery .

b) Adjust water now of chilled water through chiller.

c) Check leaving water temperatures and return water temperatures through chiller. Reset to correct design temperatures.

d) Check water temperature at inlet side of Cooling coils. Note rise or drop of temperatures from source.

e) Proceed to balance each chilled water coil.

f) Upon completion of flow readings and adjustments at coils, set all memory stops and record all data.

8.3. **Final Balancing**

Upon completion of the above, the final balancing shall be completed as follows:

a) After adjustments to coils are made, recheck settings at the pumps and chillers and read just if required.

b) Install pressure gauges on coil, read pressure drop through coil at set flow rate on call for full cooling. Set Pressure drop across bypass valve to match coil full pressure drop. This prevents unbalanced flow conditions when coils are on full bypass.

c) Set Chilled Water bypass to pressure differential specified on drawings.

d) Record and check the following items at each cooling elements:

Flow Rate
Inlet Water Temperature
Leaving Water Temperature
Pressure drop of each coil
Pressure drop across by pass valve
Pump operating suction and discharge pressures and final total discharge head.
List of all mechanical specifications of pumps
Rated and actual running amperage and KW of Pump Motor

8.4. Upon completion of final balancing, all information shall be inserted of a sheet listing all items required by specifications and be included in complete test and balance report. All sheets shall be neatly typed.

8.5. Submit sample forms to the M & E Engineer for approval prior to starting balancing.

9.0. **TEST OF REFRIGERATION MACHINES**

9.1. The Refrigeration machines shall be tested by the equipment supplier for performance, and compliance with specification. The Contractor shall liaise and co-ordinate with the equipment supplier to carry out the tests.

9.2. The test shall consist of operating the equipment at prevailing conditions and recording chilled water temperature and condenser water in US GPM and power input.

9.3. Calculated refrigeration tonnage shall be compared with predicted full and part load curves provided by the manufacturer. These curves shall indicate power input plotted against tons of refrigeration output at condenser water temperature ranging from 32°C and 0.5°C intervals.

9.4. Chilled Water and Condenser Water quantities shall have been determined from measurements of USGPM handled by water pumps.

9.5 Test shall consist of a minimum continuous run of 6 hours with 24 readings made for each item above, unless continuously recordings instruments are used.

9.6. Supply calibrated instruments for testing. Instruments shall be calibrated immediately prior to tests and after completion of tests.

9.7. The noise level of the equipment shall be measured and recorded.

HVAC ELECTRICAL WORKS

1.0 SCOPE

HVAC contractor shall refer to Electrical Schematic drawings to understand his exact scope of Electrical works for HVAC works. HVAC Contractor scope of Electrical works shall start from feeders provided by the Electrical Contractor near each Panel.

CHIILER UNITS

HVAC ELECTRICAL CONTRACTOR

Supply, Installation Testing and commissioning of Chiller MCC with MCCB as the feeder with Motor Protection relay.

Supply, Laying of power cables with necessary cable support system up to the Chiller starter panel

Supply and Installation of earthing system upto Chiller MCC

Supply, Installation Testing and commissioning of chillers with Starters

Supply, Laying, Testing and commissioning of power and control cables with necessary termination from Chiller starter panel to Chiller Motors

Supply, Laying, Testing and commissioning of control cables with necessary termination from Motorised valve actuator to Starter

The chiller starter panel shall be able to accommodate the cable sizes as indicated in the single line diagram.

AHU (IF ANY)

HVAC ELECTRICAL CONTRACTOR

Supply, Installation Testing and commissioning of AHU MCC with MCB feeder.

AHU local starter panel shall be supplied and installed in AHU room

Supply, Laying of cables with necessary cable support system up to the AHU starters panel

Supply and Installation of earthing system up to starter panel

Supply, Laying, Installation Testing and commissioning of power and control cables with termination and necessary cable tray support system from AHU starters panel to AHU Motors, including control cables for motorised valve actuators and limit switch.

CHILLED WATER PUMP MCC

HVAC ELECTRICAL CONTRACTOR

Supply and Installation of Chilled Water pump MCC with starters

Supply and Installation of Local Push button station (LPB) with control cable

Supply, Laying of cables with necessary cable support system up to the Chilled water pump MCC

Supply, Laying, Testing and commissioning of power and control cables with necessary termination from Chilled water pump MCC up to the motors with necessary termination and cable tray support system

Supply and Installation of earthing system for MCC

Supply and Installation of Single Phase power for Fan coil units

Supply, Laying of power cables with necessary cable support system up to the FCU units.

Supply and Installation of earthing system for MCC panel on the roof.

2.0 CODES AND STANDARDS

Unless otherwise specified herein, all electrical equipment, cabling and method of installation shall comply with Indian Electricity Rules, Tariff Advisory Committee Regulations on Building Safety, National Building Code, National Electricity Code and other relevant Indian Standard Specifications by the Bureau of Indian Standards.

3.0 GENERAL REQUIREMENTS

3.1 The CONTRACTOR shall consider harmonics suppression equipment and shall limit the values as follows : (a) Total Harmonic Voltage Distortion (THVDF) : 3%
(b) Single Harmonic Voltage Distortion (SHVDF) : 2%
(c) Even Harmonics : 1%

3.2 Smoke detector shall be installed in the return air path in the AHU room and when this picks up, the AHU motor shall trip automatically.

3.3.1 During fire in any floor Main Incomer of AHU MCC shall trip and the pressurisation fans for smoke free lobby and stair case lift lobby shall be energised. Necessary contacts/signals shall be obtained from the fire alarm system and incorporated in the AHU panel.

4.0 MOTORS

4.1 All motors shall conform to the requirements of IS:325-1996.
The motors to be of EEF 1 Type

4.2 All motors shall be specifically designed for 50HZ operation at 240 volts for single phase and 415 volts for three phase and with Class B insulation. Degree of protection shall be IP 54 for indoor and IP55 of outdoor installation.

4.3 Fractional horsepower motors shall be single phase squirrel cage capacitor start, induction run.

4.4 All motors up to and 7.5 HP shall be suitable for DOL starting

4.5 All motors above 7.5 HP shall be with Star Delta starting
The contractor shall submit characteristics such as starting KVA and power factor , recommended star-Delta transition period and full load starting and running currents for all motors.

5.0 CABLES

5.1 Cables shall be 1100V grade, aluminium/Copper conductor, PVC insulated, PVC sheathed conforming toIS:1554, 1988 and specification.

5.2 Cable sizes shall be selected to ensure that they have adequate current carrying capacity and to limit the voltage drop during running to 5% and voltage dip during starting of the motor to 10% Also adequate derating factors shall be considered.

5.3 Cabling to the equipment operating during fire condition for. eg. pressurisation fans for smoke free lobbies and lift lobbies shall be connected to the Main LV switchboard and shall be by FRLS PVC outer sheathed cables. the properties of the FRLS PVC compound shall be as given in the cable specification. The cables shall be laid in cable trays along the electrical riser and either in cable trays or in conduits upto the equipment. The conduits shall be of not less than 20 mm dia. The conduits shall be of medium duty PVC and heavy duty PVC when run concealed and exposed respectively. The installation of cable trays and conduits shall be as per approved drawings.

6.0 EARTHING

6.1 All equipments of the A/C and Mechanical ventilation system like motors, cable trays, junction boxes, distribution boards, etc. Shall be connected to the nearest building earthing conductor by conductor sizes for chillers Motors 50X6 GI flat, Cooling tower /AHU/pumps Condenser Pump shall be with 25x6 flat. FCU by 4sqmm Cu. Wire.

7.0 BAS INTERLOCKS

Potential free contacts and inputs as listed in the BAS input/output table given elsewhere shall be made available .

8.0 TESTING

Type test certificates of equipments supplied under this contract shall be furnished for review. In the absence of the same, the CONTRACTOR shall carry out the type tests

without any extra cost. Major Electrical items shall be offered for routine tests inspection at works. Sample pieces of all important items shall be offered for approval at site and kept at sample room to verify / cross check the future supplies.

9.0 WIRING DIAGRAM

The Contractor shall provide in the plant room a complete "as installed" wiring diagram identifying all numbered control circuits and all colour codings mounted in a glazed frame.

10.0 DRAWINGS

The CONTRACTOR shall submit generally applicable switchgear layout along with the Tender and GA, scheme drawings of switchgear, control panels and layout requirements for review prior to fabrication.

Electrical Operation & Maintenance;

The electricians and supervisor deputed by the contractor should possess wiremen competency certificate as per Qualification of workmen Indian Electricity rule 1956 (suitable for working upto 22KV/ 11KV/ 415 Volts installation).

1.1 The electricians should have minimum 2 years of experience in handling 22 KV/ 11KV/ 415 Volts installations and should be able to understand control and power circuits.

1.2 The Supervisor should pocess the Electricity License issued by Electrical Inspector of Govt. authority/PWD (Electrical) Maharashtra, for system voltage upto 22KV.

1.3 The supervisor should have minimum 2 year experience in handling 22 KV/ 11KV/ 415 Volts installations and should be able to understand control and power circuits.

1.4 Supervisor should have minimum qualification of diploma in electrical engineering and should know the basics of computer knowledge and should easily understand the electrical drawings.

1.5 All necessary training to workmen to be given by contractor before deputing and they should know all control and power circuit of all HT and LT installations at IITM before deputing.

1.6 The successful bidder shall abide by all applicable statutory provisions in respect of workmen deployed by him to the satisfaction of the Central & State Government Authority. The contractor shall comply with the provisions of all statutes and amendment there off at their cost including payment of wages as per wage act.

1.7 The electrician and supervisor will work under supervision of electrical incharge and abide by all security rules and regulations of IITM.A penalty will be imposed for each shift of absence by dividing the value of AMC by 365 days. The deputed workmen should not be changed frequently so as to avoid disruption in service. Also if the deputed manpower is found unsuitable, contractor has to replace them immediately.

HVAC Operation & Maintenance

Contractor shall carry out the operation of the HVAC installation for a period of two years from the date of commissioning and handling over the entire system, i.e. during the defects liability period. Further, he shall also carry out all inclusive maintenance of the entire system for a period of three years beyond the defects liability period.

A .Operation Contract(HVAC System)

1. 24 hrs .a day year round
2. All standy equipment to be operated as per mutually agreed program
3. Proper entry & upkeep of relevant log books.
4. Maintain complaints register. submit weekly report.
5 .Proper housekeeping of all areas under the contract.
6.Prepare daily oil & energy consumption report & summary of operation.

B. All inclusive Maintenance Contract

1. Routine preventive Maintence Schedule to be submitted
   a)Schedule to cover manufacturer's recommendation and/or common engineering practice(for all sub-station & DG SETS under Contract)
   b)Plant & Machinary history card giving full details of equipment and frequency of checks and overhaul.
   c)Monthly status report.
2. Uptime during Maintenance Contract
   a) 100% uptime of all systems with standbys under contract.
   b) Uptime shall be assessed every month and in case of shortfall during any month, the Contract shall by a month.
   c) There shall be no reimbursement for the extended period.
   d) Break-downs shall be attended to within minimum response time.
3. Manpower
   a)Statutory requirements of other applicable labour legislation to be complied with; and monthly certification to that effect to be submitted.
   b) Duty allocation and Roaster control shall be cntractor's responsibility.
   c) No overtimes shall be payable by AC contractors group for any reason whatsoever.
4. Shutdowns
   a) Routine shutdowns shall be permitted only during every six month(winter) season.
   b) Contractor shall be at liberty to carry out maintenance as and when required but with prior permission.

TOOLS and Accessories

All tools & accessories required for the proper running and maintenance of plant, together with spare tin of oil and grease of each type necessary, will be supplied along with the manuals.

Operating Timings and Procedure

5.0 The AC operator and supervisor will work under supervision of IITM in charge and abide by all security rules and regulations of IITM.A penalty will be imposed for each shift of absence by dividing the value of AMC by 365 days. The deputed workmen should not be changed frequently so as to avoid disruption in service. Also if the deputed manpower is found unsuitable, contractor has to replace them immediately.

LIST OF APPROVED MAKE:

Sr.No.	Component	Approved Make
1	Motors	Siemens/crompton//Bharat bijlee
2	Insulation	
	A. – Fibreglass	Up Twiga / Khimco / Owens / Eqv.
	B. - Nitrie Rubber	Armaflex / K fles / Sekisui Pilon - Thermobreak
3	Grilles / Diffusers	Ravistar / Air Products / Air cosns air/ Treat Air
5	Pre-Filters	Pyramid / Airtech / ARW
6	Ducting Sheet	TATA / Jindal
7	Ducting	Alfa / Radiant
8	Pipe Supports	Energia / Intellotec./Amtech
9	Chillers	Uniflair/ Daikin/Carrier/Kirloskar/Klima Veneta
10	Pumps	Grundfos / Kirloskar /Armstrong
11	AHU	Treat Air / Carryair / Chauhan Engg
12	Precision Air Conditioners	Uniflair/ Stulz/Blue Box/Airedale
13	Valves	Audco/Kirloskar/Inter valve
14	Pressure Switch	Hoonywell/Indfoss/Swiezer
15	Dial type Pressure Guage	Wika
16	Dial type Thermometer	Wika
17	PVC Drain Pipe	Filolex/Reliance
18	Fire Dampers	Cosmos/Ravistar /Airmaster
19	Supply/Ventilation Fans	Kruger/Nicotra
20	Split AC	Daikin/LG/Carrier/Toshiba
21	Piping Plastic	George Fischer

22	Butterfly Valve	Kirloskar / Audco / Intervalve
23	Expansion rubber bellows	Cori / Eq
24	Ball Valves	Audco / Kirloskar
25	Auto Balancing valve	Tour Anderson / Watts
26	Automatic Air vents	Anergy
27	Duct inline fans	Nicotra / Krugger/Dyna
28	Check Valves	Intervalve
29	Y Strainer	Sant
30	Air Seperator	Anergy / Energia
31	Power Cable	Polycab / Finolex/KEI
32	Control Cable	Polycab / Finolex / KEI
33	Electrical Components	Siemens / Schneider
34	(Switches, Hrc Fuses Etc.)	
35	Cricuit Breakers	Siemens / Schneider
36	L.T. Breaker	Siemens / Schneider
37	Switch Fuse Unit	Siemens / Schneider
38	MCCB	Siemens / Schneider
39	MCB	Siemens / Schneider
40	Push Buttons	Siemens / Schneider
41	Indicator Lamp	Siemens / Schneider
42	Ammeter (Digital Type)	Siemens / Schneider
43	Voltmeter (Digital Type)	Siemens / Schneider
44	Connector	Siemens / Schneider
45	Selector Switch	Siemens / Schneider
46	Electric Wire	Siemens / Schneider
47	Cable Gland	Siemens / Schneider

48	Lugs & Sockets	Siemens / Schneider
49	PVC Tape	Steel Grip / Bhore / Eqv.
50	Screw	Nettlefold / Gkw / Eqv.
51	Bimetallic Clamps & Connection	Smoutan / PEC / Milind / Eqv.

The Air-conditioning equipments and installations shall conform to Indian Standards whenever applicable. The applicable Indian Standards are :

a)	IS 3615	:	Glossary of terms used in Refrigeration and Air-conditioning.
b)	IS 325	:	Three phase induction motor.
c)	IS 1239	:	Mild steel tubes, tubular and other wrought steel fittings.
d)	IS 639	:	Steel pipe flanges.
e)	IS 277	:	Galvanised sheet steel.
f)	IS 737	:	Wrought aluminum and aluminum alloy sheet and strip for general engineering purpose.
g)	IS 655	:	Metal air ducts.
h)	IS 732	:	Code of practice for electrical wiring and fittings for buildings.
i)	IS 900	:	Code of practice for installation and maintenance of induction motors.
j)	IS 1248	:	Direct acting electrical indicating instruments.
k)	IS 6392	:	Steel pipe flanges.
l)	IS 1367	:	Technical supply conditions for threaded steel fasteners.
m)	IS 3588	:	Axial flow fans electric.
n)	IS 4894	:	Centrifugal fan.
o)	IS 2074	:	Ready mixed paint.
p)	IS 2208	:	HRC cartridge fuse links upto 650 V.
q)	IS 1554	:	PVC insulated (heavy duty) electrical cables for working voltages upto and including 1100 V.
r)	IS 659	:	Air-conditioning safety code.
w)	IS 616	:	Mechanical refrigeration safety code.

1.1.1 BOQ

Sl.No	Description of Work	Unit	Qty
	PRICISION CHILLERS		
1	Supply, installation, testing & commissioning of 175 TR 'TWIN SCREW' type Air-cooled liquid chillers, complete with spring loaded anti vibration mounts, With first charge of Refrigerant Gas, Lubricating oil etc., for the following operating conditions. The chillers shall be complete with screw compressors (Single / Multi Screw), Fin and Tube Air cooled condensers, Flooded evaporator, Drive Motor, Control panel etc., Star delta Starter, stepless capacity control, etc.,as per specifications mentioned in the technical specification sheet. The Chiller shall be capable of opearting in open ambient temperature of local ambient of Pune City, and shall use R-134 a Refrigerant. The Chiller should be installed on Spring Mounted Antivibration mounts.Chiller shall be selected for 45 deg.C abmient temp.with starting to full load timing as 3.0 min. maximum.	Nos	3
1.1.	**Cooling Capacity (175 TR x 3 Nos) (2 W + 1 SB)**		
	Chiller Flow rate : 335 US GPM Chiller tubes to be designed for the above flow rate.		
	Fouling Factor : 0.0005 ~ 0.0001		
	IKW/TR : 1.25 ~ 1.36 Kw/TR		
	EWT : 12.00 Deg C		
	LWT : 7.00 ° C		
	EER ratio (To be Furnished with technical bid)		
	OR		
	Supply, installation, testing & commissioning of 175 TR 'TWIN SCREW' type Air-cooled liquid chillers, complete with spring loaded anti vibration mounts, With first charge of Refrigerant Gas, Lubricating oil etc., for the following operating conditions. The chillers shall be complete with screw compressors (Single / Multi Screw), Fin and Tube Air cooled condensers, Flooded evaporator, Drive Motor, Control panel etc., Star delta Starter, stepless capacity control, etc.,as per specifications mentioned in the technical specification sheet. The Chiller shall be capable of opearting in open ambient temperature of local ambient of Pune City, and shall use R-134 a Refrigerant. The Chiller should be installed on Spring Mounted Antivibration mounts.Chiller shall be selected for 45 deg.C abmient temp.with starting to full load timing as 3.0 min. maximum.	Nos	3
1.2	**Cooling Capacity (175 TR x 3 Nos) (2 W + 1 SB)**		
	Chiller Flow rate : 335 US GPM Chiller tubes to be designed for the above flow rate.		
	Fouling Factor : 0.0005 ~ 0.0001		
	IKW/TR : 1.25 ~ 1.36 Kw/TR		
	EWT : 20.00 Deg C		
	LWT : 14.00 ° C		
	EER ratio (To be Furnished with technical bid)		
	TOTAL VALUE FOR CHILLERS		
2	**CENTRIFUGAL PUMPS**		

2.1	Supply of Chilled water pump, End Suction Back pull out type horizontal , Single Stage Pumps, running at 2900 rpm bareshaft fitted with drip tight Make mechanical seal with O ring silicone carbide seat retainer. along with accessories like fabricated MS base frame , coupling guard , foundation bolts , flexible spacer coupling & coupled to foot mounted TEFC three phase motor (EFF-1) , Class F insulation & IP 55 protection of suitable rating. The motor shall be compatible with VFD drive as specified in the enquiry document. Pump design parameters to be designed as follows. Flexible bellows at pump inlet and pump outlet as per suction and delivery sizes to be considered in the rate. **Metallurgy:** **Body : Cast Iron (IS 210 FG260), Impeller : LT Bronze (IS 318 Grade LTB2), Shaft : SS 410, Shaft Sleeve : SS 410**		
	Pump design parameters to be designed as follows.		
	Primary chilled water pump module		
	Flow rate : 335 US GPM @ 50 Mtr head required as per site condition. (2W+2SB).	Nos	4
2.2	Control Panel consisting of Panel + VFD (Common for both pumps) housed in a single enclosure with incomer and two nos outgoing feeder. The terminations shall be suitable as per cable. Please read the control panel logic in technical specification section.	Nos	1
	TOTAL VALUE FOR PUMPS		
3	**CHILLED WATER SYSTEM**		
3.1	Supply, installation, testing & commissioning of Polyethylene High Density (PE 100) from **+GF+** piping of PN-16 with all necessary **GF Elctronic Fusion welding/Victaulic** Fitting only such as Couplings, Bends, Reducers, T, expanders, flanges etc, supports such as u clamps, threaded rod, pre insulated pedestals, nut and washers as per site condition and 19 thick Closed cell rubber nitrile of Class "O". The insulation of shall be covered with 26 G aluminium cladding with superior workmanship.		
3.1.1	250 mm Dia	RMT	125
3.1.2	200 mm Dia	RMT	350
3.1.3	150 mm Dia	RMT	RO
3.1.4	100 mm Dia	RMT	75
3.1.5	80 mm Dia	RMT	75
3.1.7	65 mm Dia	RMT	40
3.1.8	40 mm Dia	RMT	RO
3.1.9	32mm Dia	RMT	125

4.1	Centric Disc Butterfly valve with a single piece Rubber lined body. Short Wafer body. Integrally moulded seat. Rating PN 16. General design and manufacturing as per API 609 category A/BS 5155/MSS SP-67. Flange ANSI 150 , properly insulated with 25 mm rubber nitrile class O closed cell insulation with 26G Al. cladding.		
4.1.1	250 mm Dia		
4.1.2	200 mm Dia	Nos	30
4.1.3	150 mm Dia	Nos	
4.1.4	100 mm Dia	Nos	8
4.1.5	80 mm Dia	Nos	32
4.1.6	65 mm Dia	Nos	4
4.1.7	40 mm Dia	Nos	
5	Flow Switch suitable for 200 mm Dia Pipe	Nos	3
6	Diferential pressure switch suitable for 200 mm Dia Pipe	Nos	2
7	100 mm dia dial type pressure gages with needle valve & as per specifications mentioned in technical data sheet. Pressure gauge, scale range 0-10 bar. Complete with 3 valves an piping. To be mounted over all pumps. Size 10 DN	Nos	4
8	100 mm dia dial type pressure gages with needle valve & as per specifications mentioned in technical data sheet.		6
9	Dial type industrial type imported thermometer with 100mm dia dial & as per specifications mentioned in technical data sheet	Nos	8
10	Chiller Inlet & Outlet Rubber Expansion Bellows - 200 mm Dia	Nos	6
11	Supply, Installation of ball valve CS body SS 304 Ball full three piece design full port end connection socket weld type class # 150.	Nos	6
11.1	15 mm Dia	Nos	6
11.2	25 mm Dia	Nos	12
11.3	32 mm Dia	Nos	92
12	Balancing valve with measurement points (STA-D). Pressure class PN 16. Made up of AMETAL, Seat seal: Stem with EPDM O-ring Spindle seal: EPDM O-ring Handwheel: Polyamide and TPE.		
12.1	25 mm Dia	Nos	46
13	Flanged Balancing Valve With measurement points (STAF - SG). Pressure class PN 16. Body: Ductile iron EN-GJS-400-15. spindle of AMETAL Seat seal: Cone with EPDM ring. Bonnet bolts: Chromed steel.		
13.1	200 mm Dia	Nos	2
13.2	SITC of Y-Strainer with SS mesh of following sizes;		
	200 mm Dia	Nos	3
14	Automatic Air vent of 1/2 "	Nos	8

15	Closed Expansion Tank with Expansion Vessel and pressurizing Pumps 1 Working + 1 Standby. The tank capacity to be 1000 Ltr . Expansion tank to be of M S Construction with Armaflex / K- Flex Insulation 32 mm thick & 26 Gage Aluminum Cladding with diamond finish and with related piping, Isolating valves , Safety valves , Drains, Overflow and Guages.Tank shall be internally coated with anti-corrosive coating. **Pressurisation unit** with double pump(0.85HP) 230V, 50Hz, single phase) pressure transmitter, IP65 control panel(Remote operation, Duty cycling, Dry-Run protection)	Nos	1
16	Centrifugal Air Separator for Chilled Water in MS construction with SS internal perforated sheet,Tank shall be internally coated with anti-corrosive coating. with Armaflex / K Flex insulation 32 mm & 26 Gage Aluminum Cladding with diamond finish and necessary valves etc.suitable for the following flow rates.		
16.1	Suitable to mount on 250 mm Dia pipe	Nos	1
17	SITC of chemical dosing plant suitable for above system for flushing and treating the water including following 1. 500 Ltr make up water storage tank x 01 nos 2. FIrst charge of Dosing chemicals for the commissioning of the system and chemicals for the 6 months operation. 3. Treated water tank of capacity 2000 Ltr. Interconnecting piping, accessories and valves complete in all respect. 25 mtr of 25 NB size pipe to be considered as interconnecting pipe. 03 Nos of ball velves and 02 nos of ball float vales to be considered in the item.	Lot	1
18	SITC of MS tank with capacity of 15000 Ltr to be used as thermal storage for 5 mins back up supply. The tank to be of M S Construction and with anti corrosive coating from inside with Armaflex / K- Flex Insulation 32 mm thick & 26 Gage Aluminum Cladding with diamond finish and with related piping, Isolating valves , Safety valves , Drains, Overflow and Guages. 8 mm Shell thickness and 12 mm Dish thickness. The tank shall have necessary ports with flanges Table F	Lot	1
19	SITC of cooling distribution unit (CDU) to provide cooling water close control and above the dew point. Shall be capable of 150 KW cooling capacity. The CDU shall be approved to work with IBM 'iDataPlex / RDHX' racks. It shall have full run and stand by capabilities with redundant pumps. It shal have internalmanifold with leak free quick release couplings. It shall have a auto fill and bleed off connection. FUll alarm monitoring and connectivity to MODBUS. Complete in all respect. **(This is an optional item)**	Nos	8
20	Structural steel such as Channel, Angles, Plates, I section, Beam section etc with two coats of red oxide and two coats of synthetic enamale quick drying paint. The colour shall be approved by the Architect.	Ton	5

	TOTAL VALUE FOR CHILLED WATER PIPING		
21	**ELECTRIFICATION WORK**		
21.1	Electrical Panel No 1 - 3 : Chiller panel		
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,400 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication,and BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	3
	Outgoing Feeder:- As per SLD		
21.2	Electrical Panel No 4 - 7, Chiller Pump panel		
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,40 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication, BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	4
	Outgoing Feeder:- As per SLD		
21.3			
	Electrical Panel No 8, Pump Panel		
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,40 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	1
	Outgoing Feeder:- As per SLD		
21.4	Electrical Panel No 9-11, PAC panel.		

	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,100 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication, BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	1
	Outgoing Feeder:- As per SLD		
22	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)		
22.3.1	50mm, 50x50 perforated tray. (16 SWG)	Rmt.	
22.3.2	100mm, 50x50 perforated tray. (16 SWG)	Rmt.	
22.3.3	150mm, 50x50 perforated tray. (16 SWG)	Rmt.	
22.3.4	200mm, 50x50 perforated tray. (16 SWG)	Rmt.	
22.3.5	300 mm, 50x50 perforated tray. (14 SWG)	Rmt.	
22.3.6	450 mm, 50x50 perforated tray. (14 SWG)	Rmt.	65
22.3.7	600 mm, 50x50 perforated tray. (14 SWG)	Rmt.	50
22.3.8	450 mm, 75x75 Ladder tray. (14 SWG)	Rmt.	
22.3.9	600 mm, 75x75 Ladder tray. (14 SWG)	Rmt.	75
22.3.10	750 mm, 75x75 Ladder tray. (14 SWG)	Rmt.	
23	Cable Tray Covers suitable for following size trays		
23.4.1	50mm perforated tray.	Rmt.	R.O.
23.4.2	100mm perforated tray.	Rmt.	R.O.
23.4.3	150mm perforated tray.	Rmt.	R.O.
23.4.4	200mm, perforated tray.	Rmt.	R.O.
23.4.5	300 mm perforated tray.	Rmt.	R.O.
23.4.6	450 mm perforated tray.	Rmt.	R.O.
24	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Actual cable lengths shall be measured at site prior to procurement.)**		
24.6.1	3.5C x 400 Sq.mm. A2XFY Cable.	Rmt.	
24.6.2	3.5C x 300 Sq.mm. A2XFY Cable.	Rmt.	400
24.6.3	3.5C x 240 Sq.mm. A2XFY Cable.	Rmt.	
24.6.4	3.5C x 185 Sq.mm. A2XFY Cable.	Rmt.	
24.6.5	3.5C x 150 Sq.mm. A2XFY Cable.	Rmt.	
24.6.6	3.5C x 120 Sq.mm. A2XFY Cable.	Rmt.	
24.6.7	3.5C x 95 Sq.mm. A2XFY Cable.	Rmt.	
24.6.8	3.5C x 70 Sq.mm. A2XFY Cable.	Rmt.	
24.6.9	3.5C x 50 Sq.mm. A2XFY Cable.	Rmt.	375

24.6.10	3.5C x 35 Sq.mm. A2XFY Cable.	Rmt.	
24.6.11	3.5C x 25 Sq.mm. A2XFY Cable.	Rmt.	
24.6.12	4C x 25 Sq.mm. AYFY Cable.	Rmt.	
24.6.13	4C x 10 Sq.mm. YWY Cable.	Rmt.	
24.6.14	4C x 16 Sq.mm. YWY Cable.	Rmt.	350
24.6.15	4C x 6 Sq.mm. YWY Cable.	Rmt.	
24.6.16	4C x 4 Sq.mm. YWY Cable.	Rmt.	
24.6.17	4C x 2.5 Sq.mm. AYFY Cable.	Rmt.	600
24.6.18	3C x 6 Sq.mm. YWY Cable.	Rmt.	
24.6.19	3C x 4 Sq.mm. YWY Cable.	Rmt.	
24.6.20	3C x 2.5 Sq.mm. YWY Cable.	Rmt.	
25	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
25.7.1	3.5C x 70 Sq.mm. A2XFY Cable.	Nos	
25.7.2	3.5C x 50 Sq.mm. A2XFY Cable.	Nos	12
25.7.3	3.5C x 35 Sq.mm. A2XFY Cable.	Nos	
25.7.4	3.5C x 25 Sq.mm. A2XFY Cable.	Nos	
25.7.5	4C x 16 Sq.mm. AYFY Cable.	Nos	
25.7.6	4C x 10 Sq.mm. YWY Cable.	Nos	
25.7.7	4C x 16 Sq.mm. YWY Cable.	Nos	8
25.7.8	4C x 4 Sq.mm. YWY Cable.	Nos	
25.7.9	4C x 2.5 Sq.mm. YWY Cable.	Nos	8
25.7.10	3C x 6 Sq.mm. YWY Cable.	Nos	
25.7.11	3C x 4 Sq.mm. YWY Cable.	Nos	
25.7.12	3C x 2.5 Sq.mm. YWY Cable.	Nos	
26	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.		
26.8.1	3.5C x 400 Sq.mm. A2XFY Cable.	Nos	
26.8.2	3.5C x 300 Sq.mm. A2XFY Cable.	Nos	16
26.8.3	3.5C x 240 Sq.mm. A2XFY Cable.	Nos	
26.8.4	3.5C x 185 Sq.mm. A2XFY Cable.	Nos	
26.8.5	3.5C x 150 Sq.mm. A2XFY Cable.	Nos	
26.8.6	3.5C x 120 Sq.mm. A2XFY Cable.	Nos	
26.8.7	3.5C x 95 Sq.mm. A2XFY Cable.	Nos	
27	Supply, laying and connection of copper earthing 25mm x 3mm thick copper strip.	Rmt	150
	TOTAL VALUE FOR ELECTRIFICATION WORK		

HVAC Works for UPS Room

Sl.No	Description of Work	Unit	Qty
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '		
1	The system should be with necessary IDU's & ODU's. Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type. The refrigerate shall be R407 C, R 410 A only.		
	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refrigerant Charge as per piping Installation, IDU & ODU Supports (ODU Support with painted MS Channel of sufficient size). The unit shall be with necessary corded remote and the holder for the same.		
1.1	10 TR / 4000 CFM Capacity	Nos	4
	EER ratio (To be Furnished with technical bid)		
2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclusive of necessary Supports as per standard practices.		
	Gas Line (inch.) Liquid Line (inch.)		
2.1	41.3 19.1	RMT	R.O.
2.2	34.9 19.1	RMT	R.O.
2.3	34.9 15.9	RMT	100
2.4	28.6 12.7	RMT	R.O.
2.4	19.1 12.7	RMT	R.O.
2.5	12.7 6.4	RMT	R.O.
2.6	15.9 6.4	RMT	R.O.
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	135
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	15
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.		
5.1	50 mm dia.	Rmt.	0
5.2	40 mm dia.	Rmt.	20
5.3	25 mm dia.	Rmt.	40

6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make. inclusive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.		
6.1	18 guage	SQM	R.O
6.2	20 guage	SQM	R.O.
6.3	22 guage	SQM	R.O.
6.4	24 guage	SQM	40
7	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	2
8	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1
9	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 2 W + 2 SB. Each unit shall run for 8 hrs.	Nos	1
10	Supply ,Installation And commissioning of following Hi-wall Type Split Units including indoor - Outdoor Combination, Refrigerent piping and Interconnecting control cabling of 15 Mtr. length, Refergerant Charge as per piping Insttalation, Automatic Timer of 4 Hrs. Cycle, IDU & ODU Supports as per std. Practice, And must be atleast 5- Star rated	Nos	2
10.1	1.5 TR High Wall Unit (1W+1 SB) BMS Room		
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")		

HVAC Works for Battery Room

Sl.No	Description of Work	Unit	Qty
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '		
1	The system should be with necessary IDU's & ODU's. Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type.The refrigerat shall be R407 C, R 410 Aonly.		

	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refergerant Charge as per piping Insttalation, IDU & ODU Supports (ODU Support with painted MS Channel of suffient size). The unit shall be with necessary corded remote and the holder for the same.		
1.1	5 TR / 2000 CFM Capacity	Nos	2
	EER ratio (To be Furnished with technical bid)		
2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclussive of necessary Supports as per standard practices.		
	Gas Line (inch.) Liquid Line (inch.)		
2.1	41.3 19.1	RMT	R.O.
2.2	34.9 19.1	RMT	R.O.
2.3	28.6 15.9	RMT	R.O.
2.4	28.6 12.7	RMT	R.O.
2.4	19.1 12.7	RMT	50
2.5	12.7 6.4	RMT	R.O.
2.6	15.9 6.4	RMT	R.O.
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	50
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	5
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.		
5.1	50 mm dia.	Rmt.	R.O
5.2	40 mm dia.	Rmt.	20
5.3	25 mm dia.	Rmt.	R.O
6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.		
6.1	18 guage	SQM	R.O
6.2	20 guage	SQM	R.O.
6.3	22 guage	SQM	R.O.
6.4	24 guage	SQM	15

7	Door Louver in extruded AL consutruction. The Grill shall be powder coated. The color shall be approved by the architect / consulting engineer before the delivery at site.	SQM	0.5
8	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	1
9	Propeller fan of capacity 500 CFM for exhaust. The fan shall be Industrial type and shall have safety grill at inlet and mesh at outlet to prevent any bird entry. 4 P, 1400 RPM, single phase, Motor IP 54 Protection, F Class insulation, Motor 0.12 KW (For Batery room Exhaust provision)	Nos	1
10	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1
11	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 1W + 1 SB. Each unit shall run for 8 hrs.	Nos	1
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")		

HVAC Works for Electrical Room

Sl.No	Description of Work	Unit	Qty
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '		
1	The system should be with necessary IDU's & ODU's.Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type.The refrigerat shall be R407 C, R 410 Aonly.		
	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refergerant Charge as per piping Insttalation, IDU & ODU Supports (ODU Support with painted MS Channel of suffient size). The unit shall be with necessary corded remote and the holder for the same.		
1.1	10 TR / 4000 CFM Capacity	Nos	2
	EER ratio (To be Furnished with technical bid)		

2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclussive of necessary Supports as per standard practices.		
	Gas Line (inch.) Liquid Line (inch.)		
2.1	41.3 19.1	RMT	R.O.
2.2	34.9 19.1	RMT	R.O.
2.3	34.9 15.9	RMT	50
2.4	28.6 12.7	RMT	R.O.
2.4	19.1 12.7	RMT	R.O.
2.5	12.7 6.4	RMT	R.O.
2.6	15.9 6.4	RMT	R.O.
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	50
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	5
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.		
5.1	50 mm dia.	Rmt.	R.O
5.2	40 mm dia.	Rmt.	20
5.3	25 mm dia.	Rmt.	R.O
6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.		
6.1	18 guage	SQM	R.O
6.2	20 guage	SQM	R.O.
6.3	22 guage	SQM	R.O.
6.4	24 guage	SQM	20
7	Door Louver in extruded AL consutruction. The Grill shall be powder coated. The color shall be approved by the architect / consulting engineer before the delivery at site.	SQM	0.5
8	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	2

9	Propeller fan of capacity 250 CFM for Fresh AIr. The fan shall be Industrial type and shall have safety grill at inlet and mesh at outlet to prevent any bird entry. 4 P, 1400 RPM, single phase, Motor IP 54 Protection, F Class insulation, Motor 0.12 KW (For Electrical room FA provision)	Nos	1
10	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1
11	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 1W + 1 SB. Each unit shall run for 8 hrs.	Nos	1
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")		

The following reference drawings are attached.

S.NO.	DRG.NO.	DESCRIPTION
1	IITM_DC_TD_HVAC_101	Electrical SLD
2	IITM_DC_TD_HVAC_102	P & ID For Chilled Water
3	IITM_DC_TD_HVAC_103	First Floor Section
4	IITM_DC_TD_HVAC_103	Ground Floor HVAC Layout
5	IITM_DC_TD_HVAC_FP01	First Floor HVAC Layout
6	IITM_DC_TD_HVAC_FP02_A	First Floor Under Floor Layout
7	IITM_DC_TD_HVAC_100	Chiller Yard layout

PRECISION AIR CONDITIONER

GENERAL

1.1 Introduction

These specifications describe requirements for a Precision Cooling system. The system shall be designed to control temperature and humidity conditions in rooms containing server, with good insulation and vapor barrier. The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation requirements of the room.

Site Condition:

- Location : Pune
- Altitude : 630 M from MSL
- Temperature Condition

	Summer				Mosoon				Winter			
CONDITIO	DBT	WBT	%RH	Gr/Lb	DBT	WBT	%RH	Gr/Lb	DBT	WBT	%RH	Gr/Lb
Outside	104	76	28	90	83	79	82	144	50	42	50	26
Inside	71.6	61.5	55	62	71.6	61.5	55	62	71.6	61.5	55	62

Design Requirements

The Precision Cooling system shall be a self-contained, factory-assembled unit with down flow air delivery. The unit shall have a Sensible cooling capacity of 28 TR with a net sensible cooling capacity of 0.95 percent of total cooling capacity based on an entering air temperature of 75.2 °F dry bulb, 50% RH and 104 °F ambient. The unit is to be supplied with 440 volt 3 ph 50 Hz electrical service. Net capacities shall include losses due to fan motor heat.

CONSTRUCTION FEATURES: Frame

The unit construction shall be enable access to all the main components of the machine **from the front** for installation purposes and routine servicing. With this feature, the machines can be installed **side by side**, or in between cabinets for other technical applications (racks). Outside panels shall be coated with grey epoxy-polyester paint, which guarantees the long-term durability of their original features. The front panels are attached to the framework by means of rapid-coupling "fasteners". The standard panels are lined on the inside with heat- and sound-proofing insulation to class 1.

Down flow Air Supply

The supply air shall exit from the bottom of the unit with the air scrolled towards the bottom of the unit.

Down flow Air Return

The return air shall enter the unit from the top through ducting connected to false ceiling.

Exterior Panels

The main unit color shall be Grey or Black.

Double-Skin Panels (Optional)

The exterior panels shall be internally lined with 20 gauge sheet metal, sandwiching the insulation between the panels, for easy cleaning.

Filters, Down flow Unit

Air filters of box type, made of self-extinguishing, artificial-fiber cellular material. The frame containing the filter material is made of metal. Low airflow and clogged filter alarm sensors consisting of two pressure switches for controlling the operating conditions of the fans and the build-up of dirt on the air filters inside the unit. The filters shall be placed directly above the cooling coil / evaporator & be fully accessible from the front of the PAC.

Filter efficiency should be 95% down to 5 microns

Extra Filter Set

Commissioning filters should be provided for the initial working in dirty room conditions.

Blower Section

The blower section shall be designed for 16500 CFM at an external static pressure of 0.2 in. wg. The fans shall be the centrifugal type, single inlet and shall be dynamically balanced as a completed assembly. The motor should be Electronically Commutated type with IP44 protection with reputed make. The unit should be able to maintain a constant static pressure in the floor to ensure constant airflow from all the grills at varying load demands.

The fans shall draw air through a Flat coil to ensure even air distribution and maximum coil performance. A static regain duct shall be factory-installed to the bottom of the blower.

Motor

The fan motor shall be EC type, and directly mounted on the blower fan. The motor shall be removable from the front of the cabinet.

Humidifier

An immersed electrode humidifier shall be factory-installed inside the unit. Bypass air slots shall be included to enable moisture to be absorbed into the air stream. The humidifier capacity shall be suitable to the unit. The humidifier shall be removable from the front of the cabinet. Electrodes should be cleanable type.

Dehumidification

Removal of excess moisture should be done without reducing the airflow from the unit or without bypassing any air through the coil without cooling. This minimizing the amount of time

required to dehumidify.

Reheat

The environmental control unit shall include a factory-installed reheat to control temperature during dehumidification and during low room load. The heater bank should be with Aluminium finned heating element, and to work in 3 Steps to give a heating capacity of 9 KW minimum.

Heaters should be complete with safety thermostat for manual resetting to cut off the power supply and trigger the alarm in the event of overheating

Dual Refrigeration System

Each unit shall include two (2) independent refrigeration circuits, liquid line filter driers, Electronic expansion valves and liquid line solenoid valves. Compressors shall be located outside the airstream and shall be removable and serviceable from the front of the unit. Each circuit should have step control using variable capacity compressor or multiple compressors. This will also improve energy efficiency of the unit.

Scroll Compressors

The compressor shall be scroll-type of reputed make. The compressor shall be suction gas cooled motor, vibration isolators, thermal overloads, automatic reset high pressure switch with lockout after three failures, rotalock service valves, pump down low pressure transducer, suction line strainer, and a maximum operating speed of 2900 RPM.

Input kw/TR of the compressor should be lower at part load condition of 50% than similar values of 100%.

Evaporator Coil

The evaporator coil shall be flat design and have sufficient sq. ft. face area to produce the required **Sensible** cooling demand, three/four rows deep. It shall be constructed of rifled copper tubes and aluminum fins and have a maximum face velocity of 2.8M/Sec for 16500 CFM. A stainless steel condensate drain pan shall be provided covering the entire portion of the evaporator section. **Evaporator must be with blue fin coating.**

Expansion Valve

The expansion device must be of **Electronic Expansion valve** in order to set and meet exact superheat in the circuit. It should have minimum 1000 steps. EXV must be controlled through microprocessor. **Conventional Thermostatic Valve is not acceptable.**

Liquid receiver with safety plug installed inside the unit (in the air-cooled DX versions) in must.

Refrigerant

The system shall be designed for use with R-407C/R410 refrigerant, which meets the EPA clean air act for phase out of HCFC refrigerants.

Microprocessor Control With Small Graphic Display (HMI)

The control unit shall be factory-set for Intelligent Control which uses PID logic. It should have graphic display with keys to check the status and set the parameters in the unit.

Sequential Load Activation - On initial startup or restart after power failure, each operational load is sequenced with a minimum of one second delay to minimize total inrush current.

The system shall display user menus for: active alarms, event log, unit view/status overview (including the monitoring of room conditions, operational status in % of each function, date and time), total run hours, various sensors, display setup and service contacts. A password shall be required to make system changes within the service menus. Service menus shall include: set points, standby settings (lead/lag), timers/sleep mode, alarm setup, sensor calibration, options setup, system/network setup, auxiliary boards and diagnostics/service mode. A password shall be required to access the advanced menus, which include the factory settings and password menus.

Individual machine should have individual controller.

RS485 serial adapter for data transfer to a central supervisor system with STD protocol or MODBUS protocol;

WATER LEAK DETECTOR comprising a control module installed on the electric switchboard and an external sensor.

Power ON after power back- Unit should be able to start the cooling delivery within __ minutes after resuming the power. Unit should also have the option to power the controller and EC fans through UPS power source during power failure.

Smoke Sensor

The smoke sensor shall immediately shut down the environmental control system and activate the alarm system when activated. The smoke sensor shall be mounted in the electrical panel with the sensing element in the return air compartment. The smoke sensor is not intended to function as or replace any room smoke detection system that may be required by local or national codes. The smoke sensor shall include supervision contact closure.

Air-Cooled Systems

The indoor evaporator unit shall include refrigerant piping, with a factory holding charge of nitrogen. The hot-gas and liquid lines shall be spun shut and shall include a factory-installed Schrader valve. Field relief of the Schrader valve shall indicate a leak-free system.

Air-Cooled Condenser

The outdoor air-cooled condenser shall be the low profile, multiple direct drive, propeller fan type. The condenser shall balance the heat rejection of the compressor at 104 °F ambient. The condenser shall be constructed of aluminum and contain a copper tube, aluminum fin coil arranged for (horizontal)/Vertical air discharge. **The condenser must have fan speed controller in order to maintain the head during low ambient temperature.**

INSTALLATION OF PRECISION AIR CONDITIONING UNITS General

Install precision air conditioning units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.

Electrical Wiring

Install and connect electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's electrical connection diagram submittal to electrical contractor.

Piping Connections
Install and connect devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of
manufacturer's piping connection diagram submittal to your piping contractor.

Field Quality Control
Start up cooling units in accordance with manufacturer's startup instructions. Test controls and demonstrate compliance with requirements. These specifications describe requirements for a CTP room environmental control system. The system shall be designed to maintain temperature and humidity conditions in the rooms containing electronic equipment.

The manufacturer shall design and furnish all equipment to be fully compatible with heat dissipation
Requirements

Vendor do the erection of the Air Handling Unit at site at specified locations. The lifting shifting activity shall not be considered in the scope of installation. It shall be only an assembly activity to be conducted at site.

UTILITIES AVAILABLE AT BATTERY LIMIT:

Electrical Supply	:	415V, 3 Phase 50Hz
Medium	:	Water, Available at 32 Deg C.

EXCLUSIONS:

The following items shall be excluded from the scope of supply of the equipment supplier:

a) All kinds of Civil works including foundation. (Supplier shall give Foundation details)
b) Laying and termination of power cable to MCC cum Control Panel. c) Piping and Ducting beyond the specified battery limits.

GUARANTEE:

The Precision climate control Unit shall be guaranteed for satisfactory performance at specified conditions and rating. All components shall be warranted against faulty design, defective or improper materials poor workmanship or failure from normal use during the guarantee period.

The system supplied shall be warranted for trouble free operation for 12 Months from the date of commissioning.

All guarantees from equipment suppliers will be vested in the client.

Warrantes will be full guarantees & will include all overhead, profit, incidental charges and sundries. Where damage is caused to any other item by any failure of the item guaranteed, then the guarantee shall also include the costs incurred in rectifying that damage.

Documentations (While Offer submission)

- Technical Datasheets.
- Deviation to the specification, if any.

Documentations (After award of Contract)

- General Arrangement drawings.
- Quality Assurance Plan.

Recommended Make :

1. **Uniflair**
2. **Stoolz**
3. **Blue Box**
4. **Aire Dale**

BoQ

Sl.No	Description of Work	Unit	Qty
1	Supply of Precision AC as per the technical specification. (2W+1SB)		
1.1	30 TR Net Cooling Capacity	Nos	3
	EER ratio (To be Furnished with technical bid)		
2	Refrigerant Piping as per manufacturing standard with armaflex 25 mm thk rubber nitrile insulation. The distance between the IDU and ODU shall be 20 RMT ea only.	LOT	1
	-		
3	PVC drain piping. Insulated with 13 mm rubber nitrile armaflex insulation. The pipe shall be of finolex make only.		
3.1	40 mm	RMT	80
4	GI Class B, ERW pipe for fresh water		
4.1	25 NB	RMT	60
5	Refrigerant gas R 407 C as per manufacturers specification and quantity	LOT	3
6	Deep pleated 4" filters with an ASHRAE 52.2 MERV 8 rating (Spare)	Lot	3
8	Fan Aided Floor Grills in front of Tape Library (600x600mm). To be used as floor diffuser in powder coated MS construction. The Diffuser shall be able to take a load of 1000 Kg UDL. The top shall have an anti static coating.	Nos	14
9	SITC of GI Ducting (180 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.		
9.1	18 guage	SQM	R.O
9.2	20 guage	SQM	R.O.
9.3	22 guage	SQM	R.O.
9.4	24 guage	SQM	20
10	SITC of Aluminum eggcrate powder coated return air grill with aluminum border and grid in in ½ x ½ x ½-inch sizes.		
10.1	600 mm X 600 mm	Nos	R.O.
	TOTAL VALUE FOR PAC		

SPECIAL CONDITIONS AND TECHNICAL

SPECIFICATION FOR BMS

1. FIRE DETECTION AND ALARM SYSTEM WITH INTEGRATED VOICE EVACUATION

1.1. DESCRIPTION:

1.1.1. This section of the specification includes the furnishing, installation, and Connection of an intelligent reporting, microprocessor controlled, addressable, fire detection and emergency voice alarm communication system. It shall include, but not be limited to, alarm initiating devices, alarm notification appliances, control panels, auxiliary control devices, annunciators, power supplies, and wiring as shown on the drawings and specified herein.

1.1.2. The fire alarm system shall comply with requirements of NFPA Standard 72 for Protected Premises Signaling Systems except as modified and supplemented by this specification. The system shall be electrically supervised and monitor the integrity of all conductors.

1.1.3. The system shall be an active/interrogative type system where each addressable device is repetitively scanned, causing a signal to be transmitted to the main fire alarm control panel (FACP) indicating that the device and its associated circuit wiring is functional. Loss of this signal at the main FACP shall result in a trouble indication as specified hereinafter for the particular input.

1.1.4. The facility shall have an emergency voice alarm communication system. Digitally stored message sequences shall notify the building occupants that a fire or life safety condition has been reported. Message generator(s) shall be capable of automatically distributing up to eight (8) simultaneous, unique messages to appropriate audio zones within the facility based on the type and location of the initiating event. The Fire Command Center (FCC) shall also support Emergency manual voice announcement capability for both system wide or selected audio zones, and shall include provisions for the system operator to override automatic messages system wide or in selected zones.

1.1.5. The system shall be support additional, alternate Fire Command Centers, which shall be capable of simultaneous monitoring of all system events. Alternate Fire Command Centers shall also support an approved method of transferring the control functions to an alternate Fire Command Center when necessary. All Fire Command Centers shall be individually capable of assuming Audio Command functions such as Emergency Paging, audio zone control functions, and Firefighter's Telephone communication functions.

1.1.6. Each designated zone shall transmit separate and different alarm, supervisory and trouble signals to the Fire Command Center (FCC) and designated personnel in other buildings at the site via a multiplex communication network.

1.1.7. The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

1.1.8. The system and its components shall be Underwriters Laboratories, Inc. listed under the appropriate UL testing standard as listed herein for fire alarm applications and the installation shall be in compliance with the UL listing.

1.2. SCOPE:

1.2.1. A new intelligent reporting, microprocessor controlled fire detection system shall be installed in accordance with the specifications and drawings.
1.2.2. The system shall be designed such that each signaling line circuit (SLC) is limited to only 80% of its total capacity at initial installation.
1.2.3. Initiation Device Circuits (IDC) shall be wired Class A (NFPA Style D) as part of an addressable device connected by the SLC Circuit.
1.2.4. On Style 6 or 7 (Class A) configurations a single ground fault or open circuit on the system Signaling Line Circuit shall not cause system malfunction, loss of operating power or the ability to report an alarm.
1.2.5. Alarm signals arriving at the FACP shall not be lost following a primary power failure (or outage) until the alarm signal is processed and recorded.
1.2.6. Speaker circuits may be controlled by NAC outputs built into the amplifiers, which shall function as addressable points on the Digital Audio Loop.
1.2.7. Notification Appliance Circuits (NAC) speaker circuits shall be arranged such that there is a minimum of one speaker circuit per floor of the building or smoke zone which ever is greater.
1.2.8. Audio amplifiers and tone generating equipment shall be electrically supervised for normal and abnormal conditions.
1.2.9. Notification Appliance Circuits (NAC) speaker circuits and control equipment shall be arranged such that loss of any one (1) speaker circuit will not cause the loss of any other speaker circuit in the system.
1.2.10. Two-way emergency telephone communication circuits shall be supervised for open and short circuit conditions.
1.2.11. Speaker circuits shall be arranged such that there is a minimum of one speaker circuit per smoke zone.
1.2.12. Speaker circuits shall be electrically supervised for open and short circuit conditions. If a short circuit exists on a speaker circuit, it shall not be possible to activate that circuit.
1.2.13. Audio amplifiers and tone generating equipment shall be electrically supervised for abnormal conditions. Digital amplifiers shall provide built-in speaker circuits, field configurable as four Class B (Style Y), or two Class A (Style Z) circuits.
1.2.14. Digital amplifiers shall be capable of storing up to two minutes of digitally recorded audio messages and tones. The digital amplifiers shall also be capable of supervising the connection to the associated digital message generator, and upon loss of that connection shall be capable of one of the following system responses:

a. The digital amplifier shall automatically broadcast the stored audio message.

b. The digital amplifier shall switch to a mode where a local bus input on the digital amplifier will accept an input to initiate a broadcast of the stored message. This bus input shall be connected to a NAC on a local FACP for the purpose of providing an alternate means of initiating an emergency message during a communication fault condition.

c. Speaker circuits shall be either 25 VRMS or 70VRMS. Speaker circuits shall have 20% space capacity for future expansion or increased power output requirements.

d. Two-way emergency telephone (Fire Fighter Telephone) communication shall be

supported between the Audio Command Center and up to seven (7) remote Fire Fighter's Telephone locations simultaneously on a telephone riser.

e. Means shall be provided to connect FFT voice communications to the speaker circuits in order to allow voice paging over the speaker circuit from a telephone handset.

f. The digital audio message generator shall be of reliable, non-moving parts, and support the digital storage of at least 16 or 32 minutes of tones and emergency messages, shall support programming options to string audio segments together to create up to 1000 messages, or to loop messages and parts of messages to repeat for pre-determined cycles or indefinitely.

1.2.15. Basic System Functional Operation

When a fire alarm condition is detected and reported by one of the system initiating devices, the following functions shall immediately occur:

1. The System Alarm LED shall flash.

2. A local piezo electric signal in the control panel shall sound.

3. The 640-character LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.

4. Printing and history storage equipment shall log the information associated each new fire alarm control panel condition, along with time and date of occurrence.

5. All system output programs assigned via control-by-event interlock programming to be activated by the particular point in alarm shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.

6. The audio portion of the system shall sound the proper audio signal (consisting of tone, voice, or tone and voice) to the appropriate zones.

1.3. APPLICABLE PUBLICATIONS:

The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only.

A. National Fire Protection Association (NFPA) - USA:

No. 70	National Electric Code (NEC)
No. 72-1996	National Fire Alarm Code
No. 90A	Air Conditioning Systems
No. 92A	Smoke Control Systems
No. 92B	Smoke Management Systems in Malls, Atria, Large Areas

No. 101 Life Safety Code

B. Underwriters Laboratories Inc. (UL) - USA:

No. 50 Cabinets and Boxes

No. 268 Smoke Detectors for Fire Protective Signaling Systems

No. 864 Control Units for Fire Protective Signaling Systems

No. 268A Smoke Detectors for Duct Applications.

No. 521 Heat Detectors for Fire Protective

No. 228 Door Closers-Holders for Fire Protective Signaling Systems.

No. 464 Audible Signaling Appliances.

No. 38 Manually Actuated Signaling Boxes.

No. 346 Waterflow Indicators for Fire Protective Signaling Systems.

No. 1481 Power supplies for Fire Protective Signaling Systems.

No. 1076 Control Units for Burglar Alarm Proprietary Protective Signaling Systems.

No. 1971 Visual Notification Appliances.

APPROVALS:

A. The system shall have proper listing and/or approval from the following nationally recognized agencies:

UL Underwriters Laboratories Inc

ULC Underwriters Laboratories Canada

B. The Fire Alarm Control Panel and all transponders shall meet the modular listing requirements of the ninth edition of UL Standard 864 (Control Units). Each subassembly, including all printed circuits, shall include the appropriate UL 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.

1.4. EQUIPMENT AND MATERIAL, GENERAL:

1.4.1. All equipment and components shall be new, and 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.

1.4.2. 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.

1.4.3. 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.

1.4.4. CONDUIT AND WIRE:

A. Conduit:

1. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

2. Where possible, all wiring shall be installed in conduit or raceway. Conduit fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single conduit.

3. Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, as per NEC Article 760-29.

4. Wiring for 24 volt control, alarm notification, emergency communication and similar power-limited auxiliary functions may be run in the same conduit as initiating and signaling line circuits. All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.

5. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or backboxes, except where conduit entry is specified by the FACP manufacturer.

6. Conduit shall be 3/4 inch (19.1 mm) minimum.

B. Wire:

1. All fire alarm system wiring must be new.

2. Wiring shall be in accordance with local, state and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line

circuits, and 14 AWG (1.63 mm) for notification appliance circuits.

3. All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signaling system.

4. Wire and cable not installed in conduit shall have a fire resistance rating suitable for the installation as indicated in NFPA 70 (e.g., FPLR).

5. The system shall permit the use of IDC and NAC wiring in the same conduit with the multiplex communication loop.

6. All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.

7. All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate cross talk.

C. Terminal Boxes, Junction Boxes and Cabinets:

All boxes and cabinets shall be UL listed for their intended purpose.

D. Initiating circuits shall be arranged to serve like categories (manual, smoke, waterflow). Mixed category circuitry shall not be permitted except on signaling line circuits connected to intelligent reporting devices.

E. The fire alarm control panel shall be connected to a separate dedicated branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold water pipe or grounding rod.

1.4.5. MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

1.4.5.1. The main FACP Central Console shall contain a microprocessor based Central Processing Unit (CPU). The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, control circuits, and notification appliance circuits, local and remote operator terminals, printers, annunciators, and other system controlled devices.

1.4.5.2. In conjunction with intelligent Loop Control Modules and Loop Expander Modules, the main FACP shall perform the following functions:

- Supervise and monitor all intelligent addressable detectors and monitor modules connected to the system for normal, trouble and alarm conditions.
- Supervise all initiating signaling and notification circuits throughout the facility by way of connection to addressable monitor and control modules.

- Detect the activation of any initiating device and the location of the alarm condition. Operate all notification appliances and auxiliary devices as programmed. In the event of CPU failure, all SLC loop modules shall fallback to degrade mode. Such degrade mode shall treat the corresponding SLC loop control modules and associated detection devices as conventional two-wire operation. Any activation of a detector in this mode shall automatically activate associated Notification Appliance Circuits.
- Visually and audibly annunciate any trouble, supervisory, security or alarm condition on operator's terminals, panel display, and annunciators.
- When a fire alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
  - The system alarm LED shall flash.
  - A local piezo-electric audible device in the control panel shall sound a distinctive signal.
  - The 640-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
  - Printing and history storage equipment shall log and print the event information along with a time and date stamp.
  - All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- When a supervisory condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
  - The system trouble LED shall flash.
  - A local piezo-electric audible device in the control panel shall sound a distinctive signal.
  - The 640-character backlit LCD display shall indicate all information associated with the supervisory condition, including the type of trouble point and its location within the protected premises.
  - Printing and history storage equipment shall log and print the event information along with a time and date stamp.
  - All system outputs assigned via preprogrammed equations for a particular point in trouble shall be executed, and the associated system outputs (notification appliances and/or relays) shall be activated.
- When a security alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:
  - The system security LED shall flash.
  - A local piezo-electric audible device in the control panel shall sound a distinctive signal.
  - The 640-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
  - Printing and history storage equipment shall log and print the event information along with a time and date stamp.
  - All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.
- When a pre-alarm condition is detected and reported by one of the system initiating devices or appliances, the following functions shall immediately occur:

- The system pre-alarm LED shall flash.
- A local piezo-electric audible device in the control panel shall sound a distinctive signal.
- The 640-character backlit LCD display shall indicate all information associated with the fire alarm condition, including the type of alarm point and its location within the protected premises.
- Printing and history storage equipment shall log and print the event information along with a time and date stamp.
- All system outputs assigned via preprogrammed equations for a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated

1.4.5.3. Operator Control

1. Acknowledge Switch:

   a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition. In addition, the FACP shall support Block Acknowledge to allow multiple trouble conditions to be acknowledged with a single depression of this switch.

   b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

2. Signal Silence Switch:

   a. Depression of the Signal Silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition. The selection of notification circuits and relays that are silence able by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.

3. Drill Switch:

   a. Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

4. System Reset Switch:

   a. Depression of the System Reset switch shall cause all electronically latched initiating devices to return to their normal condition. Initiating devices shall re-report if active. Active notification appliance circuits shall not silence upon Reset. Systems that de-activate and subsequently re-activate notification appliance circuits shall not be considered equal. All programmed Control-By-Event equations shall be re-evaluated after the reset sequence is complete if the initiating condition has cleared. Non-latching trouble conditions shall not clear and re-report upon reset.

5. Lamp Test:

a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

6. Scroll Display Keys:
   a. There shall be Scroll Display keys for FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. Depression of the Scroll Display key shall display the next event in the selected queue allowing the operator to view events by type.
7. Print Screen:
   1. Depression of the PRINT SCREEN switch shall send the information currently displayed on the 640-character display to the printer.

1.4.5.4. System Capacity and General Operation

1.1. The control panel shall be capable of expansion via up to 10 SLC modules. Each module shall support a maximum of 318 analog/addressable devices for a maximum system capacity of 3180 points. The system shall be capable of 3072 annunciation points per system regardless of the number of addressable devices.

1.2. The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a backlit 640-character liquid crystal display, individual, color coded system status LEDs, and an alphanumeric keypad for the field programming and control of the fire alarm system. Said LCD shall also support graphic bit maps capable of displaying the company name and logo of either the owner or installing company.

1.3. All programming or editing of the existing program in the system shall be achieved without special equipment and without interrupting the alarm monitoring functions of the fire alarm control panel.

1.4. The FACP shall be able to provide the following software and hardware features:

1.4.1. Pre-signal and Positive Alarm Sequence: The system shall provide means to cause alarm signals to only sound in specific areas with a delay of the alarm from 60 to up to 180 seconds after start of alarm processing. In addition, a Positive Alarm Sequence selection shall be available that allows a 15-second time period for acknowledging an alarm signal from a fire detection/initiating device. If the alarm is not acknowledged within 15 seconds, all local and remote outputs shall automatically activate immediately.

1.4.2. Smoke Detector Pre-alarm Indication at Control Panel: To obtain early warning of incipient or potential fire conditions, the system shall support a programmable option to determine system response to real-time detector sensing values above the programmed setting. Two levels of Pre-alarm indication shall be available at the control panel: alert and action.

1.4.3. Alert: It shall be possible to set individual smoke detectors for pre-programmed pre-alarm thresholds. If the individual threshold is reached, the pre-alarm condition shall be activated.

1.4.4. Action: If programmed for Action and the detector reaches a level exceeding the pre-programmed level, the control panel shall indicate an action condition. Sounder bases installed with either heat or smoke detectors shall automatically activate on action Pre-Alarm level, with general evacuation on Alarm level.

1.4.5. The system shall support a detector response time to meet world annunciation requirements of less than 3 seconds.

1.4.6. Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

1.4.7. NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meet the requirements of NFPA 72.

1.4.8. Programmable Trouble Reminder: The system shall provide means to automatically initiate a reminder that troubles exist in the system. The reminder will appear on the system display

and (if enabled) will sound a piezo alarm.

1.4.9. On-line or Off-line programming: The system shall provide means to allow panel programming either through an off-line software utility program away from the panel or while connected and on-line. The system shall also support upload and download of programmed database and panel executive system program to a Personal Computer/laptop.

1.4.10. History Events: The panel shall maintain a history file of the last 4000 events, each with a time and date stamp. History events shall include all alarms, troubles, operator actions, and programming entries. The control panels shall also maintain a 1000 event Alarm History buffer, which consists of the 1000 most recent alarm events from the 4000 event history file.

1.4.11. Smoke Control Modes: The system shall provide means to perform FSCS mode Smoke Control to meet NFPA-92A and 90B and HVAC mode to meet NFPA 90A.

1.4.12. The system shall provide means for all SLC devices on any SLC loop to be auto programmed into the system by specific address. The system shall recognize specific device type ID's and associate that ID with the corresponding address of the device.

1.4.13. Drill: The system shall support means to activate all silence able fire output circuits in the event of a practice evacuation or "drill". If enabled for local control, the front panel switch shall be held for a minimum of 2 seconds prior to activating the drill function.

1.4.14. Passwords and Users: The system shall support two password levels, master and user. Up to 9 user passwords shall be available, each of which may be assigned access to the programming change menus, the alter status menus, or both. Only the master password shall allow access to password change screens.

1.4.15. Two Wire Detection: The system shall support standard two wire detection devices specifically all models of System Sensor devices, Fenwal PDS-7125/7126 and CPD-7021, Hochiki model SLK-24F/24FH, Edwards 6250B/6270B and 6264B and Simplex models 2098-9201/9202 and 9576.

1.4.16. Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

1.4.17. Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

1.4.18. Environmental Drift Control: The system shall provide means for setting Environmental Drift Compensation by device. When a detector accumulates dust in the chamber and reaches an unacceptable level but yet still below the allowed limit, the control panel shall indicate a maintenance alert warning. When the detector accumulates dust in the chamber above the allowed limit, the control panel shall indicate a maintenance urgent warning.

1.4.19. Custom Action Messages: The system shall provide means to enter up to 100 custom action messages of up to 160 characters each. It shall be possible to assign any of the 100 messages to any point.

1.4.20. Print Functions: The system shall provide means to obtain a variety of reports listing all event, alarm, trouble, supervisory, or security history. Additional reports shall be available for point activation for the last Walk Test performed, detector maintenance report containing the detector maintenance status of each installed addressable detector, all network parameters, all panel settings including broad cast time, event ordering, and block acknowledge, panel timer values for Auto Silence, Silence Inhibit, AC Fail Delay time and if enabled, Proprietary Reminder, and Remote Reminder timers, supervision settings for power supply and printers, all programmed logic equations, all custom action messages, all non-fire and output activations (if pre-programmed for logging) all active points filtered by alarms only, troubles only, supervisory alarms, prealarms, disabled points and activated points, all installed points filtered by SLC points, logic zones, annunicators, releasing zones, special zones, and trouble zones.

1.4.21. Local Mode: If communication is lost to the central processor the system shall provide

added survivability through the intelligent loop control modules. Inputs from devices connected to the SLC and loop control modules shall activate outputs on the same loop when the inputs and outputs have been set with point programming to participate in local mode or when the type codes are of the same type: that is, an input with a fir alarm type code shall activate an output with a fire alarm type code.

1.4.22. Resound based on type for security or supervisory: The system shall indicate a Security alarm when a monitor module point programmed with a security Type Code activates. If silenced alarms exist, a Security alarm will Resound the panel sounder. The system shall indicate a Supervisory alarm when a monitor module point programmed with a supervisory Type Code activates. If there are silenced alarms, a Supervisory alarm will Resound the panel sounder.

1.4.23. Read status preview - enabled and disabled points: Prior to re-enabling points, the system shall inform the user that a disabled device is in the alarm state. This shall provide notice that the device must be reset before the device is enabled thereby avoiding activation of the notification circuits.

1.4.24. Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

1.4.25. Multi-Detector and Cooperating Detectors: The system shall provide means to link one detector to up to two detectors at other addresses on the same loop in cooperative multi-detector sensing. There shall be no requirement for sequential addresses on the detectors and the alarm event shall be a result or product of all cooperating detectors chamber readings.

1.4.26. Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.

1.4.27. ACTIVE EVENT: The system shall provide a Type ID called FIRE CONTROL for purposes of air-handling shutdown, which shall be intended to override normal operating automatic functions. Activation of a FIRE CONTROL point shall cause the control panel to (1) initiate the monitor module Control-by-Event, (2) send a message to the panel display, history buffer, installed printer and annunciators, (3) shall not light an indicator at the control panel, (4) Shall display ACTIVE on the LCD as well a display a FIRE CONTROL Type Code and other information specific to the device.

1.4.28. NON-FIRE Alarm Module Reporting: A point with a type ID of NON-FIRE shall be available for use for energy management or other non-fire situations. NON-FIRE point operation shall not affect control panel operation nor shall it display a message at the panel LDC. Activation of a NON-FIRE point shall activate control by event logic but shall not cause any indication on the control panel.

1.4.29. Security Monitor Points: The system shall provide means to monitor any point as a type security.

1.4.30. One-Man Walk Test: The system shall provide both a basic and advanced walk test for testing the entire fire alarm system. The basic walk test shall allow a single operator to run audible tests on the panel. All logic equation automation shall be suspended during the test and while annunciators can be enabled for the test, all shall default to the disabled state. During an advanced walk test, field-supplied output point programming will react to input stimuli such as CBE and logic equations. When points are activated in advanced test mode, each initiating event shall latch the input. The advanced test shall be audible and shall be used for pull station verification, magnet activated tests on input devices, input and output device and wiring operation/verification.

1.4.31. Control By Event Functions: CBE software functions shall provide means to program a variety of output responses based on various initiating events. The control panel shall operate CBE through lists of zones. A zone shall become listed when it is added to a point's

zone map through point programming. Each input point such as detector, monitor module or panel circuit module shall support listing of up to 10 zones into its programmed zone map.

1.4.32. Permitted zone types shall be general zone, releasing zone and special zone. Each output point (control module, panel circuit module) can support a list of up to 10 zones including general zone, logic zone, releasing zone and trouble zone. It shall be possible for output points to be assigned to list general alarm. Non-Alarm or Supervisory points shall not activate the general alarm zone.

1.4.33. 1000 General Zones: The system shall support up to 1000 general purpose software zones for linking inputs to outputs. When an input device activates, any general zone programmed into that device's zone map will be active and any output device that has an active general zone in its map will be active. It shall also be possible to use general zone as arguments in logic equations.

1.4.34. 1000 Logic Equations: The system shall support up to 1000 logic equations for AND, OR, NOT, ONLY1, ANYX, XZONE or RANGE operators that allow conditional I/O linking. When any logic equation becomes true, all output points mapped to the logic zone shall activate.

1.4.35. 10 trouble equations per device: The system shall provide support for up to 10 trouble equations for each device, which shall permit programming parameters to be altered, based on specific fault conditions. If the trouble equation becomes true, all output points mapped to the trouble zone shall activate.

1.4.36. Control-By-Time: A time based logic function shall be available to delay an action for a specific period of time based upon a logic input with tracking feature. A latched version shall also be available. Another version of this shall permit activation on specific days of the week or year with ability to set and restore based on a 24 hour time schedule on any day of the week or year.

1.4.37. Multiple agent releasing zones: The system shall support up to 10 releasing zones to protect against 10 independent hazards. Releasing zones shall provide up to three cross-zone and four abort options to satisfy any local jurisdiction requirements.

1.4.38. Alarm Verification, by device, with timer and tally: The system shall provide a user-defined global software timer function that can be set for a specific detector or indicating panel module input. The timer function shall delay an alarm signal for a user-specified time period and the control panel shall ignore the alarm verification timer if another alarm is detected during the verification period. It shall also be possible to set a maximum verification count between 0 and 20 with the "0" setting producing no alarm verification. When the counter exceeds the threshold value entered, a trouble shall be generated to the panel.

1.4.5.5. Central Processing Unit

- ✓ The Central Processing Unit shall communicate with, monitor, and control all other modules within the control panel. Removal, disconnection or failure of any control panel module shall be detected and reported to the system display by the Central Processing Unit.
- ✓ The Central Processing Unit shall contain and execute all control-by-event (including Boolean functions including but not limited to AND, OR, NOT, ANYx, and CROSSZONE) programs for specific action to be taken if an alarm condition is detected by the system. Such control-by-event programs shall be held in non-volatile programmable memory, and shall not be lost with system primary and secondary power failure.
- ✓ The Central Processing Unit shall also provide a real-time clock for time annotation, to the

second, of all system events. The time-of-day and date shall not be lost if system primary and secondary power supplies fail.

- ✓ The CPU shall be capable of being programmed on site without requiring the use of any external programming equipment. Systems that require the use of external programmers or change of EPROMs are not acceptable.
- ✓ Consistent with UL864 standards, the CPU and associated equipment are to be protected so that voltage surges or line transients will not affect them.
- ✓ Each peripheral device connected to the CPU shall be continuously scanned for proper operation. Data transmissions between the CPU and peripheral devices shall be reliable and error free. The transmission scheme used shall employ dual transmission or other equivalent error checking techniques.
- ✓ The CPU shall provide an EIA-232 interface between the fire alarm control panel and the UL Listed Electronic Data Processing (EDP) peripherals.
- ✓ The CPU shall provide two EIA-485 ports for the serial connection to annunciation and control subsystem components.
- ✓ The EIA-232 serial output circuit shall be optically isolated to assure protection from earth ground.
- ✓ The CPU shall provide one high-speed serial connection for support of network communication modules.
- ✓ The CPU shall provide double pole relays for FIRE ALARM, SYSTEM TROUBLE, SUPERVISORY, and SECURITY. The SUPERVISORY and SECURITY relays shall provide selection for additional FIRE ALARM contacts.
- ✓ The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

1.4.5.6. System Display

- ✓ The system display shall provide all the controls and indicators used by the system operator and may also be used to program all system operational parameters.
- ✓ The display assembly shall contain, and display as required, custom alphanumeric labels for all intelligent detectors, addressable modules, and software zones.
- ✓ The system display shall provide a 640-character backlit alphanumeric Liquid Crystal Display (LCD). It shall also provide ten Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM, SECURITY, SUPERVISORY, SYSTEM TROUBLE, OTHER EVENT, SIGNALS SILENCED, POINT DISABLED, and CPU FAILURE.
- ✓ The system display shall provide a keypad with control capability to command all system functions, entry of any alphabetic or numeric information, and field programming. Two different password levels with up to ten (one Master and nine User) passwords shall be accessible through the display interface assembly to prevent unauthorized system control or programming.
- ✓ The system display shall include the following operator control switches: ACKNOWLEDGE, SIGNAL SILENCE, RESET, DRILL, and LAMP TEST. Additionally, the display interface shall allow scrolling of events by event type including, FIRE ALARM, SECURITY, SUPERVISORY, TROUBLE, and OTHER EVENTS. A PRINT SCREEN button shall be provided for printing the event currently displayed on the 640-character LCD.

1.4.5.7. Loop (Signaling Line Circuit) Control Module:

- ✓ The Loop Control Module shall monitor and control a minimum of 318 intelligent addressable devices. This includes 159 intelligent detectors (Ionization, Photoelectric, or Thermal) and 159 monitor or control modules.
- ✓ The Loop Control Module shall contain its own microprocessor and shall be capable of operating in a local/degrade mode (any addressable device input shall be capable of activating any or all addressable device outputs) in the unlikely event of a failure in the main CPU.
- ✓ The Loop Control Module shall provide power and communicate with all intelligent addressable detectors and modules on a single pair of wires. This SLC Loop shall be capable of operating as a NFPA Style 6 (Class B) circuit.
- ✓ The SLC interface board shall be able to drive an NFPA Style 6 twisted unshielded circuit up to 12,500 feet in length. The SLC Interface shall also be capable of driving an NFPA Style 6, no twist, no shield circuit for limited distances determined by the manufacturer. In addition, SLC wiring shall meet the listing requirements for it to exit the building or structure. "T"-tapping shall be allowed in either case.
- ✓ The SLC interface board shall receive analog or digital information from all intelligent detectors and shall process this information to determine whether normal, alarm, or trouble conditions exist for that particular device. Each SLC Loop shall be isolated and equipped to annunciate an Earth Fault condition. The SLC interface board software shall include software to automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information may also be used for automatic detector testing and the automatic determination of detector maintenance requirements.

1.4.5.8. Enclosures

- ✓ The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
- ✓ The back box and door shall be constructed of 0.060 steel with provisions for electrical conduit connections into the sides and top.
- ✓ The door shall provide a key lock and include a transparent opening for viewing all indicators. For convenience, the door shall have the ability to be hinged on either the right or left-hand side.
- ✓ The control unit shall be modular in structure for ease of installation, maintenance, and future expansion.

1.4.5.9. Digital Voice Command Center

- ✓ The Digital Voice Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset.

- ✓ Function: The Voice Command Center equipment shall perform the following functions:

a. Operate as a supervised multi-channel emergency voice communication system.
b. Operate as a two-way emergency telephone system control center.
c. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
d. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
e. Provide all-call Emergency Paging activities through activation of a single control switch.
f. As required, provide vectored paging control to specific audio zones via dedicated control switches.
g. Provide a factory recorded "library" of voice messages and tones in standard WAV. File format, which may be edited and saved on a PC running a current Windows® operating system.
h. Provide a software utility capable of off-line programming for the VCC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the VCC shall not inhibit the emergency operation of other nodes on the fire alarm network.
i. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.
j. The Digital Voice Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
k. The Digital Voice Command and associated equipment shall be protected against unusually high voltage surges or line transients.

A. Power Supply:

1. The Addressable Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
2. The Addressable Main Power Supply shall provide the required power to the CPU using a switching 24 VDC regulator and shall incorporate a battery charger for 24 hours of standby power using dual-rate charging techniques for fast battery recharge.
3. The Addressable Main Power Supply shall provide a battery charger for 24 hours of standby using dual-rate charging techniques for fast battery recharge. The supply shall be capable of charging batteries ranging in capacity from 25-200 amp-hours within a 48-hour period.
4. The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
5. The Addressable Main Power Supply shall be power-limited per UL864 requirements.

B. System Circuit Supervision

1. The FACP shall supervise all circuits to intelligent devices, transponders, annunciators and peripheral equipment and annunciate loss of communication with these devices. The CPU shall continuously scan above devices for proper system operation and upon loss of response from a device shall sound an audible trouble, indicate which device or devices are not responding and print the information in the history buffer and on the printer.
2. Transponders that lose communication with the CPU shall sound an audible trouble and

light an LED indicating loss of communications.

3. Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.
4. All speaker and emergency phone circuits shall be supervised for opens and shorts. Each transponder speaker and emergency phone circuit shall have an individual ON/OFF indication (green LED).

C. Field Wiring Terminal Blocks

1. All wiring terminal blocks shall be the plug-in/removable type and shall be capable of terminating up to 12 AWG wire. Terminal blocks that are permanently fixed to the PC board are not acceptable.

D. Audio Amplifiers

1. The Audio Amplifiers will provide Audio Power (@25 Volts RMS) for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
   - Earth Fault on DAP A (Digital Audio Port A)
   - Earth Fault on DAP B (Digital Audio Port B)
   - Audio Amplifier Failure Detected Trouble
   - Active Alarm Bus input
   - Audio Detected on Aux Input A
   - Audio Detected on Aux Input B
   - Audio Detected on Firefighter's Telephone Riser
   - Receiving Audio from digital audio riser
   - Short circuit on speaker circuit 1
   - Short circuit on speaker circuit 2
   - Short circuit on speaker circuit 3
   - Short circuit on speaker circuit 4
   - Data Transmitted on DAP A
   - Data Received on DAP A
   - Data Transmitted on DAP B
   - Data Received on DAP B
   - Board failure
   - Active fiber optic media connection on port A (fiber optic media applications)
   - Active fiber optic media connection on port B (fiber optic media applications)
   - Power supply Earth Fault
   - Power supply 5V present
   - Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble
4. The audio amplifier shall provide the following built-in controls:
   - Amplifier Address Selection Switches
   - Signal Silence of communication loss annunciation Reset
   - Level adjustment for background music
   - Enable/Disable for Earth Fault detection on DAP A

- Enable/Disable for Earth Fault detection on DAP A
- Switch for 2-wire/4-wire FFT riser

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.

E. Audio Message Generator (Prerecorded Voice)/Speaker Control:

1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.
5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:

LED Indicators:

- Lamp Test
- Trouble
- Off-Line Trouble
- Microphone Trouble
- Phone Trouble
- Busy/Wait
- Page Inhibited
- Pre/Post Announcement Tone

F. Controls with associated LED Indicators:

1. Speaker Switches/Indicators
   a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
   b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
2. Emergency Two-Way Telephone Control Switches/Indicators
   a. The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
   b. The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

G. Remote Transmissions:

1. Provide local energy or polarity reversal or trip circuits as required.
2. The system shall be capable of operating a polarity reversal or local energy or fire alarm transmitter for automatically transmitting fire information to the fire department.
3. Provide capability and equipment for transmission of zone alarm and trouble signals to

remote operator's terminals, system printers and annunciators.

4. Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

H. System Expansion:

Design the main FACP and required components so that the system can be expanded in the future (to include the addition of twenty percent more circuits or zones) without disruption or replacement of the existing control panel. This shall include hardware capacity, software capacity and cabinet space.

I. Field Programming

1. The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or other electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/information.

2. It shall be possible to program through the standard FACP keyboard all system functions.

3. All field defined programs shall be stored in non-volatile memory.

4. Two levels of password protection shall be provided in addition to a key-lock cabinet. One level shall be used for status level changes such as point/zone disable or manual on/off commands (Building Manager). A second (higher-level) shall be used for actual change of the life safety program (installer). These passwords shall be five (5) digits at a minimum. Upon entry of an invalid password for the third time within a one minute time period an encrypted number shall be displayed. This number can be used as a reference for determining a forgotten password.

5. The system programming shall be "backed" up via an upload/download program, and stored on compatible removable media. A system back-up disk shall be completed and given in duplicate to the building owner and/or operator upon completion of the final inspection. The program that performs this function shall be "non-proprietary", in that, it shall be possible to forward it to the building owner/operator upon his or her request.

6. The installer's field programming and hardware shall be functionally tested on a computer against known parameters/norms which are established by the FACP manufacturer. A software program shall test Input-to-Output correlations, device Type ID associations, point associations, time equations, etc. This test shall be performed on an IBM-compatible PC with a verification software package. A report shall be generated of the test results and two copies turned in to the engineer(s) on record.

J. Specific System Operations

1. Smoke Detector Sensitivity Adjust: Means shall be provided for adjusting the sensitivity of any or all analog intelligent smoke detectors in the system from the system keypad or from the keyboard of the video terminal. Sensitivity range shall be within the allowed UL window.

2. Alarm Verification: Each of the Intelligent Addressable Smoke Detectors in the system may be independently selected and enabled to be an alarm verified detector. The alarm verification function shall be programmable from 5 to 50 seconds and each detector shall be able to be selected for verification during the field programming of the system or anytime after system turn-on. Alarm verification shall not require any additional hardware to be added to the control panel. The FACP shall keep a count of the number of times that each detector has entered the verification cycle. These counters may be displayed and reset by the proper operator commands.

K. System Point Operations:

1. Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.
2. System output points shall be capable of being turned on or off from the system keypad or the video terminal.
3. Point Read: The system shall be able to display the following point status diagnostic functions without the need for peripheral equipment. Each point shall be annunciated for the parameters listed:

a. Device Status.
b. Device Type.
c. Custom Device Label.
d. Software Zone Label.
e. Device Zone Assignements.
f. Analog Detector Sensitivity.
g. All Program Parameters.

4. System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:
5. System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 4000 system events. Each of these events will be stored, with time and date stamp, until an operator requests that the contents be either displayed or printed. The contents of the history buffer may be manually reviewed; one event at a time, and the actual number of activations may also be displayed and or printed. History events shall include all alarms, troubles, operator actions, and programming entries.
6. The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.
7. Automatic Detector Maintenance Alert: The fire alarm control panel shall automatically interrogate each intelligent system detector and shall analyze the detector responses over a period of time.
8. If any intelligent detector in the system responds with a reading that is below or above normal limits, then the system will enter the trouble mode, and the particular Intelligent Detector will be annunciated on the system display, and printed on the optional system printer. This feature shall in no way inhibit the receipt of alarm conditions in the system, nor shall it require any special hardware, special tools or computer expertise to perform.
9. The system shall include the ability (programmable) to indicate a "pre-alarm" condition. This will be used to alert maintenance personal when a detector is at 80% of its alarm threshold

in a 60 second period.

2.4. SYSTEM COMPONENTS:

MAIN FIRE ALARM CONTROL PANEL OR NETWORK NODE:

A. Speakers:
   1. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.
   2. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).
   3. Frequency response shall be a minimum of 400 HZ to 4000 HZ.
   4. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

B. Audible/Visual Combination Devices:
   1. Shall meet the applicable requirements of Section A listed above for audibility.
   2. Shall meet the requirements of Section B listed above for visibility.

C. Programmable Electronic Sounders:
   1. Electronic sounders shall operate on 24 VDC nominal.
   2. Electronic sounders shall be field programmable without the use of special tools, at a sound level of at least 90 dBA measured at 10 feet from the device.
   3. Shall be flush or surface mounted as shown on plans.

D. Horn/Strobes:
   1. Operate on 24 VDC
   2. Have two selectable tone options of temporal 3 and non-temporal continuous pattern.
   3. Have at least 2 audibility options
   4. Maximum Pulse Duration: 0.2 second.
   5. Strobe Intensity: UL 1971.
   6. Flash Rate: UL 1971.
   7. Strobe Candela Rating: Determine by positioning selector switch on back of device.

E. Interactive Display
   1. The system shall be an interactive Touch Screen Interface.
   2. The system shall operate on an UL listed Embedded platform operating at no less than 700 MHz on the Microsoft® Windows® XP Embedded platform.
   3. The Embedded platform shall have: no less than 256 megabytes of RAM, a flash drive with no less than 1 Gigabytes of storage space, 100 Base-T Ethernet NIC card, and USB ports.
   4. The Embedded platform shall have a minimum 17" touch screen display.
   5. The Embedded platform shall come equipped with all necessary gateway modules to allow connection to the network it monitors as standard equipment.
      a. A UL listed Ethernet Hub shall be provided for connection of multiple interactive displays and/or gateways.

1.5. SYSTEM COMPONENTS - ADDRESSABLE DEVICES

1.5.1. Addressable Devices - General

1. Addressable devices shall provide an address-setting means using rotary decimal switches.
2. Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches. Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.
3. Detectors shall be Analog and Addressable, and shall connect to the fire alarm control panel's Signaling Line Circuits.
4. Addressable smoke and thermal detectors shall provide dual (2) status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the flashing mode operation of the detector LEDs can be programmed off via the fire control panel program.
5. The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.
6. Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance. The detectors shall be listed by UL as meeting the calibrated sensitivity test requirements of NFPA Standard 72, Chapter 7.
7. The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.
8. The following bases and auxiliary functions shall be available :
    a. Sounder base rated at 85 DBA minimum.
    b. Form-C Relay base rated 30VDC, 2.0A
    c. isolator base
9. The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
10. Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (example: ION, PHOTO, THERMAL).

1.5.2. Addressable Manual Fire Alarm Box (manual station)

1. Addressable manual fire alarm boxes shall, on command from the control panel, send data to the panel representing the state of the manual switch and the addressable communication module status. They shall use a key operated test-reset lock, and shall be designed so that after actual emergency operation, they cannot be restored to normal use except by the use of a key.
2. All operated stations shall have a positive, visual indication of operation and utilize a key type reset.

3. Manual fire alarm boxes shall be constructed of Lexan with clearly visible operating instructions provided on the cover. The word FIRE shall appear on the front of the stations in raised letters, 1.75 inches (44 mm) or larger.

1.5.3. Intelligent Photoelectric Smoke Detector

1. The detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density.

1.5.4. Intelligent Laser Photo Smoke Detector

1. The intelligent laser photo smoke detector shall be a spot type detector that incorporates an extremely bright laser diode and an integral lens that focuses the light beam to a very small volume near a receiving photo sensor. The scattering of smoke particles shall activate the photo sensor.
2. The laser detector shall have conductive plastic so that dust accumulation is reduced significantly.
3. The intelligent laser photo detector shall have nine sensitivity levels and be sensitive to a minimum obscuration of 0.03 percent per foot.
4. The laser detector shall not require expensive conduit, special fittings or PVC pipe.
5. The intelligent laser photo detector shall support standard, relay, isolator and sounder detector bases.
6. The laser photo detector shall not require other cleaning requirements than those listed in NFPA 72. Replacement, refurbishment or specialized cleaning of the detector head shall not be required.
7. The laser photo detector shall include two bicolor LEDs that flash green in normal operation and turn on steady red in alarm.

1.5.5. Intelligent Thermal Detectors

1. Thermal detectors shall be intelligent addressable devices rated at 135 degrees Fahrenheit (58 degrees Celsius) and have a rate-of-rise element rated at 15 degrees F (9.4 degrees C) per minute. It shall connect via two wires to the fire alarm control panel signaling line circuit.

1.5.6. Addressable Control Module

1. Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances.
2. The control module NAC may be wired for Style Z or Style Y (Class A/B) with up to 1 amp of inductive A/V signal, or 2 amps of resistive A/V signal operation.
3. Audio/visual power shall be provided by a separate supervised power circuit from the main fire alarm control panel or from a supervised UL listed remote power supply.

4. The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 amps at 30 VDC.

1.5.7. Addressable Relay Module

1. Addressable Relay Modules shall be available for HVAC control and other building functions. The relay shall be form C and rated for a minimum of 2.0 Amps resistive or 1.0 Amps inductive. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to insure that 100% of all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

1.5.8. Isolator Module

1. Isolator modules shall be provided to automatically isolate wire-to-wire short circuits on an SLC Class A or Class B branch. The isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop segment or branch. At least one isolator module shall be provided for each floor or protected zone of the building.
2. If a wire-to-wire short occurs, the isolator module shall automatically open-circuit (disconnect) the SLC. When the short circuit condition is corrected, the isolator module shall automatically reconnect the isolated section.
3. The isolator module shall not require address-setting, and its operations shall be totally automatic. It shall not be necessary to replace or reset an isolator module after its normal operation.
4. The isolator module shall provide a single LED that shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

1.5.9. Serially Connected Annunciator Requirements

1. The Annunciator shall communicate to the fire alarm control panel via an EIA 485 (multi-drop) two-wire communications loop. The system shall support two 6,000 ft. EIA-485 wire runs. Up to 32 annunciators, each configured up to 96 points, may be connected to the connection, for a system capacity of 3,072 points of annunciation.
2. An EIA-485 repeater shall be available to extend the EIA-485 wire distance in 3,000 ft. increments. An optional version shall allow the EIA-485 circuit to be transmitted over Fiber optics. The repeater shall be UL864 approved.
3. Each annunciator shall provide up to 96 alarm and 97 trouble indications using a long-life programmable color LED's. Up to 96 control switches shall also be available for the control of Fire Alarm Control Panel functions. The annunciator will also have an "ON-LINE" LED, local piezo sounder, local acknowledge and lamp test switch, and custom zone/function identification labels.
4. The annunciator may be field configured to operate as a "Fan Control Annunciator". When configured as "Fan Control," the annunciator may be used to manually control fan or damper operation and can be set to override automatic commands to all fans/dampers programmed to the annunciator.

5. Annunciator switches may be programmed for System control such as, Global Acknowledge, Global Signal Silence, Global System Reset, and on/off control of any control point in the system.
6. An optional module shall be available to utilize annunciator points to drive EIA-485 driven relays. This shall extend the system point capacity by 3,072 remote contacts.
7. The LED annunciator shall offer an interface to a graphic style annunciator and provide each of the features listed above.

1.6. BATTERIES AND EXTERNAL CHARGER:

A. Battery:

1. Shall be 12 volt, Gel-Cell type.
2. Battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.
3. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks refilling, spills and leakage shall not be required.

B. External Battery Charger:

1. Shall be completely automatic, with constant potential charger maintaining the battery fully charged under all service conditions. Charger shall operate from a 120/240-volt 50/60 hertz source.
2. Shall be rated for fully charging a completely discharged battery within 48 hours while simultaneously supplying any loads connected to the battery.
3. Shall have protection to prevent discharge through the charger.
4. Shall have protection for overloads and short circuits on both AC and DC sides.

1.7. EXECUTION

1.7.1. INSTALLATION:

A. Installation shall be in accordance with the NEC, NFPA 72, local and state codes, as shown on the drawings, and as recommended by the major equipment manufacturer.

B. All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

C. All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.

D. Manual Pull Stations shall be suitable for surface mounting or semiflush mounting as shown on the plans, and shall be installed not less than 42 inches, nor more than 48 inches above the finished floor.

1.7.2. TYPICAL OPERATION:

A. Actuation of any manual station, smoke detector heat detector or water flow switch shall cause the following operations to occur unless otherwise specified:

1. Activate all programmed speaker circuits.
2. Actuate all strobe units until the panel is reset.
3. Light the associated indicators corresponding to active speaker circuits.
4. Release all magnetic door holders to doors to adjacent zones on the floor from that the alarm was initiated.
5. Return all elevators to the primary or alternate floor of egress.
6. A smoke detector in any elevator lobby shall, in addition to the above functions, return all elevators to the primary or alternate floor of egress.
7. Smoke detectors in the elevator machine room or top of hoistway shall return all elevators in to the primary or alternate floor. Smoke detectors or heat detectors installed to shut down elevator power shall do so in accordance with ANSI A17.1 requirements and be coordinated with the electrical contractor.
8. Duct type smoke detectors shall, in addition to the above functions shut down the ventilation system or close associated control dampers as appropriate.
10. The Pop-up of the alarm conditions as well as real-time FAS data to be seen on Enterprise Building Integrator (GUI)
9. Activation of any sprinkler system low pressure switch or valve tamper switch shall cause a system supervisory alarm indication.

1.7.3. TEST:

- ✓ Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
- ✓ Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- ✓ Close each sprinkler system flow valve and verify proper supervisory alarm at the FACP.
- ✓ Verify activation of all flow switches.
- ✓ Open initiating device circuits and verify that the trouble signal actuates.
- ✓ Open signaling line circuits and verify that the trouble signal actuates.

- ✓ Open and short notification appliance circuits and verify that trouble signal actuates.
- ✓ Ground initiating device circuits and verify response of trouble signals.
- ✓ Ground signaling line circuits and verify response of trouble signals.
- ✓ Ground notification appliance circuits and verify response of trouble signals.
- ✓ Check presence and audibility of tone at all alarm notification devices.
- ✓ Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.
- ✓ Each of the alarm conditions that the system is required to detect should be introduced on the system. Verify the proper receipt and the proper processing of the signal at the FACP and the correct activation of the control points.
- ✓ When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures. This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, verification functionality and similar.

1.7.4. FINAL INSPECTION:

A. At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

1.7.5. INSTRUCTION:

A. Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

B. The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

Gas based fire suppression system

(i) Scope of work

Supply, install, test Operation & Maintenance and put in operation NOVEC 1230 (Fluro Ketone FK-5-1-12) based fire suppression system. The fire suppression system shall include and not be limited to gas release control panel, CCOE approved seamless cylinders, discharge valve (with solenoid or pneumatic actuator) as the case may be, discharge pipe, check valve and all other accessories required to make a complete operation system meeting applicable requirements of NFPA 2011 standards and installed in compliance with

all applicable requirements of the local codes and standards. The system shall be listed / approved by UL. All components of the system shall be UL approved

a) The system design should be based on the specifications contained herein, NFPA 2011 and in accordance with the requirements specified in the design manual of the agent. The system shall be properly filled and supplied by an approved OEM.

b) The key components of the system (Key components are valves and its accessories, actuators, flexible discharge and connection hoses, check valves, pressure switch, and nozzles) shall be UL listed. The NOVEC 1230 gas shall:

- Comply with NFPA 2011 standard
- Have the approval from US EPA (Environmental Protection Agency) for use as a total flooding fire extinguishing for the protection of occupied space:
- Have given Underwriters' Laboratories Inc. (UL, USA) component listing for the NOVEC 1230 gaseous agent.
- Must have zero ozone depletion potential (ODP)
- Have a minimal life span in atmosphere, with atmospheric life time of less than 5 days
- Be efficient, effective and does not require excessive space and high pressure for storage;
- Commercially available

d) Design Condition:- The Novec 1230 agent is stored in seamless steel cylinders and dry nitrogen is added to provide additional energy to give the required rapid discharge. At the normal operating pressure of 25 bar at 21^{o} C, the agent is a liquid in the container.

e) Consider simultaneous total flooding of all voids within the protected volume. The system shall be designed in accordance with the OEM's Design Manual.

f) In order to extinguish a fire using clean agent, the concentration of agent delivered to each void shall be above the minimum design concentration. The following shall be considered while designing the system:-

- The minimum design concentration shall be 4.7 %. Class A Design concentration.
- If the protected volume has a floor and / or ceiling void the spaces shall be included in the protected volume, employing a minimum design concentration not below that of the main room compartment.
- The discharge nozzles shall be located within the protected volume in compliance to limitations and with regard to spacing, floor and ceiling coverage, etc. The nozzles shall be positioned such that they would cover the entire area up to the extreme corners of the area under protection and the design concentration will be established in all parts of the protected volumes.
- The final numbers of discharge nozzles shall be according to the OEM's product manual.
- The average pressure at each nozzle shall not be less than 6.034 Bar.
- The gas flow calculations shall be carried out on special software given by OEM.
- The software should support usage of seamless cylinders which have a different design compared to the standard containers used worldwide. The system acceptance report shall show the resulting concentration in each independent void to be above 4.2% and the average pressure at each nozzle to be not less than 6.034 Bar.

- The agent discharge time shall not exceed 10 seconds & not less than 5 seconds.
- The design concentration shall follow at minimum NFPA 2011 for under floor, room and ceiling space. Unless otherwise approved, room temperature for air-conditioned space shall be taken around 20°C. For non-air conditioned space, the temperature shall be taken around ambient temperature. The system shall be designed with minimum design concentration of 4.2 % as applicable to Class A & C fire.
- The system engineering company should carry out the piping Isometric design and validate the same with a hydraulic flow calculation generated by using the UL approved software and Appropriate fill density to be arrived at based on the same.
- The system shall be so designed that a fire condition in any one protected area shall actuate automatically the total flooding of clean agent in that area independently. The entire system shall incorporate inter-alia detection, audible and visual alarms, actuation and extinguishing.

(ii) System Design

a) Cylinders

- The clean agent shall be stored in cylinders designed to hold the agent at ambient temperature. UL listed Seamless PESO approved Cylinders shall be charged to a fill density as specified in the manufacturer's listed manual.
- The cylinders shall be designed to meet the requirement of US Department of Transportation or other authorities, as specified in NFPA 2001.
- Cylinder shall be mounted according to manufacturer recommendations.
- Each agent cylinder shall have a permanent nameplate indicating the agent, pressurization level of the container and nominal agent volume.
- Initial fill & subsequent filling of Seamless cylinders shall be done at UL & PESO approved filling station.

b) Cylinder Valve

- The Valve assembly shall be mounted directly on the cylinder and should NOT have any adaptor provision between the cylinder and Valve as per requirements of PESO. Cylinders with Adaptor between Valve assemblies shall be rejected as it is a violation of the PESO norms.
- Each cylinder valve shall have a provision for fixing a supervisory pressure switch and a safety burst disc to protect the cylinder from over pressure. The cylinder valve shall have a disabling plug to prevent accidental discharge of the valve during transportation and installation. Each valve is to be fitted with a pressure gauge for monitoring loss of pressure.
- The master cylinder valve is to be released electrically which is performed by means of a solenoid valve arrangement. Pilot cylinder actuation and pyrotechnic devices shall not be used.

c) Cylinder valve Actuators

- In a single cylinder system, the cylinder shall have a solenoid operated actuator and a manual actuator incorporating a strike knob mounted on top of the solenoid operated actuator. Multi cylinder systems shall have the same fitted on to the master cylinder and

pressure operated actuators fitted on each slave cylinder. All actuators shall be original OEM make. Locally manufactured actuators shall not be used.

d) Hoses

- Each cylinder valve shall be provided with a plug in type flexible rubber discharge hose of minimum 40mm size with a test pressure of 52 Bar. Each hose shall be permanently marked with the test pressure and OEM's part number. Multi cylinder systems shall have an interconnect hose for each cylinder. All hoses shall be original OEM make and locally manufactured hoses shall not be used.
- Manifold with check valve
- Manifold shall be fabricated from ASTM A106 Schedule 80 seamless pipe and shall have integral check valves provided for each cylinder. The Manifold shall preferably be supplied by the original equipment manufacturer instead of fabricating the same at site.

e) Re-filling and maintenance

- In case of any leakage or accidental discharge of the agent, it shall be responsibility of SI to re-fill the cylinders from a valid PESO / UL approved OEM filling station in India itself. The SI should indicate the source of re-filling and the time that will be taken for re-filling and replacement.

f) Piping and fittings

- All Pipes shall be of ASTM - A-106, Gr: B, schedule - 40 seamless Pipes and fittings shall be as per ASTM-A-105 / A-234 standard.
- The thickness of the piping shall be calculated in accordance with ASME B31.1 The internal pressure used for this calculation shall be as mentioned in NFPA 2001.
- Each pipe sections shall be cleaned internally after preparation and before assembly by means of swabbing, utilising a non flammable cleaner. The pipe network shall be clean from particulate matter and oil residue before installation of nozzles or discharge devices.
- Fittings shall have a minimum rated working pressure equal to or greater that the minimum design working pressure as specified in NFPA 2001. The minimum acceptable ratings of the fittings shall be Class 300 lb threaded/ weld Forged Steel

g) Fire Detection and Gas Release Panel

- Fire detection shall be achieved using smoke detectors, which shall be connected to the respective fire alarm panel. The protected area shall have fire control panel and one set of detectors. In case of fire, the smoke detectors shall detect the condition at an early stage (the moment products of combustion enter the detector) and shall cause the alarm panel to activate.
- The moment the first detector gets activated the specific detector number shall be displayed and the panel buzzer shall start operating. At the end of timer one, stage 1 bells and relays shall be switched on. There shall be two sounders, both of which get switched on simultaneously to ensure that atleast one shall work even if the other fails. The stage 1 bells shall be identified by the fact that they pulsate at the rate defined by timer 1.
- When the second detector also activates, the second detector number shall also be displayed on the panel and stage 2 bells shall be activated which is identified by a continuous tone. The stage 2 bells indicate that area is to be evacuated. The output from

the panel to the gas release module (actuator output) shall activate at the end of timer two, which is initiated from the moment the panel enters stage 2. It is important to note that the actuator output on the panel shall be enabled only if the automatic gas release mode is selected. Even as the panel enters stage 2, it shall be possible to delay the release of the gas by pressing the hold off switch on the panel, which resets the timer to zero. The moment the switch is released the timer shall start as fresh.

- In the manual mode, even if the panel enters the stage 2, the actuator output shall not be enabled. In this case, actuator output shall be enabled if and only if the manual release switch is pressed, which shall cause the panel to enter stage 2 directly and at the end timer 2 enables the actuator output.

2. CLOSE CIRCUIT TV MONITORING SYSTEM

<u>High Speed Dome Camera:</u>

A GENERAL

The network (IP) Dome camera shall consist of a 1/3" Progressive Scan CMOS Sensor, 3 MegaPixel Colour Dome Camera with 2.8 ~ 12.0mm Manual Verifocal Auto iris Lens, WDNR, Day & Night function with required accessories. Motorized zoom lens with optical and digital zoom and auto focus and high resolution digital video of 4CIF (704x582 PAL) using the H.264 or better compression algorithm and TCP/IP transmission.

Box Camera specifications

- Network (IP) based camera available in NTSC and PAL formats.
- Maintain 25fps PAL/ 30 fps NTSC video at 4CIF/ 2CIF/ CIF/ DCIF/ QCIF digital video resolution ranging between 704 x576 to 704 x288 in PAL formats.
- The camera shall digitize and compress the video using the H.264 or latest in video compression technology.
- The Camera Video encoding should be MJPEG/H.264 dual streaming.
- The camera shall have a minimum focal length of 3.4 mm to 122.4 mm
- The camera shall have a minimum optical zoom of 36X and 12x digital or better
- The digital video shall provide dual encoded video streams to allow simultaneous and independent viewing and recording of live video at different frame rates and/or quality.
- The camera shall provide the option to set each stream at a frame rate between 1-30 NTSC /1-25 PAL
- The camera shall have minimum 8 Alarm inputs and 4 Alarms (Relay) outputs
- The camera shall have an Ethernet (IP) interface using an RJ-45 CAT5, CAT5e or CAT6 UTP cable
- The camera shall as minimum provide the communication protocols: TCP/IP, HTTP, DHCP, Multicast,ICMP, SMTP, RTP/ RTSP, PPPoE etc.
- The camera IP protocol shall communicate over the Ethernet network using Multicasting technology.

- The camera shall comprise of Image sensor of a 1/3" or ¼" CCD
- The camera shall deliver a 360° continuous pan travel
- The camera tilt travel as minimum shall be between 0° to -/ +180°
- The camera shall provide 128 or better preset positions with preset accuracy of +/- 0.1°
- The camera shall provide a freeze image option for preset call up
- The camera shall have a built in auto flip feature on 0°~180° & auto flip off on 0°~95°.
- The camera shall provide four (4) user defined patterns including pan, tilt, zoom, functions; pattern programming shall be available through the digital IP management system
- The camera shall provide "home" settings for the camera to return after pre-programmed time frame
- The camera shall be a minimum high-resolution 550 TV lines or better in colour mode and 650 TV lines or better in B/W mode.
- The camera shall have interlined CCD.
- The camera shall have light sensitivity of 0.0131 lux color/day and 0.0014 lux monochrome/night
- The camera shall provide angle of view of 57.8(w)-1.7(T)
- The camera shall have white balance controls, manual or automatic
- The camera shall have a minimum Electronic Shutter speed of 1/60 ~1/20,000 – 1/50 - 1/10,000
- The camera shall have automatic backlight compensation (BLC)
- The camera shall have automatic gain control (AGC).
- The Video to Noise ratio should be >52dB
- Camera shall provide ICR Day/Night option
- Minimum supports 8 patrols and 4 patterns.
- Privacy Masking: Up to 8 zones
- No. of simultaneous users 6 or above.
- The cameras shall support Wide Dynamic Range more than 52 db
- The camera shall maintain operation at temperature of -22° F - 122° F (-45°-50° C) in normal operation - (-40°-50° C)
- The housing shall be mountable in Outdoor bracket mount
- The camera shall meet the standards of NEMA 4X/ IP 66
- The Camera manufacturer should have UL, FCC and CE listed.

IP Box Type Camera for entrance/ exit door:

- The camera should have 1/3 " Sony Super HAD color CCD
- The camera shall be a minimum high-resolution 580 TV lines on colour mode and 700 TV lines in B/W mode.
- The camera should support video encoding on H.264/MJPEG dual streaming.
- It should have capability of mounting C/CS type lens
- The camera shall provide support of dual streaming
- The camera should support minimum six resolutions: 704 × 576, 352 × 288, 160 × 144
- The camera should support 704 × 576 resolution at 25 fps
- The camera should have minimum illumination of 0.00001Lux @ F1.2, for deliverance of video captured in very low luminous environment / conditions

- The camera should have electronic Day & night operation
- The camera should support video compression in H.264 format & audio compression in ADPCM 4 Bit.
- Should support Protocols: TCP/IP,HTTP,DHCP,DNS,RTP/RTSP, PPPoE (FTP,SMTP, NTP, SNMP addible)
- The camera should have Interface of Ethernet (RJ-45, 10/100 Base-TX)
- The camera should be accessed through Web-browser in Microsoft IE 6.0 or above
- Multiple-users should be able to have access to the camera
- The camera should have variable video bit rate & Constant bit rate .
- The camera should have 1 channel Alarm inpu and 1 channel Alarm output
- Serial port of RS-485 & RS-232 for universal data protocols should be available
- The camera having a feature of internal memory for recording event data.
- 8 Zone Motion Detection should be supported in the camera
- 8 zone Privacy Masking Should be supported in the camera.
- The camera should have Power over Ethernet (PoE) feature.
- The Camera should support multiple controlling PTZ protocol.
- Operating temperature range should be 32~122F (0~50ºC)temperature
- Power consumption should be not more than 3 W.
- The Camera manufacturer should have UL, FCC and CE listed.

SOFTWARE REQUIREMENTS:

Network Video Management Software:

- This shall be a highly scalable enterprise level software solution. It shall offer a complete video surveillance solution that will be scalable to required numbers of cameras that can be added on a unit-by-unit basis.
- The network video management software shall be licensed and shall operate on open architecture and should require no proprietary hardware. It should allow for seamless integration of third party security infrastructure where ever possible.
- The network video management software should allow for video to be streamed on a video mosaic wall.
- The user with administrative rights shall create clients (users) and give access to the software client application based on predefined user access rights.
- The system shall allow the recording, live monitoring, playback of archived video and data simultaneously.
- The software shall provide the following:
  - ✓ Several simultaneous live picture connections of camera in network.
  - ✓ Configuration of monitoring situation (site maps and workspace).
  - ✓ Programming of alarm-triggered automatic events in various alarms configuration.
  - ✓ System set up with limited operation options for clearly defined surveillance tasks.
  - ✓ Programming of automatic recording events on a network recorder.
- The software shall display dual H.264 video streams in real time simultaneously at frame rates ranging from 1 fps to 25 fps and resolution ranging from 1 CIF to 4CIF.
- Each camera's bit rate, frame rate and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
- The software shall provide automatic search and registration of components of video surveillance system on the network which can be cameras, monitors, alarm panels etc.

- The software shall provide drag & drop functions on the system and also for set up of connection between cameras and monitors.
- The software shall allow:
    - ✓ Live display of cameras.
    - ✓ Live display of camera sequences.
    - ✓ Control of PTZ cameras.
    - ✓ Playback of archived video.
    - ✓ Retrieval of archived video.
    - ✓ Instant Replay of live video.
    - ✓ Use of site maps.
    - ✓ Use of Macros
    - ✓ Configuration of system settings.
    - ✓ Configuration and programming of P/T/Z cameras, features like camera addressing, BLC, auto tours, presets etc.
- The software should be able to do video recording on any of the following options - inbuilt hard disks on the server, direct attached storage boxes attached to servers, network attached storage, storage area network.
- The software should be capable of handling camera and alarm icons on area maps. The area map should be configurable to pop up upon the receipt of an alarm received from a camera on the map. This can be on the same or other monitors on the PC.
- The software shall be able to select the required recording based on the time recording was activated, the duration of recording, operator activated recording, event activated recording, scheduled recording.
- The software shall offer a plug and play type hardware discovery service with the function of automatically discover devices as they are attached to the network.
- The software shall provide a reporting utility for tracking for the following minimum options. Video and images shall be stored with reports for documenting events.
    - ✓ Alarms
    - ✓ Incidents
    - ✓ Operator logs
- The software shall have the facility to export the desired portion of clipping of video from a desired date/time to another desired date/time on DVD/ on any client/ network storage device. Viewing of this recording shall be possible on authorized player which shall be provided by software manufacturer or in media player on computer utilizing a Window environment.

- The software database servers shall not limit the number of network video recording servers which can be networked together to form video management and recording system.
- The software database server shall maintain a catalog of settings for all the clients, servers, and IP cameras & IP enabled cameras in the system. If database management & recording can not be managed by single server, in such cases, additional server should be provided.
- The software shall enable the client to dynamically create connections between cameras and clients and view live or recorded video on the digital VGA monitors (video, serial ports and digital I/Os).
- The software shall provide the client seamless operation of all cameras and clients available in the system regardless of the actual connection to different Network Video Recording servers.
- The software shall detect signal loss, low signal to noise ratio etc. and have the capability to alert the systems administrator.
- The software shall receive all incoming events (motion detection and triggered digital input and relay output) in the system and take appropriate actions based on user-defined event/action relationships.
- The software shall create an audit trail of all events and user activities.
- The software shall support a built-in Virtual Video Matrix Switcher:

    - ✓ The Virtual Matrix Switch shall provide a full matrix operation of IP video to analog output.
    - ✓ The Virtual Matrix Switch shall provide a full matrix operation of IP video to digital monitors.
    - ✓ The Virtual Matrix Switch shall have the capability of creating camera sequences with the following functionalities:
        - ➲ Each Sequence shall have capability up to hundreds of cameras.
        - ➲ Each camera in the sequence shall have its own individual dwell time, from 1 to 60 seconds.
        - ➲ Each entry in a sequence shall have the capacity to trigger PTZ camera presets, patterns or auxiliaries.
        - ➲ Multiple users shall be able to view the same camera sequence simultaneously, not necessarily synchronized one with the other.

- The software shall provide alarm management module.
    - ✓ The alarm management shall be able to set any monitor or groups of monitors to automatically display cameras in response to alarm inputs.
    - ✓ The alarm management shall be able to reset automatically or manually alarmed video.

- The software shall support absolute redundancy with X to N, N to X and N to N redundancy configurations. This feature should be provided, if specified by purchaser.
- It shall be possible to search for recordings in the software by camera, date and time. If a data and time is specified, playback shall commence from that date and time. It shall be possible to playback more than one camera simultaneously.
- The software should support at least 64 video streams concurrently. It should support atleast 4 monitors in one server/ workstation for displaying live video. It should allow minimum 5 levels of user and alarm prioritization. It should allow minimum 16 cameras to be replayed simultaneously.

Network Video Recording Software:

- Software shall support recording of H.264 video streams. It shall support recording of video and audio for all the channels.
- Software shall support triplex applications, recording, re-play and backup simultaneously. It shall be compatible with windows Server OS or Linux for highest performance and reliability.
- Software shall operate on open architecture and should not require any proprietary hardware.
- Software shall be able to record minimum 32 different video streams or more simultaneously. It shall be accessible from any PC connected to the network.
- Software shall provide network time server function to ensure the synchronization of the video servers and the recordings.
- The servers shall be connected to the network so that these can be placed at any location which has network access.
- The software should be able to receive alarms of different types from equipment to start a recording. These alarms can be motion detection, video loss, and unified picture, trigger input.
- The software alarm recording shall support pre-and post-alarm periods. Both can be configured in duration.
- The software should provide a status of the available recording capacity, as well as an indication of the remaining possible recording time.
- Fault Tolerant Recording:
  - ✓ If software & server(s) operation are interrupted, like power disconnection and once the server(s) are restarted, these shall automatically resume recording of any cameras these were recording prior to the interruption.
  - ✓ The software shall support network fault-tolerant recording such that if the network connection between a video management server and video recording server becomes unavailable, for example through cable breakage, network congestion or WLAN interruption, the system operation shall automatically recover when the connection is restored.
  - ✓ On the stations with more than 32 cameras and more than one recording server, system should be configurable with failover recording without any additional licensing.
- Search & Export:
  - ✓ It shall be possible to search for recordings in the software by camera, date and time. If a data and time is specified, playback shall commence from that date and time. It shall be possible to playback more than one camera simultaneously.
  - ✓ The software shall be able to export sections of recordings to a separate Windows folder, which can then be written to CD-ROM, DVD-ROM or tape media to be played back at a location not connected to the network video management & recording network. The export process should make available a player application, which can be provided with the exported video. Export should be possible in Windows media player compatible format. Simultaneous export of multiple cameras should also be possible.

Video Analytics Software:

- Possible applications of analytics software over the IP based video surveillance system, for specified number of cameras for specific stations, as defined by purchaser shall include the following minimum video analytics software.
  a. Intrusion Detection
  bc. Camera Tampering

Intrusion Detection:

- ✓ The offered video analytic software shall include a comprehensive intrusion detection features. The intrusion detection shall be used for generating alarm under following scenarios:
  a.) People crossing at ends.
  b.) People entering in operation areas.
  c.) Object placed
  d). It should also generate directional alarms in defined areas like parking places, elevators etc.
- ✓ The software shall have filters to distinguish between humans, animals or objects.

Camera Tampering:

- ✓ The software shall be able to detect sabotage or tampering to the cameras. It shall be able to detect camera blurring, camera blinding and change of orientation of fixed cameras.
- ✓ Camera tampering feature shall be provided for all fixed cameras.

- ➢ Video Analytics Software can be implemented either at firmware level at fixed IP cameras or at server level in the control room. This server shall be only working for Video Analytics Software.
- ➢ Video analytics software should be provided on fixed IP cameras.

GUI (Graphic User Interface) Client Software Features:

- ➢ The GUI software shall perform the following applications simultaneously without interfering with any of the storage server operations (recording, alarms, etc.):
  - ✓ Live display of cameras.
  - ✓ Live display of camera sequences.
  - ✓ Control of PTZ cameras.
  - ✓ Playback of archived video.
  - ✓ Retrieval of archived video.
  - ✓ Instant replay of live video.
  - ✓ Use of graphical controls (maps) and alarm management.
  - ✓ Use of procedures (Macros).
  - ✓ Configuration of system settings.
  - ✓ Execution of system macros.

- ➢ The GUI software shall support any form of IP network connectivity, including: LAN, WAN, VPN, and wireless technologies.
- ➢ The GUI software shall support multicast and unicast video streaming.
- ➢ The GUI software shall provide an authentication mechanism, which verifies the validity of the user.
- ➢ The GUI software shall allow for live monitoring of video.
- ➢ It shall enable view of 1 to minimum 16 video tiles simultaneously on a single digital monitor at 25 fps per camera.
- ➢ The software shall provide on each of the digital monitors independently the following tile views:

  - ✓ Full screen
  - ✓ Quad

- ✓ 3x3 (9-view)
- ✓ 4x4 (16-view) or better.
- ✓ 1+5 or 1+9 or 1+11 or 1+12 or 1+15 or better (one large and remaining small views)

- The GUI software shall allow operators to view an instant replay of any camera.
  - ✓ The operator shall be able to define the amount of time he wishes to go back from a predefine list or through a custom setup period.
  - ✓ The operator shall be able to control the playback with play, pause, forward, and speed buttons.

- The operator shall be able to choose and trigger following minimum action from a macro/site map:

  - ✓ View map or procedure in a video tile.
  - ✓ Starting/stopping PTZ pattern.
  - ✓ Go to PTZ preset.

- The GUI software shall provide management and control over the system using a standard PC mouse, keyboard and CCTV keyboard.
- The GUI software shall display all cameras attached to the system regardless of their physical location on the network.
- The GUI software shall display all camera sequences created in the system.
- The GUI software shall allow operators to control (pause/play, skip forwards, skip backwards) camera sequences, without affecting other operators' ability to view and control the same sequence.
- The GUI software shall display all cameras, sequences and users in a logical tree.
- The GUI software operator shall be able to drag and drop a camera from a tree of available cameras into any video tile for live viewing.
- The GUI software operator shall be able to drag and drop a camera sequence from a tree of cameras into any video tile for live viewing.
- The GUI software shall support graphical site representation (map) functionality, where digital maps are used to represent the physical location of cameras and other devices throughout facility.
- The maps shall have the ability to contain hyperlinks to create a hierarchy of interlinked maps.
- The operator shall be able to drag and drop a camera from a map into a video tile for live viewing in the same browser without opening a new browser.
- The operator shall be able to click on an icon in a map to initiate PTZ camera preset, run PTZ pattern, view camera in an analog monitor or send an I/O stream.
- The GUI software shall support digital zoom on a fixed camera's live video streams.
- The GUI software shall support digital zoom on a PTZ camera's live video streams.
- The operator shall be able to control pan-tilt-zoom, iris, focus, dome relays and dome patterns.
- The software shall be able to display video of cameras on LCD/Plasma monitors or on any size of monitor as specified by purchaser.
- The software shall allow the control of display from the client PC.
- The operator from the GUI software shall be able to decide the screen layout and also the cameras that shall be displayed on the monitors.
- The software shall support multicasting.

- The software shall support display of full screen to minimum 4x4 layout of cameras. Other display patters to be supported should be 2 x 2, 3 x 3, 1+ 5, 1+ 7, 1+ 9, 1+12, 1+15 or better.

  Its shall be possible to switch the screen layout in response to an alarm

3. ACCESS CONTROL SYSTEMS

3.1. SCOPE

3.1.1. The scope of work shall cover supply, installation, testing and commissioning of entire access control system meeting the intends of the specifications and drawings.

3.1.2. The system generally covers control of:

1.2 i) Normal door entry and exit with Reader and Controllers.
1.3 ii) Emergency exits
1.4 iii) Panic Hardware, Locking devices etc.,

3.1.3. The scope of work shall also cover field training of owner's representatives for a period of 10 working days or as required on the operation and maintenance of the system during normal and emergency conditions and also include the Annual Maintenance as required by the client.

3.2. Standards

1.5 The systems shall be standard products of adequate field experience and UL listing.

3.3. Submittals

3.3.1. THE TENDERER SHALL SUBMIT ALONG WITH THE TENDER:

1.6 I) Block diagram of the system proposed.

1.7 ii) Makes of various components and their catalogues.

1.8 iii) Comments on variances from the tender specifications indicating the financial implications.

3.3.2. UPON AWARD OF THE CONTRACT THE FOLLOWING SUBMITTALS SHALL BE MADE:

1.9 i) Final block diagrams
1.10 ii) Layout drawings of all floors showing runs of conduits and cables.
1.11 iii) Layout of security command center (SCC)
1.12 iv) Catalogues and selections of all equipment and component.
1.13 v) Samples of wiring materials, cards with the in scripts and all visible components.
1.14 All submittals shall be got approved before procurement.

3.4. General requirements:

The Access Control System shall be used to serve the objective of allowing entry and exit to and from the premises to authorized personnel only. The system employed shall be based on contact less smart card type technology.
The ACS shall use a Client Server architecture based around a modular PC network, utilizing industry standard operating systems, networks and protocols.

The system shall allow the distribution of system functions such as monitoring and control and graphical user interface etc. across the network to allow maximum flexibility and performance. The architecture shall include support of various Wide Area Networks using standard hardware and software to link nodes into a single integrated system. The network protocol used shall be industry standard TCP/IP. The system shall also support remote configuration and operation using standard dial-up modems.All controller subsystems shall have distributed intelligence. Normal access control decisions shall be made at the local panel without reference to the host.

Access decisions shall be made at each card reader, based on access criteria downloaded from the site controller. No reference shall be made to the site neither controller nor central management system during the access control attempt In the event of failure in the communication link between a sub-system panel and the server computer, the access control sub-system shall be capable of buffering a minimum of 100000 access transactions until communication is re-established with the server computer. Similarly, the lift/elevator access controller shall be capable of maintaining its access time schedules for securing floors in the event of communication failure with the server computer. The local time schedules shall be uploaded to the server computer once the communication is resumed. Changes in the server system database shall be capable of being downloaded to the relevant access controllers and the local databases of the connected sub-systems via the same physical communication links. Such downloading of data shall not disrupt normal data communications over the same links.Each card will contain a unique site code and a unique card number. The smart cards must have a capability to store two finger templates in its memory

All entry points would have a Biometric smart card reader and every entry would have to have a dual authentication. The authentication time should be less than 3 seconds. The monitoring, control and reporting facilities of the system shall be powerful Enough to enable security managers to manage their site's overall security The system should be capable of handling multiple locations from one software The Access Control System (ACS) shall be capable of integrating multiple building functions including access control, alarm management, intrusion detection, video, imaging and badging, database partitioning, and external system database sharing of employee personal information (MIS interface). The system shall be at the time of bid listed by Underwriters Laboratories listed for UL 294 Access Control Systems,. Bidders shall also provide copies of their UL listing cards or other proof of compliance before the award of a contract. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of control panels, card readers, and sensors. The

system shall incorporate the necessary hardware, software, and firmware to collect, transmit, and process alarm, tamper and trouble conditions, access requests, and advisories in accordance with the security procedures of the facility. The system shall control the flow of authorized personnel traffic through the secured areas of the facility. This particular specification covers the design, supply installation, testing, commissioning and support services of a Card based Access and Alarm Control System.
The system shall be designed for ultimate reliability and maximum operating efficiency using only the highest quality, fully field proven products. (the vendor should have installed similar system and has been working for at least a period of 2 years)

The vendors should own the access control software and if it is not owned the vendor should submit an undertaking from the OEM for support of the system & hardware throughout the lifecycle of the system.

3.5. Controllers

1.15 1. ***The Controllers shall be UL/EN certified and conform to UL/294 EN 50133-1 standards. The Integrated Security Management System (ISMS) hardware shall comprise of modular components that connect over standard interfaces to one another called intelligent controllers. Each Intelligent Controller shall have database storage and processing module (DBU), and once data has been downloaded to the DBU it shall locally make access control decisions. Access granted or denied decisions (excluding card & biometric validation time) shall be made in less than 1 second***

1.16 2. The DBU shall store firmware in non-volatile flash memory to allow for convenient updates through the head-end software application. The DBU shall store the cardholder and configuration database information in battery-backed memory so that loss of primary power will not cause the loss of the database. The DBU shall have modular configuration and support configurations that include Upto 12 doors with IN & OUT Reader Configuration. It should have capability to optionally support minimum 44 monitored input points and minimum 14 auxiliary output points by using modules.. It shall be possible to configure Access Controller in redundant mode.

1.17 3. Network Communications: The Access Controllers should have an on – board Ethernet, TCP/ UDP with its monitoring client PC over the local or wide area network. It should have an on – board web server and should support reading technologies as defined in the reader specifications.

1.18 Full stand-alone operation even in the event of power failure based upon internal backup battery.

1.19 Shared load operation for redundant configuration: a Control Unit shall be able to manage the Terminal devices assigned to another Control Unit should the latter be out of service. The two control units must share the same communication network.

3.6. APPLICATION SOFTWARE

1.20 The system shall be based on a multiple client – server architecture.

1.21 Disaster recovery: The ISMS product shall support disaster recovery solution using off-site database replication. It shall be capable of supporting options for 99.99% and 99.999% availability.

1.22 The system must be capable of running a pair of similarly configured computers in a hot backup configuration where at any point in time, one is the acting Primary and the other acting as the Hot Backup. An on-line database duplication mechanism must be supported.

1.23 Clients: The system shall support an unrestricted number of clients to suit growing requirements. The system shall provide the means for multiple operators to simultaneously administer the system from convenient locations connected via a LAN / WAN.

1.24 System Partitioning: The ISMS shall support an unrestricted number of partitions. The access point readers, monitor points, and auxiliary outputs shall be managed on a partition basis by simply defining which devices are to be included in a partition.

1.25 Events and Alarm Notification: The system should be capable of segregating events and alarms. Alarm management should be capable of being user defined based on priority levels and escalation. The ISMS shall be optionally configured to require operator comments when acknowledging alarms. Each alarm shall be capable of linking video from digital video recorders (if applicable) for incident playback. E-mail Alarms: The ISMS shall support the ability to automatically e-mail alarm condition messages to a destination e-mail address to be defined by the user.

1.26 History Archive and System Back up: The system shall allow on line archiving of history logs, along with database back up of system configuration and cardholder details.

1.27 Cardholder Management System

1.28 The ACS shall store security related cardholder/pass holder information in a relational database such as Microsoft SQL Server. The cardholder database shall support at least 100000 cardholders. The cardholder database shall be delivered with at least 40 user definable fields for storing data specific to the requirements of different ACS systems. It shall be possible to increase or decrease this number of user definable fields.

1.29 It shall be possible to define which user fields in the cardholder database are searchable fields. All searchable fields shall be able to be used to call up a list of cardholders who match a certain criteria. In addition, it shall be possible to search on multiple cardholder characteristics at one time.

1.30 It shall be possible for multiple cardholders to be selected and a single edit to be performed on all of these cardholders selected. For example, it shall be possible to select all cardholders in department "X" and change their address to "Z" in a single operation.

1.31 The ACS shall define templates in order to add groups of cardholders with predefined characteristics. A template shall contain all the

relevant details for a particular group of cardholders such as all their user fields and access levels.

1.32 It shall be possible to assign a single cardholder multiple cards for use in the ACS. Multiple cards assigned to a single cardholder shall be able to be in different states. For example, it shall be possible for a single cardholder to have both an "active" card assigned and an "inactive", "lost" or "stolen" card assigned.

1.33 Cards may be created and assigned to cardholders separately. It shall be possible to "return" a card when a cardholder no longer requires it, and then reassign it to another cardholder without having to delete and recreate the card.

1.34 When cardholders or cards are deleted or expired, or when a card is returned from use by a cardholder, the system shall automatically download this to the field controllers so that these cards no longer provide access.

Operator Security and Sign-On

Security

If necessary, each operator may be assigned a user profile that defines the following:

- Security and/or Control Level
- Operator Identifier
- Unique Password
- Area Assignment / Area Profile
- Start Graphic for that operator
- Timeout Value for that operator

Sign-On/Sign-Off

The operator shall be permitted to sign on to the system if the correct Operator Identity and the Operator Password have been entered. This password shall be encrypted. It shall also be possible to have the system linked to Windows such that the operator uses their Windows Account Name and password to sign on to the ACS system. This ensures that operators only need to remember 1 set of credentials.

After a series of three (3) unsuccessful attempts to sign-on the Operator Workstation interface shall be locked for a configurable period of time. During Operator Workstation lockout the other Windows functions of the computer running the Operator Workstation software shall not be affected.

It shall be possible to assign operators either single or multi-user passwords

Each operator shall be assigned a password and a set of authorized areas.

The operator may sign-off at any time by issuing a sign-off command.

A keyboard time-out feature shall be provided such that the operator shall be automatically signed off after a defined period of keyboard inactivity

Area Assignment / Area Profile

Each operator shall be assigned one or more specific areas of the building with the appropriate monitoring and control responsibility (no view, view only, alarm acknowledge only or full control). An area shall be defined in this context as a logical entity comprising of a set of points in the system. This in turn may represent a physical space in the building. Areas shall be used to partition the database in such a way as to assign operators control over certain areas and prevent unauthorized access to other areas.

It shall be possible to define individual tenant access by means of area assignment. Likewise, an operator's ability to control or monitor certain parts of a facility can be controlled by means of area assignment.

The system shall provide the facility to create area profiles, which combine areas and time periods, and which can be assigned to operators with the same area access requirements. By using area profiles in this way, area access can be specified to apply during certain time periods, allowing different areas of access at different times of the day or week.

1.35 Photo Identification Badges

1.36 It shall be possible to capture portraits and signatures for all cardholders and then create photo identification badges using these images.

3.7. READER SPECIFICATION

A. Read Only Contact less Smart Card Readers

1. Provide surface mounting style 13.56 MHz contact less smart card readers suitable for minimal space mounting configurations

2. Contact less smart card readers shall comply with ISO 14443A/B and ISO 15693 and shall read credentials that comply with these standards

3. The read range should be Upto 4 cm.

4. A red LED flashes green and beeper sounds when reader is presented with a Smart card

B. Contact less Bio Smart Card Reader

1. Provide surface mounting style 13.56 MHz contact less smart card readers suitable for minimal space mounting configurations.

2. Contact less smart card readers shall comply with ISO 14443A /B and ISO 15693 and shall read credentials that comply with these standards.

3. It should be possible to read either of the templates stored on the cards, the verification time should be less than 1 sec.

Door Hardware

- ✓ Door contacts shall be long-life multi-read type employing a stable magnet. The contact shall be corrosion resistant and hermetically sealed for fail-proof operation in dusty and high humid areas. The type of contacts shall be suitable for the door, metal or wooden, and the application.
- ✓ The contacts shall be NO or NC as required with an appropriate gap spacing but not less than 15mm. Contacts shall not freeze or get stuck if the door is sparingly used. The contact rating shall be to suit the size of door and the power supply of the access control system. Door locks shall be electromagnetic type and should be UL listed with 600lbs holding force and 12V operation. Lock will remain open in `fail-safe'.
- ✓ Wiring from the door contact and door lock to the controller and/or reader shall be minimum 0.8 mm^2 shielded cable or as per bill of materials.
- ✓ Panic bars should be DORMA make and should have provision for auxiliary contacts. Hardware shall be stainless steel bars suitable for single swing half hour rated fire rated wood or steel door complete with approved trim and it shall be as specified in the bill of materials. Door width will be minimum 750mm and a maximum of 1200mm.
- ✓ Tripod is designed to control pedestrians entering or exiting restricted area in medium level of security generally under some surveillances .The rotation is 3 X 120 degree (Tri-arm design) for bi-directional application with high volume of pedestrian movement. The mechanism would be electro mechanical as specified and would have solenoid locking.
- ✓ The rotation should stop after moving 120 deg. (tri arm). Tripod should have hydraulic damping which shall ensure that head always rotates quietly and smoothly to the neutral position. Tripod shall rotate to lock behind the pedestrian as one passes through the Tripod pathway. The lock should have Positive action lock which prevents two passages at one time. The throughput with access would be 15-20 persons per minute. In event of power off the tripod should be free to rotate in either direction.

1.37 The arms of tripod must be SS and they should have options for MS & SS body.

1.38 The OEM should have a service base in the place of installation

3.8. Acceptance Testing

1.39 The system shall be tested and validated for its function as an integrated security system conforming to the intents of the specifications. The following functional tests shall be carried out in the presence of the engineer-in-charge.

Card Readers	•	Card acceptance & entry clearance

	•	Card rejection
	•	Measure maximum distance of card reading (Proximity cards)
	•	Tamper switch
Doors	•	Door contact activation
	•	Door closing forces for delivering & door opening
	•	Time to door shut and to latch
	•	Panick/Fire escape hardware operation
Terminal Controller	•	Communication Failure mode: Full mode operation Event recording Supervising the monitoring circuits
	•	Power failure mode Full mode operation Event recording Supervising the monitoring circuits
Main Controller(SCC)	•	Same as FC's
	•	Uploading from TC's
	•	Databank and retrieval

1.40

4. Building Management System

System Architecture

Architecture of BMS system shall be of.

- Management Level (BMS Servers/Software)
- Control Level (DDC Controllers)
- Field Level (Field Sensors)

Each level of the system which is modular in structure shall operate independently of the next level up.

a. The Controllers shall utilize standard protocols at all levels. The following protocols are being used at the various level

- Control level BACnet, Ethernet TCP/IP / Other Communication Protocol as per Requirement.
- Management Level BACnet, Ethernet TCP/IP and shall be able to integrate any Other open protocol system with BMS

The analog and digital I/O module shall provide suitable number of channels to meet the requirement. Necessary no of power supply and communication modules shall be provided to meet system requirements.

Management level

Software and Server

At management level, the system shall have a Dedicated Management Integration Server with its own processor and Storage Capacity. BMS Software shall be inside this Dedicated Server. Normal IT Server or Computer which can be used for multiple operations other than BMS software shall NOT be used for higher reliability of BMS System.
Software shall be Linux based to make it immune against all viruses. Operating shall be on regular Windows OS.
Viewing and Operating of BMS System shall be possible on any normal Computer connected to Management Integration Server via Network.
BMS Software shall be accessible to ANY computer in the same network without any EXTRA USER LICENSE per PC.
Any User having Password for BMS shall be able to access the System.
Password shall have minimum 10 different authorities.
Simultaneously minimum 5 users shall be able to operate BMS System.
In case of failure of client PC, any other PC/Laptop shall be able to replace it without any software re-installation or re-commissioning.
Client PC shall act as only monitoring device and software and all data must be inside Dedicated management integration server designed only for BMS System.
A color LaserJet printer shall be connected to BMS system for printing of alarms, events and various report formats for the BMS system.

It must be possible to enter and / or amend all parameters (set points, control algorithms, time etc) and the structure diagrams (control and interlock programs) from various levels i.e. system controllers, DDC controllers, operator station and/or the Portable operator terminal.

Hardware

The hardware platform for the operator PC shall meet the following minimum specification:

- Core-2 Duo or Higher Processor
- 2GB RAM Memory
- Hard disk space sufficient to store data.
- 19" Super TFT/LCD monitor.
- Standard keyboard and mouse.
- DVD compatible CD R/W Drive
- Multimedia features.

Printer

A color LaserJet printer shall be connected to BMS system for printing of alarms, events and

Various report formats for the BMS system.

Software Modules

The operator station software shall be modular; object oriented, clearly structured and shall be based on Windows Operating Systems.

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.

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

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.

System INTEGRATION / ROUTER / GATEWAY / SYSTEM CORE SERVER

The Router/Gateway will be able to transmit and receives data from the DDC Controllers

The tasks of the interface shall include:

- Processing the installed DDC data points.

- Processing the installed I/O modules data points
- Converting local system controller addresses into physical DDC modules addresses
- Monitoring topology and DDC bus communication
- Synchronizing date, time and daylight savings time adjustments in the interface and the DDC modules.

A data Router /Gateway shall be of BACnet IP type approved by ANSI/ASHRAE.

It shall have 32 Bit Processor and minimum 256 MB internal Memory.

It shall save data from various DDC Controllers at least for 48 Hours in its own memory.

It must have Fire Alarm Input and one User definable Emergency Alarm Input. Upon

Receipt of these emergency signals, it shall operate all DDCs as programmed for these Emergencies. No need of emergency signal at every DDC Controller.

Control level

a. The control level shall comprise of various controllers. The controllers shall be TCP/IP Type and so shall be connected on normal Ethernet via CAT5/6 network cables. Or shall have its own communication protocol.

b. At this level, the HVAC system is controlled and monitored by the freely programmable Direct Digital Controllers (DDC). It shall be able to work in standalone mode, in case of failure of management level.

c. **Functionality of the DDC Control:**

The PID Type DDC Control equipment enables monitoring, open and closed-loop control and optimisation of HVAC systems.DDC controllers shall be used for monitoring/ controlling equipment intended to perform on the basis of logic, interlock and controller parameter.

They consist of freely programmable and modular DDC Controller units connected to operator Station through router/gateway. At this level the actual processing takes place based on controlling application software provided in DDC Controller. The processes are carried out at the DDC controllers for stand-alone control of plant.

Controller must be Modular type. IO cards shall be added as per requirement. User shall be able to add more IO points at later stage without replacing the complete controller. In case of failure of any IO Module, only that Module shall be replaceable

Display Units must be optional. User shall able to add displays at later stage without any change in cabling and Panel.

Controller must be DIN Rail mounting type without any screw or specific clamp. It shall be easy to install and remove from Panel.

All the Input Output terminal Blocks and Communication Terminal Blocks must be Screw less. It shall be simple press and fit Type.

Controller shall have Non-Volatile Memory Backup for storing DDC Program File.

It should have real time clock with lithium Battery Backup.

Controller must be able to work with any of the following standard Signal Type from or to field devices.

- 4-20 mA
- 0-20 mA
- 0-10 VDC
- 0-5 VDC

User must be able to change any field device with another field device of any of the above signal type without changing any Controller or IO Module.
For e.g. user shall be able to change pressure sensor having 4-20 mA current output to pressure sensor having 0-10 V Voltage output without change of any IO Module.

Alarms, switching commands, positioning commands, set point values, measuring values and counted values are processed in DDC Controllers.
The system involves monitoring and control of each HVAC system, with software that is programmable, to suit the parameters that are envisaged to be controlled as per HVAC control schematics for various equipment.
Vendor should be able to design, supply and install the system in line with the HVAC requirements. The Contractor is supposed to build the system in line with the latest practices / standards.
The DDC Controller shall be designed to be mounted in a safe area environment with a rated operating temperature range of 0°C to 50°C. If the proposed DDC Controller is not rated to 50°C, DDC enclosure shall be equipped with a fan for ventilation.

The DDC controllers shall be provided with minimum 16 bit microprocessors to carry out required control and management functions.

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. It shall have minimum 4 lines of LCD Display. It shall be able to display all alphanumeric characters.

d. **DDC Panels**

i. The DDC panel housing the DDC Controllers shall be located inside the specified area.

Proper care shall be taken to ensure that there is no problem caused due to inductive interference among the signal, control and power cables. These panels shall have IP54 protection.

ii. Panel shall have Power supply arrangement for all the field equipments connected to the DDC.

Field instrument, Sensors/switches/actuators

General specification of the field instruments shall be as under.

Duct and Room Mounted Temperature Sensor:

Temperature sensors shall be Platinum RTD (Resistance Temperature Detector) type.
The following shall apply to all temperatures sensors.

- RTDs shall be 100 ohm at 0oC (±.3 ohm) platinum element with strain minimizing construction and 3 integral anchored lead wires coefficient of resistivity of 0.00385 ohms/ohm/°C.
- Sensing element to be hermetically sealed.
- Stem and tip construction to be stainless steel.
- Sensors shall operate over the following ranges with the accuracies over the noted range of the sensor.
- 0°C to + 50°C, +/- 0.3°C.

Duct / Wall Mounted Humidity Transmitter

The humidity sensor shall be in an independent housing or be combined with the room /duct type temperature sensor in the common housing as per application requirement. The sensor should be electronic type with capacitive sensing element.

- Relative Humidity sensors shall be of standard 0-10 VDC or 4-20 mA type, well protected against solid and liquid contaminants with a permeable coating.
- Range of 0-100% RH.
- Accuracy: +/- 3%
- Operating temperature range of 0 to 50 °C
- Stainless steel sheath construction complete with integral shroud to enable specified operation in air streams of up to 10 m/sec.
- Maintenance of Sensor to be by a simple field method such as solvent or mild detergent solution washing, to remove anticipated airborne contaminants.
- Maximum sensor non-linearity of ±3% RH with defined curve.

Air Differential Pressure Switch

Differential Pressure Switch will have high precession measurement capability for monitoring the status of various blowers. Depending on differential pressure generated through two pressure ports for differential pressure measurement, it provides switching contact. Differential pressure range shall be as required.

- Internal material to be suitable for continuous contact with conditioned air stream.
- Switch shall be diaphragm type with scaled adjustment knob for setting switching differential and mounting bracket.
- Maximum operating pressure shall be 10kPa.
- Temperature range shall be -10°C to 80°C.

- Digital output signal shall be provided.
- Installation: Vertical on air handling unit.
- IP54 protection housing
- Housing & cover material shall be plastic.
- Two number plastic pipe connection to be provided suitable for connecting to silicone tubes.

Differential Pressure Sensor with Transmitter

Differential pressure sensor required as per BOQ with the following minimum specifications for measuring differential pressure:

- Output shall be 0 to 10V or 4-20 mA proportional to measuring range.
- Measuring range shall be 0 to 10 Pa or 0-500pa as required.
- Voltage supply 24VDC/AC
- Pressure measuring ports shall be provided.
- Sensor housing shall be constructed of ABS/Plastic.
- Protection class IP54
- Ambient temperature range shall be 0 to 50°C.

WATER FLOW SWITCH

These shall be paddle type and suitable for the type of liquid flowing in the line. Output shall be
2NO/2NC potential free

TRANSDUCERS FOR ELECTRICAL SERVICES

Electrical transducers shall be integrated electronic type and rack mounted on the field. These shall work on 230 V supply with the output being standard type i.e. 4-20 mA, 0- 10 Volts etc.

Power factor, Voltage, Current, Frequency and Kilowatt transducers shall have standard output signal for measurement for the specified variable.

Kilowatt-Hour metering (if any) shall be poly-phase, three- element with current transformer (CT) operated type. The metering shall feature high accuracy with no more than +/- 1% error over the expected load range. The coils shall be totally encapsulated against high impulse levels.

LEVEL SWITCH

The level switches shall have to meet the following requirement:

Type	*: Float Type/Capacitance type/Conductivity type*
Mounting	*: To suit application.*
Connection	*: Flanged ANSI 150 lbs RF Carbon steel*

Float material : 316 SS
Stem Material : 316 SS
Output : 2 NO, 2 NC Potential free
Switch Enclosure : IP 55

1.40.1.1.1 **Water Flow Meters**: Water flow meters shall be axial turbine style flow meters which translate liquid motion into electronic output signals proportional to the flow sensed.

1.40.1.1.2 Flow sensing turbine rotors shall be non-metallic and not impaired by magnetic drag.

1.40.1.1.3 Flow meters shall be 'insertion' type complete with 'hot-tap' isolation valves to enable sensor removal without water supply system shutdown.

1.40.1.1.4 Accuracy shall be $\pm$ 2% of actual reading from 0.4 to 20 feet per second flow velocities.

1.40.1.1.5 Low Temperature Limit Switches. Safety low limit shall be manual reset twenty foot limited fill type responsive to the coolest section of its length.

1.40.1.1.6 High Temperature Limit Switches. Safety high limit (firestats) shall be manual reset type.

1.40.1.1.7 CO2 Sensors: Carbon Dioxide sensors shall be 0-10 Vdc analog output type, with corrosion free gold-plated non-dispersive infrared sensing, designed for duct mounting.

1.40.1.1.8 Sensor shall incorporate internal diagnostics for power, sensor, analog and output checking, and automatic background calibration algorithm for reduced maintenance. Sensor range shall be 0-2000 PPM with +/- 50 PPM accuracy.

1.40.1.1.9 Humidity Sensors.

1.40.1.1.10 Duct and room sensors shall have a sensing range of 5% to 95%.

1.40.1.1.11 Duct sensors shall be provided with a sampling chamber.

1.40.1.1.12 Outdoor air humidity sensors shall have a sensing range of 20% to 95% RH. They shall have a compensated ambient temperature range of -40°F to 170° F.

1.40.1.1.13 **Enthalpy Sensors**. Duct mounted enthalpy sensor shall include a temperature sensor and a humidity sensor constructed to close an electrical contact upon a drop in enthalpy (total heat) to enable economizer modes of operation where specified.

Actuators, General**.** All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. Valves shall be provided with actuators suitable for floating or analog signal control as required to match the controller output. Actuators shall be power failure return type where valves or dampers are required to fail to a safe position and where specified.

Control valves

Two-port seat valve
Material Grey cast iron
Pressure class PN10
Connection size DN65 – DN150, flanged
Pressure drop kvs 63 – 315 m^3/h
Actuator
Operation voltage AC 24 V +-20%
Input control signal 0-10 V and/or 4-20 mA
Run time ≤120 s
Power consumption ≤30 VA
Positioning force ≥2800 N
Degree of protection IP54

Ultrasonic BTU meter
Power Supply: 230 VAC
Communication Interface: MBus
Enclosure Protection: IP 65
Ambient Temp range: 0 to 50 deg C

E**XECUTION**

INSTALLATION

All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the temperature control system manufacturer or its exclusive factory authorized installing contracting field office (representative). The installing office shall have a minimum of five years of installation experience with the manufacturer and shall provide documentation in submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the local exclusive factory authorized temperature control contracting field office (branch or representative).

Install system and materials in accordance with manufacturer's instructions, and as detailed on the project drawing set.

Drawings of temperature control systems are diagrammatic only and any apparatus not shown, such as relays, accessories, etc., but required to make the system operative to the complete satisfaction of the Architect shall be furnished and installed without additional cost.

Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Temperature Control sub-contractor in accordance with these specifications.

Equipment furnished by the HVAC Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Temperature Control sub-contractor.

All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

WIRING

All electrical control wiring and power wiring to the control panels shall be the responsibility of the BMS contractor.

The electrical contractor (Div. 16) shall furnish all power wiring to electrical starters and motors.

All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All BMS wiring shall be installed in the conduit types specified in the Project Electrical Specifications (Division 16) unless otherwise allowed by the National Electrical Code or applicable local codes. Where BMS plenum rated cable wiring is allowed it shall be run parallel to or at right angles to the structure, properly supported and installed in a neat and workmanlike manner.

WARRANTY

Equipment, materials and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.

Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly (within 48 hours after receipt of notice) repaired or replaced by the Temperature Control sub-contractor at no expense to the Owner

WARRANTY ACCESS

The Owner shall grant to the Temperature Control sub-contractor, reasonable access to the BMS during the warranty period. The owner shall allow the contractor to access the BMS from a remote location for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period.

ACCEPTANCE TESTING

Upon completion of the installation, the Temperature Control sub-contractor shall load all system software and start-up the system. The Temperature Control sub-contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.

The Temperature Control sub-contractor shall perform tests to verify proper performance of components, routines, and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.

Upon completion of the performance tests described above, repeat these tests, point by point as described in the validation log above in presence of Owner's Representative, as required. Properly schedule these tests so testing is complete at a time directed by the Owner's Representative. Do not delay tests so as to prevent delay of occupancy permits or building occupancy.

System Acceptance: Satisfactory completion is when the Temperature Control sub-contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner’s Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

OPERATOR INSTRUCTION, TRAINING

During system commissioning and at such time acceptable performance of the BMS hardware and software has been established the Temperature Control sub-contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software and accessories.

The Temperature Control sub-contractor shall provide 40 hours of instruction to the owner's designated personnel on the operation of the BMS and describe its intended use with respect to the programmed functions specified. Operator orientation of the BMS shall include, but not be limited to; the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the System's operation.

The training shall be in three sessions as follows:

Initial Training: One day session (8 hours) after system is started up and at least one week before first acceptance test. Manual shall have been submitted at least two weeks prior to training so that the owners' personnel can start to familiarize themselves with the system before classroom instruction begins.

First Follow-Up Training: Two days (16 hours total) approximately two weeks after initial training, and before Formal Acceptance. These sessions will deal with more advanced topics and answer questions.

Warranty Follow Up: Two days (16 hours total) in no less than 4 hour increments, to be scheduled at the request of the owner during the one year warranty period. These sessions shall cover topics as requested by the owner such as; how to add additional points, create and gather data for trends, graphic screen generation or modification of control routines.

Technical Specifications for Water Leak Detection

Part 1 - General

1.1 Furnish a complete leak detection system including electronic alarm modules, water sensing cable, graphic display map, and auxiliary equipment. The system shall be capable of automatically detectingthe presence of water at any point along the continuous length of sensing cable. The system shall sound an alarm and locate, with a digital display, the point of liquid contact within 10 ft per 1000 feet of the total connected sensing cable length. No more than 1 foot of liquid, in contact with a sensing cable at a depth of 1/16 inch, shall be required to cause an audible alarm at the electronic alarm module.

1.2 The system shall be UL listed.

1.3 The system manufacturer shall have at least five years of experience with leak detection and location technology, including both sensing cable and the associated alarm electronics. The manufacturer shall provide written verification of current ISO 9001 registration.

Part 2 - Products

2.1 The alarm and locating module shall be housed in a NEMA 12 enclosure and have a 4 line x 20 character backlit LCD display which provides status and alarm data. It shall be capable of monitoring up to 5000 feet (1500 m) of sensing cable. The alarm and locating module shall

continuously monitor all sensing cable for liquid contact. Contact with liquid shall result in an audible alarm, illumination of a "leak" LED, actuation of an output relay, and digital display of the distance to the liquid location. The electronic alarm module shall continue to monitor the sensing cable after detection of liquid. It shall re-alarm if the liquid spreads, or if a second leak is detected, more than a specified distance from the original location. The complete system shall be continuously monitored for electrical continuity. The loss of continuity in any of the wires shall result in an audible alarm, illumination of a "fault" LED, and actuation of an output relay.

The electronic alarm modules shall require no operator programming and shall automatically calibrate whenever power is applied. Test, silence, and reset functions shall be activated from the front panel upon user command. The alarm module shall have a security password. It shall report, date and time stamp, and record to non-volatile memory, all alarm events into an events history log. The alarm module shall be capable of digitally communicating to host systems via RS-232 orRS-485, at the user's option. It shall also provide a 4-20 mA analog interface signal. The alarm module shall be tested and found to comply with the limits for a Class B digital device, pursuant to FCC, Part 15. The alarm module shall operate on 120VAC, 60 Hz, single phase power. Each module will require a dedicated 15 amp, 120VAC circuit.

2.2 The water sensing cable shall be resistant to corrosion. It shall detect the presence of waterbased liquids but shall not detect hydrocarbons. The cable shall be constructed of two sensing wires and two insulated wires embedded in a fluoropolymer carrier rod. The sensing wires shall be jacketed with a conductive fluoropolymer. The cable shall be constructed with no metal parts exposed to the environment. Sensing cable shall dry within 15 seconds of removal from free water; sensing cable which is braided in construction is not acceptable. The sensing cable shall have a breaking strength of 160 pounds. It shall have an abrasion resistance of >65 cycles per UL 719. The sensing cables shall be capable of accommodating any number of branches using branching connectors .

2.3 Jumper cable shall be available to interconnect sensing cables or to facilitate remote mounting of the electronic alarm module. Jumper cable may not add more than 0.01% of additional length to the leak detection circuit.

2.4 All sensing and jumper cable shall pass UL 910, Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces, and shall be Class 2 plenum cable per NEC 725-51 (a).

2.5 All sensing cable, jumper cable, and system components shall be provided by the manufacturer in modular lengths with electrical connectors which have been pre-installed and tested at the factory. Field splicing is not acceptable.

2.6 A portable test box shall be provided to the leak detection system installer. It shall become the property of the owner, upon system acceptance, for use in the ongoing preventive maintenance of the leak detection system.

Part 3 - Execution

3.1 All system components shall be installed in accordance with the manufacturer's installation instructions, NEC, and local code requirements. The sensing cable shall be installed after all piping, air conditioning, raised flooring, and other mechanical work has been completed. The subfloor sensing cable path shall remain clear of water, oil, solder, flux, dirt or other materials which may soil the sensing cable.

3.2 The sensing cable shall be installed beneath the raised flooring, around the perimeter of all rooms, a maximum of 3 feet from the outside wall. Route sensing cable a minimum distance of 3 feet beyond the perimeter of all A/C units. In addition, lay the cable in a serpentine pattern on 4 - 8 foot minimum centers to protect interior surface areas where water sources are found, such as A/C unit and CPU piping, floor drains, chillers, etc. The sensing cable should be installed under the center of floor tiles to facilitate access to, and visual location of, leaks. Sensing cable shall be secured to the sub floor with plastic hold-down clips on approximately 6 foot intervals.

3.3 The sensing cable installer shall be responsible for installation of the sensing cable, functional testing, and mapping of the system.

3.4 Upon completion of the system installation, a factory pre-connectorized 5 foot long water sensing cable shall be temporarily installed at the far end of the each leak detection circuit. The sensing cable shall be immersed in approximately 1 foot of water, at a depth of 1/8 inch, to confirm that an audible alarm is generated at the alarm module and that the appropriate distance to the leak is displayed. The installer shall perform and certify the tests in the presence of the owner's representative.

3.5 A graphic display map prepared from "as built" drawings shall be furnished upon completion. The map shall indicate the location of the sensing cables, landmarks such as equipment, A/C units, walls, floor drains, change of cable direction, and cable distance readings. The map shall be mounted next to the alarm and locating module.

Technical Specifications For Rodent Repellent

(i) OBJECTIVE:

The objective is to protect the entire premises viz., all the voids against rodents. The purpose is to keep the rodents away from the floor by generating very high frequency sound waves (above 20 Khz) which are not legible to human ear but irritates rodents. The objective is to protect all the cables below floor, above ceiling & room void from damage caused by rodents.

(ii) SCOPE:

The system proposed is to protect all the equipments, areas with relevant type of high frequency sound producing device called satellites or transducers.

Once powered up these transducers produce very high frequency variable sound waves (above 20 Khz) continuously which irritate the rodents and are forced to evacuate the place.

The system shall cover minimum of 10,000 sqf area per controller & shall be able to connect minimum 20 transducers per controller. The transducers shall cover minimum 100 sqf of area.
The devices can be tested periodically by means of a test switch provided on the Main console.

(iii) APPLICABLE STANDARD:

The OEM shall have an I DEM I and CFTRI certification for its products.

(iv) SATELLITES :

The satellites or Transducers shall be circular ceiling mounted low profile units that produce high decibel sound waves at very high frequency not less than 20 Khz. These satellites shall cover an area not less than 100 Sq.ft for Room void application,for ceiling Voids & floor void applications.

These shall be powered thru Main Controller to 20 satellites in parallel (i.e. no looping of satellites)

(v) CONTROLLER :

The controller shall support 20 Transducers and shall come with a pair of stands and brackets. The controller is installed in the control / BMS room and the transducers in the problematic areas i.e. above and below false ceiling and below false flooring.

a)Features:

- 10,000 Sq Feet of Area Coverage per system/ Controller.
- shall drive up to 20 Transducers. With minimum @ 100sft coverage each.
- LCD display with on-board controls for changing the following parameters.
- Wave Speed: Is an indicator for the number of frequency sweeps per minute. It can have a maximum value of 130 and a minimum value of 60. The incremental size is 5 i.e. 65,70,75 and so on.
- Wave Density: Is an indicator for the number of divisions within a frequency band. It can have a maximum value of 100 and a minimum value of 80. The incremental size is 10 i.e.80,90 and 100.
- Frequency Band Time: Is an indicator of the time for which the controller would operate in a pre programmed frequency band. There are 3 bands available: Band A, Band B, and Band C. This parameter can have maximum value of 10 minutes and a minimum value of 1 minute per band. Depending upon the time frame set for each band, the controller will switch the bands automatically.
- Machine/Controller ID: Is an indicator of the machine/controller identification number. It

can have any value within the range of 1 to 255.

- Password Protection: Every controller is password protected. To change the parameters mentioned above you have to key in the password. The password can be changed if required. The password can be any 5 digit number.
- Frequency Testing: This feature will enable the user to test and verify the frequency that is being transmitted from the controller to the transducer. This feature would be particularly useful during systems audit.
- Transducer Testing: All the 20 transducers can be tested in an audible range one at a time by using this feature.
- Provision for restoring all the parameters to the factory default setting
  - Inbuilt RS/EIA-485 transmission upto 1.2 kms to protected area(BMS Room).

Safety & Security

Provision of a termination switch so that the controller data can be transferred to the computer and can be subsequently viewed by installing CRMS Software.

- Daisy chain protocol for interfacing 64 controllers (nodes)
- Independent Driver for each transducer.
- Independent test facility for each transducer.
- Transducer should cover up to 500 sq. feet of area above false ceiling, below false ceiling and below false flooring or up to 400 sq. feet of area above false ceiling, below false ceiling and below false flooring
- Frequency band of > 20 KHz and <60 KHz is pre tuned for 100 different frequencies.
- UL and CE approved transformers for power supply.

(vi) GUI Software Compatibility having the following Features:

a) Facility to configure controller parameters for all controllers in one go (broadcast) or for an individual controller.
b) Facility to schedule / generate a consolidated Health Status Report of all the controllers and / or an individual controller. This is possible either with the help of the inbuilt scheduler (Daily, Weekly, Fortnightly and Monthly Schedules) or in real time.
c) Individual folders for individual Controller reports with the folder name same as the machine id. This folder will contain the Report in text format and the PCB image of the corresponding controller. One single folder for the consolidated report. This folder will contain only the report in text report and shall depict the status of all controllers.
d) PCB snapshot of the controller for faulty transducer drivers.
e) Configurable control of the image quality of the PCB snapshot, thereby enabling the customer to manage the computer Memory effectively.
f) Admin Level password for report generation and scheduling.
g) Service Level password for parameter configuration of all / individual controllers.
h) Test facility to check if the signal is being transmitted to the transducer from the drivers on the PCB.
i) Ping facility to check if all the controllers installed at the customer site are in the daisy chain network. If not then the Corresponding controller will have an „Offline‟ status else it will have an "Online‟ status.

j) Configurable ping acknowledgement / return time. This would be the time for which CRMS software would wait for the Controller to respond before it confirms thestatus of the controller as „Online‟ or „Offline‟.
k) Test Facility to test all controllers in a sequential mode or in an individual mode.
l) Online servicing/maintenance via web meetings.
m) RS/ EIA 485 to RS/EIA 232C converter to transfer the controller data to the serial port of your computer.

VERY EARLY SMOKE DETECTION & ALARM SYSTEM

Provide an air sampling smoke detection system (Very Early Smoke Detection Apparatus - VESDA) for each area shown in the Contract Documents. Provide a [Laser Focus air sampling smoke detection system for areas up to 2500 sq. ft.] [Laser OMPACT air sampling smoke detection system for areas up to 8000 sq. ft.] [Laser PLUS air sampling smoke detection system for areas up to 20000 sq. ft.] in accordance with manufacturer's recommendations.

The air sampling smoke detection system shall consist of highly sensitive smoke detectors with aspirating fans, air sampling pipe network, filters, networked controllers and a high-level interface to the building Fire Alarm System, as required.

The air sampling detectors shall provide a nominal obscuration level range from .0015 to 6% /ft., adjustable through the system operator control interface.

Multiple VESDA systems serving protected areas shall be integrated via closed loop VESDAnet 2-wire communications and a high-level RS-232 interface with the building Fire Alarm System. The system will provide access to all VESDA features and functions through the Fire Alarm Control Panel operator's interface.

The Fire Alarm System supplier shall coordinate the installation and testing of the VESDA system, in accordance with applicable codes and the Contract Documents. Provide complete VESDA system design, installation, interface, and programming to include the following:

Smoke Detector Assembly: The smoke detector, filter, and aspirating fan shall be housed in a Detector Control Assembly Enclosure and arranged in such a way that air is drawn from the protected area through the filter and detector by the aspirating fan.

The Detector Control Assembly shall house the programmable intelligent controller, which will support air flow/detector supervision, automatic and manual sensitivity adjustment, time delay and remote reset functions. LaserCOMPACT detector shall communicate with the FACP via IDNet channel.

The system shall provide 3 field-selectable levels of alarm status: Alert Level 1 (.04% obscuration/ft.), pre-Alarm Level 2 (1.06 % obscuration/ft.) and Alarm Level 3 (2.6% obscuration/ft.). Actual sensitivity levels will be determined in the field and programmed during system commissioning. Alarm Levels 1 and 2 will initiate a Supervisory Condition on the Fire Alarm System, and Alarm Level 3 will initiate the building-wide evacuation sequence as described elsewhere in the Contract Documents.

Air Sampling Pipe Network: Shall consist of a ¾ inch nominal inside diameter pipe arranged to provide optimal efficiency and air transport times which shall not exceed 60 seconds from the furthest point on the network. Sampling points shall be separated at intervals specified

in NFPA 72; not more than 30 feet and typically in the range of 13 to 26 foot intervals along the path of the piping network. Air sampling calculations shall be provided from a registered VESDA sampling pipe aspiration modeling program ASPIRE rev. 1.8 or later.

High Level Interface: Where VESDA net is used, provide interface module integral to the Fire Alarm Control Panel with connection to the High Level Interface Module and installed in the VESDAnet equipment rack assembly.

ADDRESSABLE VERY EARLY ASPIRATION SMOKE DETECTION SYSTEM

Provide a Very Early Smoke Detection (Laser COMPACT) air sampling smoke detection system for areas up to 8000 sq. ft. The air sampling smoke detection system shall consist of highly sensitive smoke detectors with aspirating fans, air sampling pipe network, filters, networked controllers and a high-level interface to the building Fire Alarm System, as required.

The air sampling detectors shall provide a nominal obscuration level range from 0.016% to 4.08% /ft., adjustable through the system operator control interface

The Fire Alarm System supplier shall coordinate the installation and testing of the VESDA system, in accordance with applicable codes and the Contract Documents. Provide complete VESDA system design, installation, interface, and programming to include the following:

Smoke Detector Assembly: The smoke detector, filter, and aspirating fan shall be housed in a Detector Control Assembly Enclosure and arranged in such a way that air is drawn from the protected area through the filter and detector by the aspirating fan.

The Detector Control Assembly shall house the programmable intelligent controller, which will support air flow/detector supervision, automatic and manual sensitivity adjustment, time delay and remote reset functions. LaserCOMPACT detector shall communicate with the FACP via addressable loop protocol.

The system shall provide 3 field-selectable levels of alarm status: Alert Level 1 (.04% obscuration/ft.), pre-Alarm Level 2 (1.06 % obscuration/ft.) and Alarm Level 3 (2.6% obscuration/ft.). Actual sensitivity levels will be determined in the field and programmed during system commissioning. Alarm Levels 1 and 2 will initiate a Supervisory Condition on the Fire Alarm System, and Alarm Level 3 will initiate the building-wide evacuation sequence as described elsewhere in the Contract Documents.

ADDRESSABLE ASPIRATION SMOKE DETECTION SYSTEM (NORMAL SENSITIVITY)

Aspiration unit with pre-installed addressable sensor is designed to cover areas up to 1800 to 3600 square feet based on the number of sensors. This coverage would be carried out by using single or two pipe networks, active air sampling techniques combined with addressable smoke sensing technology available with single / dual inlet detection system;

Provides remote sensor location for difficult service areas—up to 50 ft. with flexible tubing or 82 ft. with rigid pipe

Aspiration unit provides airflow monitoring circuitry and an aspiration system that is configurable. The airflow level is displayed on a ten element bar graph with adjustments for flow sensitivity and high/low flow thresholds and can be adjustable air speed settings from the Aspiration unit for easy setup.

Individual smoke sensitivity selection and Aspiration smoke sensor have Sensitivity Range - 0.5% to 3.0% / foot obscuration

Optional water trap with drain prevents nuisance alarms associated with condensation buildup

Directly sit at addressable loop without using any interface module and communicate all information to panel and Ability to display and print detailed sensor information Smoke sensitivity in percent per foot and in easy-to-understand terms.

UL Listed to Standards 268A and 268 and ULC Listed to Standard S529

RECOMMENDED MAKE FOR LV/BMS WORKS

FIRE ALARM SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	ADDRESSABLE FIRE ALARM CONTROL PANEL	SIMPLEX / NOTIFIER
2	REPEATER PANEL	SIMPLEX / NOTIFIER
3	SMOKE DETECTOR	SIMPLEX / NOTIFIER
4	HEAT DETECTOR	SIMPLEX / NOTIFIER
5	MULTI SENSOR	SIMPLEX / NOTIFIER
6	HOOTERS / SOUNDER	SIMPLEX / NOTIFIER
7	STROBE CUM SOUNDERS	SIMPLEX / NOTIFIER
8	MANUAL CALL POINTS	SIMPLEX / NOTIFIER
9	MONITOR MODULE	SIMPLEX / NOTIFIER
10	CONTROL MODULE	SIMPLEX / NOTIFIER
11	FAULT/LOOP ISOLATOR	SIMPLEX / NOTIFIER
12	RELAY MODULE	SIMPLEX / NOTIFIER
13	RESPONSE INDICATOR	AGNI
14	FRLS ARMOURED CABLE	POLYCAB / FINOLEX
15	POWER SUPPLY	MICRO POWER / EQ
ACCESS CONTROL SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	DOOR CONTROLLER	HONEYWELL / SEIMENS
2	PROXIMITY CARD READER	HID / HONEYWELL / SEIMENS
3	PROXIMITY CARD	HID / HONEYWELL / SEIMENS
4	MAGNETIC DOOR LOCK	CAPTURE
5	MAGNETIC DOOR CONTACT	SECURICO
6	TIME ATTENDANCE SOFTWARE	HONEYWELL
7	BREAK GLASS UNIT (GREEN MCP)	SYSTEM SENSOR
8	FRLS ARMOURED CABLE	POLYCAB / FINOLEX

9	PVC CONDUIT (L.H.S.F.T)	
10	POWER SUPPLY	MICRO POWER / EQ
CCTV SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	CCD CAMERA DOME	HONEYWELL / SEIMENS/ SONY / AXIS
2	CCD CAMERA BOX - INDOOR	HONEYWELL / SEIMENS/ SONY / AXIS
3	LENS	SAMSUNG / AXIS
4	CCD CAMERA BOX - OUTDOOR	HONEYWELL / SEIMENS/ SONY / AXIS
5	DOME CAMERA	HONEYWELL / SEIMENS/ SONY / AXIS
6	DIGITAL VIDEO RECORDER	HONEYWELL / SEIMENS/ SONY / AXIS
7	LCD FLAT SCREEN MONITOR	SAMSUNG / PANASONIC / SONY
8	RG 11 ARMOURED CABLE	POLYCAB / FINOLEX
9	FRLS ARMOURED CABLE	POLYCAB / FINOLEX
10	LHSFT PVC CONDUIT	
11	POWER SUPPLY	MICRO POWER / EQ
GAS SUPPRESSION SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	NOVEC 1230 FLUID	KIDDE FIRE / TYCO / SEIMENS
2	SEAMLESS CYLINDER	KIDDE FIRE / TYCO / SEIMENS
3	VALVE	KIDDE FIRE / TYCO / SEIMENS
4	ACTUATOR	KIDDE FIRE / TYCO / SEIMENS
5	NOZZLE	KIDDE FIRE / TYCO / SEIMENS
6	PIPE	TATA / JINDAL
7	GAS RELEASE PANEL	RAVEL - UL LISTED
8	RELEASE SWITCH	RAVEL - UL LISTED
9	ABORT SWITCH	RAVEL - UL LISTED
RODENT REPELLENT SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	RODENT REPELLENT CONTROL PANEL	MASER
2	TRANSDUSER	MASER

WATER LEAK DETECTION SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	CABLE	SONTAY
2	CONTROL PANEL	SECURICO
WATER LEAK DETECTION SYSTEM		
SR. NO.	**ITEM NAME**	**MAKE**
1	ASPIRATION SYSTEM	SYSTEN SENSOR / XTRAILS

DRAWINGS

Sr. No	DRAWING NUMBER	DESCRIPTION
1	IITM_DC_ACS_MECH_00.dwg	ACCESS CONTROL LAYOUT FOR GROUND FLOOR
2	IITM_DC_ACS_MECH_01.dwg	ACCESS CONTROL LAYOUT FOR FIRST FLOOR
3	IITM_DC_CCTV_MECH_00.dwg	CCTV LAYOUT FOR GROUND FLOOR
4	IITM_DC_CCTV_MECH_01.dwg	CCTV CONTROL LAYOUT FOR FIRST FLOOR
5	IITM_DC_FAS_MECH_00.dwg	FAS LAYOUT FOR GROUND FLOOR
6	IITM_DC_FAS_MECH_01.dwg	FAS CONTROL LAYOUT FOR FIRST FLOOR

BoQ

Sr. No.	Description	Unit	Qty.
	Fire Alarm System		
1.0	Supply, installation, testing & commissioning of Networkable 1 Single Loop Intelligent Analogue Addressable Fire Alarm Control Panel with minimum 80 characters LCD display including **Bacnet Gateway for Integration with BMS System**, The panel shall have the facility to be networked with other panel.	Nos	1
2.0	Supply, installation, testing & commissioning of Analogue Addressable Multi-Sensor detectors combined (Optical + thermal) with including detector mounting base & required accessories.	Nos	29
3.0	Supply, installation, testing & commissioning of Addressable Manual Call Points (**Pull Station Type**). The same shall be square in shape & made of ABS plastic material. Surface / Flush Mounting. It shall have a "Break glass" message embedded on the glass. The addressable module shall be enclosed along with the break glass in a junction box & with required accessories.	Nos	5
4.0	Supply, installation, testing & commissioning of Conventional **Strobe cum Sounder**. The strobe cum sounder shall be made of ABS plastic material & have the Db level of minimum 90dBs and a multi tone facility, wall / ceiling mounted with mounting base & required accessories.	Nos	5
5.0	Supply, installation, testing & commissioning of Addressable Monitor Module for Beam Detectors with Surface / wall mounting box & required accessories. (**UL Approved**)	Nos	RO
6.0	Supply, installation, testing & commissioning of Addressable Control Module with surface/ wall mounting box & required accessories (**for sounders, strobe light & strobe cum sounders**)	Nos	RO
7.0	Supply, installation, testing & commissioning of Addressable Control Module with surface/ wall mounting box & required accessories (**for Access triping off**)	Nos	7
8.0	Supply, installation, testing & commissioning of Addressable Fault / Loop isolator module with Surface mounting backbox & required accessories.	Nos	3

9.0	Supply, installation, testing & commissioning of Response indicator for Above false ceiling detectors with required acessories.	Nos	10
10.0	Supply, installation, testing & commissioning of Addressable Relay Module with surface/ wall mounting box & required accessories.	Nos	RO
11.0	Supply and laying of 2C x 1.5 Sq.mm Copper Armoured Multi stranded FRLS cable on wall / slab or structure with necessary spacer & saddles. scope shall also include required end termination using gland,lugs & required accessories. (**Red in Colour**)	Rmt	500
12.0	Siren of 3 kms range	Nos	1
	SUB - TOTAL OF FAS		

GAS BASED SUPPRESSION SYSTEM

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD			
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR ELECTRICAL ROOM (OPTIONAL ITEM)			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply,Installation,Testing & Commisioning of :		
1	120 ltrs Seamless Cylinder with valve	2	Nos
2	Pressure Guage +Low pressure supervisory switch	2	Nos
3	NOVEC 1230 gas	219	Kgs
4	Electromagnetic Actuator	1	Nos
5	Manual Actuator	1	Nos
6	Pneumatic actuator	2	Nos
7	Flexible Discharge Hose	2	Nos
8	Flexible Actuation Hose	2	Nos
9	Discharge Nozzles	7	Nos.

10	Check Valve	2	Nos.
11	Flow Switch	1	Nos.
12	Manifold	1	Nos.
13	Wall mount kit	4	Nos
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot
15	Gas Release panel with release module and battery backup	1	Nos
16	Manual Release Switch	2	No
17	Abort Switch	1	No
18	Room Integrity Test	1	Lot
	SUBTOTAL		

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD			
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR BATTERY ROOM (OPTIONAL ITEM)			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply,Installation,Testing & Commisioning of :		
1	120 ltrs Seamless Cylinder with valve	2	Nos
2	Pressure Guage +Low pressure supervisory switch	2	Nos
3	NOVEC 1230 gas	187	Kgs
4	Electromagnetic Actuator	1	Nos
5	Manual Actuator	1	Nos
6	Pneumatic actuator	2	Nos

7	Flexible Discharge Hose	2	Nos
8	Flexible Actuation Hose	2	Nos
9	Discharge Nozzles	6	Nos.
10	Check Valve	2	Nos.
11	Flow Switch	1	Nos.
12	Manifold	1	Nos.
13	Wall mount kit	4	Nos
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot
15	Gas Release panel with release module and battery backup	1	Nos
16	Manual Release Switch	2	No
17	Abort Switch	1	No
18	Room Integrity Test	1	Lot
	SUBTOTAL		

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD			
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR UPS ROOM (OPTIONAL ITEM)			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply, Installation, Testing & Commissioning of		
1	120 ltrs Seamless Cylinder with valve	2	Nos
2	Pressure Guage +Low pressure supervisory switch	2	Nos
3	NOVEC 1230 gas	187	Kgs

4	Electromagnetic Actuator	1	Nos
5	Manual Actuator	1	Nos
6	Pneumatic actuator	2	Nos
7	Flexible Discharge Hose	2	Nos
8	Flexible Actuation Hose	2	Nos
9	Discharge Nozzles	6	Nos.
10	Check Valve	2	Nos.
11	Flow Switch	1	Nos.
12	Manifold	1	Nos.
13	Wall mount kit	4	Nos
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot
15	Gas Release panel with release module and battery backup	1	Nos
16	Manual Release Switch	2	No
17	Abort Switch	1	No
18	Room Integrity Test	1	Lot
	SUBTOTAL		

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD			
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR BMS ROOM (OPTIONAL ITEM)			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply,Installation,Testing & Commisioning of :		
1	80 ltrs Seamless Cylinder with valve	1	Nos
2	Pressure Guage +Low pressure supervisory switch	1	Nos
3	NOVEC 1230 gas	36	Kgs
4	Electromagnetic Actuator	1	Nos
5	Manual Actuator	1	Nos
6	Pneumatic actuator	1	Nos
7	Flexible Discharge Hose	1	Nos
8	Flexible Actuation Hose	1	Nos
9	Discharge Nozzles	1	Nos.
10	Wall mount kit	2	Nos
11	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot
12	Gas Release panel with release module and battery backup	1	Nos
13	Manual Release Switch	1	No
14	Abort Switch	1	No
15	Room Integrity Test	1	Lot
	SUBTOTAL		

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD			
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR SERVER ROOM			
S.No.	**Item Description**	**Qty**	**Unit**
	Supply,Installation,Testing & Commisioning of :		
1	120 ltrs Seamless Cylinder with valve	7	Nos
2	Pressure Guage +Low pressure supervisory switch	7	Nos
3	NOVEC 1230 gas	706	Kgs
4	Electromagnetic Actuator	1	Nos
5	Manual Actuator	1	Nos
6	Pneumatic actuator	7	Nos
7	Flexible Discharge Hose	7	Nos
8	Flexible Actuation Hose	7	Nos
9	Discharge Nozzles	23	Nos.
10	Check Valve	7	Nos.
11	Flow Switch	1	Nos.
12	Manifold	1	Nos.
10	Wall mount kit	14	Nos
11	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot
12	Gas Release panel with release module and battery backup	1	Nos
13	Manual Release Switch	7	No

14	Abort Switch	1	No
15	Room Integrity Test	1	Lot
	SUBTOTAL		

Sr. No.	Description	Unit	Qty.
	Access Control System		
1	Supply, installation, testing & commissioning of **Proximity card readers** having a read range of minimum 3 inches with mounting box, plate & required accessories.	No.	10
2	Supply of **proximity cards** with the possibility of printing the company details on its facia using dye sublimation method.	LOT	25
3	Supply, installation, testing & commissioning of TCP / IP based **Two Access Door Controllers** controlling 4 Readers (2 Entry & 2 Exit) with minimum 2 Monitor inputs & 2 Relay outputs, RS232 & RS485 communication port, complete with Encloser, in-built power supply, & Access Control Software. (**controller should have Fire trigger input facility**)	No.	2
4	Supply, installation, testing & commissioning of TCP / IP based **Four Access Door Controllers** controlling 8 Readers (4 Entry & 4 Exit) with minimum 2 Monitor inputs & 2 Relay outputs, RS232 & RS485 communication port, complete with Encloser, in-built power supply, & Access Control Software. (**controller should have Fire trigger input facility)**	No.	1
5	Supply, installation, testing & commissioning of surface mounted Electro Magnetic door locks having capacity of holding force of 650 lbs with Armature plate & required accessories with LED Indications.	No.	10
6	Supply, installation, testing & commissioning of Magnetic door Sensor (Door position sensor) with required accessories.	No.	10
7	Supply, installation, testing & commissioning of Emergency release switch (Break glass type Green in colour)	No.	5
8	Supply and laying of 6C x 1.0 Sq.mm multi stranded, Shielded Copper FRLS Armoured cable. (**For Card Reader etc.**)	Rmt.	250

9	Supply and laying of 4C x 1.0 Sq.mm multi stranded, Shielded Copper FRLS Armoured cable. (**For Magnetic Lock & Door Sensor etc.**)	Rmt.	150
	SUB - TOTAL OF ACS		

Sr. No.	Description	Unit	Qty.
	<u>Water Leak Detection System for Server Room</u>		
1	Supply, installation, testing & commissioning of of 8-32 Zone Water Leak Detection Control Panel with power supply & required accessories.	No.	1
2	Supply, installation, testing & commissioning of Water Leak Detection Cable with End Connections	Rmt.	70
3	Supply and installation of Fixing clips (At every 0.5 meter distance)	No.	Lot
4	Supply and installation of Identification tags (At every 1 meter distance)	No.	Lot
5	Water Leak Detection Module	No.	20
6	Supply, installation, testing & commissioning of Sounder / Hooter having minimum 85dB.	No.	1
	SUB - TOTAL OF WLDS		

Sr. No.	Description	Unit	Qty.
	<u>Rodent Repllent System for Server Room</u>		
1	Supply, installation, testing & commissioning of Wall mount type Digital Ultrasonic Rodent Repller Control Panel having facility to connect upto 20 transducer satellites including power supply, cabinet & required accessories. Should have facility of CRMS Software & Features like Adjustment of Wave Speed, Wave Density, Frequency Band Time, Frequency & Transducer Testing. Controller Should be Password Protected.periodic pest control using However; Chemical spray can be done once in 3 months as a contingency measure to effectively fight the pest menace.	No.	1

2	Supply, installation, testing & commissioning of Transducer Satellite Stations capable of Emitting Ultrasonic sound of frequencies between 20 Khz and 50 Khz & higher, with blinking LED Indication & mounting accessories. The transducer shall capable for covering area of minimum 500 sq.ft for ceiling / Floor void & 500 sq.ft. for room void with accessories.	No.	30
3	Centralise Reporting & Minitoring Software for Redent Repellent System	No.	1
	SUB - TOTAL OF RODENT REPELLENT SYSTEM		

Sr. No.	Item	Unit	Qty.
	BUILDING MANAGEMENT SYSTEM		
	Supply, installation, testing & commissioning of the following controls & BMS equipments		
1	**BMS Server PC & UPS**		
1.1	Central Server with Quad Core Intel E5620 Processor 2.4GHz or better at 12M Cache, 4 GB or more of RAM, DVD RW, optical mouse, keyboard & 1 serial port. Server shall be provided with requisite MS Windows Licensed software Win ser 2008, compatible with the BMS platform	No.	1
1.2	22" TFT color LCD monitor	No.	1
1.3	A4 size alarm printer suitable for application with driver software	No.	1
2	**BMS Client Workstation**		
2.1	Central Work Station **Client** with Intel processor 2 GHz or higher, with minimum 250GB HDD, 2 GB RAM, 52X DVD writer, optical mouse, keyboard & 1 serial port. Work station shall be preloaded with requisite MS Windows Licensed software compatible with the BMS platformwith Database,OS & Firewall softwares.	Nos.	1
2.2	22" TFT color LCD monitor	Nos.	1
3	**Graphical interface software**		

3.1	Providing necessary Software for monitoring through serial Modbus, BACnet and LONWORKS interface for the data points for all HVAC/ Electrical/ Other Equipments. The cost shall include 2 station and 2 client license for the BMS. The software shall include seamless integration with FAS / ACS / and CCTV System . The software shall be open system architecture type which facilitates interoperability with other systems supporting BACnet/Modbus protocols. The software shall have minimum 5000 addresses with Future Expansion Capability. The software shall have SMS, pging & email facility for transmitting specified alarms to designated personnel	No.	1
4	**Protocol Convertors / Software Integrators for the following systems capable of integrating any Industrially acceptable Communication Protocols including but not limited to : Modbus RTU / Modbus ASCII / BACnet / Lonworks / M Bus / J Bus / C Bus; Made Available either on Serial RS 485 Network or TCP / IP Network.** **(Quantity & protocol mentioned in IO summary)**		
4.1	Energy meter for electrical panels and integration through Modbus protocol	Lot	1
4.2	VFD integration through Modbus/BACnet protocol	Lot	1
5	**System interface unit for connecting database server to DDC controllers. System interface unit should be of native BACnet type with built in BACnet router. External gateway device or proprietary software driver is not acceptable.**	Lot	1
6	**Portable Operator Terminal (POT)** Capable to be hooked to any DDC controller to monitor & change set points of any parameter	No.	1
7	**DDC Controller**		

	32 bit microprocessor based programmable DDC controller, expansion module compatible to native BACnet protocol. Controller shall be standalone & networkable type with built in real time clock. Controller shall support peer to peer communication. DDC controller shall be housed in IP 55 rated MS powder coated control panel duly internally wired & tested. Panel should be provided with necessary accessories, relay boards etc. DDC controller & panel quantity will be as per the IO summary for following areas		
7.1	In Substation Room	Lot	1
7.2	In BMS Room Ground Floor	Lot	1
8	**Field Devices duly wired to DDC: supply, installation with all necessary fixtures, site calibration with documentation, testing and commissioning.**		
8.1	Level Sesors for HSD Tank	No.	4
8.2	Outdoor temp sensor	No.	1
8.3	Combined Room type temp & RH sensor	Nos.	6
8.4	Supply water temp sensor (PT-100) immersion type with thermowell	Nos.	2
8.5	Return air temp sensor	Nos.	UR
8.6	Room type temp & RH transmitter	No.	6
8.7	DPDT relay with 230 VAC, 1A cont rating for fire damper actuators	Nos.	4
8.8	Battery fumes detector sensor	Nos.	2
8.9	Level sensors for thermal storage	Nos.	2
8.10	Temperature sensor for Thermal storage	Nos.	1
9	**2 way valves with actuator**		
	Supply, Installation, Testing and Commisioning of globe type 2 way chilled water valves with electric actuators for ON/OFF control for following sizes,		
9.1	DN 32,	Nos.	UR
9.2	DN 40,	Nos.	UR
9.3	DN 50,	Nos.	UR
9.4	DN 65,	Nos.	UR
9.5	DN 80,	Nos.	1
9.6	DN 100,	Nos.	UR
9.7	DN 125,	Nos.	UR
9.8	DN 150,	Nos.	4
9.9	DN 200,	Nos.	2
9.10'	DN 250,	Nos.	UR

10	**Supply, installation, testing & commissioning following cables**		
10.1	2 core, screened 1 sq mm ATC cable	Lot	1
10.2	4 core, screened 1 sq mm ATC cable	Lot	1
10.3	6 core, screened 1 sq mm ATC cable	Lot	1
10.4	3 core 1.5 sq mm ATC shielded cable for power	Lot	1
10.5	2 core 1 sq mm ATC shielded cable DDC communication	Lot	1
10.6	CAT 6 cable for communication between supervisory controller & BMS server	Lot	1
11	**Supply, installation, testing of following PVC conduits**		
11.1	1" dia	Lot	1
11.2	1 1/2 " dia	Lot	1
	SUB - TOTAL OF BMS		

Sr. No.	Description	Unit	Qty.
	IP CCTV Surveillance System		
1	Supply, installation, testing & commissioning of 1/3" Progressive Scan CMOS Sensor, 3 MegaPixel Colour Dome Camera with 2.8 ~ 12.0mm Manual Verifocal Auto iris Lens, WDNR, Day & Night function with required accessories. Should be ONVIF Complaint.	No.	11
2	Supply, installation, testing & commissioning of 16 Channel Embedded Network Video Recorder, having features like Third Party Camera Support, HDD Management & with Redundancy. 8 HDD SATA Capacity. HDMI & VGA Out Put at up to 1920 X 1080 Pixel Resolution. Should have up to 5 Megapixel recording capacity. Should be RAID 0,1,5,10 Supported. Should have minimum 30 days of recording. The system shall have auto back up tape slot for data storage	No.	1
3	Supply, installation, testing & commissioning of Wall mount 32" High resolution Flat LCD Monitor with wall mount accessories.	No.	1
4	Supply & installation of 30U wall mount Rack for mounting the DVR	No.	1
5	Supply, installation, testing & commissioning of DC Power supply pack with battery backup for all Cameras.	No.	1
6	8 Port POE Network Switch	No.	2

7	Supply and laying of CAT 6 Shilded Cable in PVC Conduit	RMT	130
	SUB - TOTAL OF IP CCTV Surveillance System		

Sr. No.	Item	Unit	Qty.
	VESDA SYSTEM		
	Supply, installation, testing & commissioning of the following System		
1	**Sampling Unit**		
1.1	Supply, Installation, Testing & Commissioning, calculations of flow and hole sizes in pipe network. Sampling unit shall be prepared for laser chamber or optical smoke detectors. Detected smoke density shall be able to be adjusted between high sensitivity to equal as ordinary smoke detector. Sampling system is connected to loop for ordinary fire alarm via address unit. Operation of sampling unit and status shall be able to display in fire alarm central unit. Sampling unit shall have 4 exits for: 1) Pre-alarm 1 2) Pre-alarm 2 3) Fire 4) Fault 25 mm pipe network shall be connected to sampling system, each unit shall be capable of minimum 1x160 m M-pipe system. Sampling unit shall have indications for operation, fault, prealarm1 and pre-alarm 2. Smoke testing shall be done when commissioning to secure functionality of the system Power supply. 240 volts AC power supply with fault alarm connected too fire alarm system.	No.	20
2	**Sampling Pipe**		

2.1	ABS piping should be used due to its strength and heat resistant properties. The pipe sections should be glued together using a suitable ABS glue to avoid separation orleaks. If a section of pipe is likely to need to be disconnected for some reason in the future, removable unions should be used instead. **Fixings** The means of fixing the pipe to the structure will depend on site conditions. The normal methods are pipe clips, saddle clamps or even tie wraps. **End Cap** The end of the pipe is terminated with an end cap with a hole, typically 6mm diameter in it. If the end cap is not used, then practically no air will be drawn through the side holes. If the end cap does not have a hole then the contributions from the side holes will tend to be very unbalanced. **Bends** Bends are either 45 or 90 degrees. For the 90-degree bends it is very important that slow radii are used and not a sharp elbow, as this will introduce unacceptable pressure losses, and significantly increase the response times from holes beyond the bend. **T Pieces** Use of T joints should be avoided as much as possible in these types of low pressure wide bore systems. They make the pipe design and air flow calculation very difficult to predict with any accuracy.	Rmt.	250
	SUB - TOTAL OF VESDA SYSTEM		

Sr. No.	Description	Unit	Qty.
	Dry Powder Base Sprinkler system		
1	Automatic Fire Extinguisher with Clean Agent Type - The container shall be made with MIG welded MS body. The upper part shall be with flange. - The extingisher shall be fixed with sprinkler head which shall operate at an temperature of 72 Deg C. - The unit shall be fitted with pressure guage. - The propellent shall be with Nitrogen		
1.1	15 Kg Capacity	No.	47
	SUB - TOTAL OF Dry Powder Type Sprinkler System		

INTENT

The intent of this document is to define the technical requirement and the quality standards of the materials to be incorporated in the works and the workmanship during the execution of the works.

GENERAL

All works shall be as per the relevant IS / CPWD specifications unless otherwise mentioned below:

Wherever in the specifications mention is made of any produce by name, make or catalogue number, it shall be interpreted as establishing a standard of quality and shall not be construed as limiting competition. The contractor, in such cases, may use any product, which is equal to that name, provided prior written approval from the Architect / Customers representative is obtained.

Unless substitution is requested no deviation from the specification will be permitted. Failure to propose the substitution of any article within 30 days after signing of the contract or after specific details given by the Architect/Customers representative will be deemed sufficient cause for the denial of the request for substitution.

If any particular structural steel sections mentioned in the drawing and design are not available, and the employer and the Architect/Customers representative are convinced accordingly, the alternative sections are to be decided by the Architect/Customers representative at his discretion. If no extra charges have been specified for items involving work below or above ground level or above roof level for additional lifts, it should be presumed that rates for such items as shown in drawings and bill of quantities are inclusive of work at additional depths or lifts.

The contractor shall, without any extra charge, at all stages furnish any data required by the Architect/Customers representative such as levels, falls, slopes etc. to enable him to take suitable decisions required for proper execution of the work.

The Architect/Customers representatives' decision in these respects shall be final and binding on the contractor.

SECRECY

Contractor shall not disclose any information furnished by the owner/Architect/Customers representatives nor any drawings, reports and any other information prepared by the contractor for the project, without the prior written approval of the owner, except in so far as disclosure is necessary for the performance of contractors work and services under this contract.

TECHNICAL SPECIFICATIONS

The various items indicated in BOQ shall be read in conjunction with the technical specifications of the tender, and IS/CPWD specifications as applicable to such items. In the event of variance and /or ambiguity or incompleteness between Technical specifications, IS specifications, CPWD stipulations, and BOQ description, the following order shall prevail.

a) BOQ Description

b) Technical Specifications

c) IS specifications

d) CPWD specifications

1. FALSE FLOORING …

1.1. Providing and Fixing of Unifloor FS1000H access floor system shall be made from steel cementations infill and provide for adequate fire properties, acoustic barrier and air leakage resistance. The system shall be able to withstand a UDL of 1670 kg. Per sqmt. And a point load of 450 kg. Panels shall be finished with High Performance Anti Static Laminate.

1.2. Panels shall be made from steel. The bottom of the panel shall be embossed in hemispherical shape to give strength and flexural rigidity. The top sheet shall be plain and resistant welded at various locations after the top and bottom sheets have been degreased and phostated to form a single composite unit. The entire panel shall be quoted with epoxy coating on the exposed surface and then the hollow panel shall have an infill of light weight cementitious material, panel shall remain flat through and stable unaffected by humidity or fluctuation in temp throughout its normal working life. Panel shall provide for impact resistance top surfaces minimal deflection, corrosion resistance properties and shall not be combustible or aid surface spread of flame, panels shall be insulated against heat and noise transfer. Panels shall provide qualities of concrete slabs; panels shall be of size 600x600mm and 35mm thick fully interchangeable with each other within the range of a specified lay out. Panels shall be free standing onto the structure.

1.3. Pedestal - Pedestals installed to support the panel shall be suitable to achieve a specified floor height from the existing floor level and shall be placed 600mm distance in both directions to form a grid of 600x600mm. Pedestal should have GI Base plate of 100 x100 x 2.5mm thk, GI Pipe 22 Dia x 2.2 mm Thk, check nut for level adjustment, 16 mm dia threaded stud with GI pedestal head of size 75 x 75 x 3.5 mm thk, stringer, all screws etc and design shall confirm speedy assembly and removal for relocation and maintenance. Pedestal assembly shall provide for easy adjustment of levelling and accurately align panels to ensure lateral restrain. For prevention of corrosion pedestals is either powder coated or zinc electroplated as required. Pedestal shall support an axial load of 2200kg. Without permanent deformation and an ultimate load of 3500kg. The pedestal flat head then shall receive the panel which shall be fastened by screws to the pedestal head to form a rigid grid to achieve FFH of 750mm

1.4. Mode of measurement: Cut tiles less than 300mm shall be considered as 300mm and more than300mm shall be considered as 600mm.

2. FALSE CEILING

Providing and fixing false ceiling system of approved make.

1.0 FALSE CEILING GRID SYSTEMS

1.1 Galvanized Steel Grid System: Galvanized steel grid system shall be erected for the purpose of supporting mineral fiber false ceiling tiles.

Material

Main Runner: Main runner shall be of hot dipped galvanized steel and T shaped of 24mm x 38mm size and 0.33 mm thickness with double rotary stitching.

Cross Runner: Cross runner shall of hot dipped galvanized steel and T shaped of 24mm x 30mm size, 0.25mm thickness, 1200mm long and 24mm x 25mm size. 0.25mm thickness, 600mm long with double rotary stitching.

Perimeter section: Material shall be same as runners. Sections shall be 22mm x 22mm size of 0.45mm thickness. Exposed areas of all the metallic members shall be powder coated (25 micron)

Erection

Main runners shall be placed at the spacing of maximum 1200 mm c/c cross runners shall be fixed @ max. 600mm c/c to obtain a grid of 600mm x 600mm.

The grid shall be suspended by means of 4mm dia MS wire. 6mm thick MS clear of 25mm x 25mm section dash fasteners and level adjustors.

The overall grid system shall be rigid by self locking joints in accordance with false ceiling patterns, perfectly leveled and aligned at desirable height as per drawing.

1.2 Aluminium Grid System

Aluminum grid system for supporting false ceiling tiles shall be of approved make and shall be perfectly leveled, aligned at desired height and in accordance with the false ceiling pattern as per drawings.

Material

Main Runner: Main runners shall be of extruded anodized (25 microns aluminum Tee sections of 25mm x 35mm size –approved make) 2.5mm thk

Cross Runner: Cross runners shall be of extruded anodized (25micron) aluminum Tee sections of 25mm x 25mm size (approved make) 2.5 mm thk

Ceiling Sections (Cross runners)

GI channel shaped ceiling sections shall be 0.5 mm thick having a knurled web of 51.1 mm and two flanges of 26mm each with lips of 10.5mm. The ceiling sections shall be fixed to the intermediate channels in perpendicular direction at 450mm c/c with the help of connecting clips.

GI grid system for supporting false ceiling tiles shall be perfectly leveled aligned at desired height in accordance with false ceiling pattern.

1.3 FALSE CEILING TILES

The tiles shall be placed in position over the supporting grid system by means of hold down clips at four corners of each tiles and one in center of each side. The finished false ceiling shall be perfectly leveled and aligned at desired height as per drawings.

Necessary electrical and AC and other fixtures shall be provided as per drawing and in co-ordination with relevant construction activities.

1.4 Mineral fibre tiles.

Mineral fiber false ceiling tiles shall be with durable regular edging having NRC value of mm 0.50 light reflectance value of min. 80% K value of 0.052 to 0.057 w/m deg C and fire performance conforming to class I as per BS: 476. The tiles shall be of 600mm x 600m x 15mm size. The tiles shall have fissured or granulated texture on the front side as specified. Backside shall be provided with protective coating.

1.5 Fire propagation

Index of performance not exceeding 12 and a sub index not exceeding 6 (when each side is tested separately to BS 476 Part-6)

Surface spread of flame Class 1 (both sides) as per test to BS 476 part-7)

Gypsum boards shall be of specified thickness and of specified finish (painted with plastic emulsion paint / laminated with 0.5mm thick lamination). The gypsum board shall be screw fixed to the underside of false ceiling grid system with 12.5mm dia dry wall screw @ 230mm c/c by drilling machine. Joints in the board shall be finished flush with fillers, finisher and primer as per manufacturer's recommendation to give a seamless finish.

3. FIRE RATED PARTITION...

3.1 Providing and fixing Min. 2 Hour fire rated 132mm thick Gypsteel Ultra™ stud partition which includes two layers of tapered edge 15mm thick Gyproc® Fire line boards (conforming to IS:2095 – 1996-Part-I) is screw fixed with drywall screws of 25mm & 50mm at 300mm centres to either side of 70mm Gypsteel Ultra™ C stud (0.5mm thick having one flange of 34mm and

another flange of 36mm made of GI Steel) placed at 610mm centre to centre in 72mm Gypsteel Ultra™ floor and ceiling channel (0.5mm thick have equal flanges of 32mm made of GI steel), which is anchored to the floor & true ceiling using suitable anchor fasteners. The boards are to be fixed to the framework with joints staggered to avoid leakage through joints. A Gypsteel Ultra 70mm Noggin channels has to be provided at the horizontal joints of the outer layer of boards screw fixed to the studs using metal to metal flat head screws.

3.2 Finally square and tapered edges of the boards are to be jointed and finished so as to have a flush look which includes filling and finishing with Gyproc Jointing compound, Gyproc Joint Paper tape and two coats of Drywall Top Coat (as per recommended practices of Saint- Gobain Gyproc India) . The junction of the partition with masonry & all penetration through the partition has to be treated with a intumescent fire sealant of equivalent fire rating.

3.3 MEASUREMENT AND RATES.

For item rate tenders. False ceiling/flooring, Insulation, partition, paneling shall be measured in sqm. Correct up to two places of decimal. Dimensions shall be measured correct up to 0.01 M.

No deduction shall be done for cut outs for fixtures, cables etc upto 0.18 sqm area. No extra shall be paid for providing such cutouts.

Rate for item rate tenders shall include all materials, labour, transport, conveyance, erection, storage, other incidental expenditures involved in carrying out the items.

4. FIRE RATED STEEL DOORS

4.1 providing and fixing 2 hr fire rated double skin steel door constructed from 1.25mm thick galvanized steel sheet formed to provide a 46mm thick fully flush door shell with lock seam joints at stile edges and the internal construction of the door is a specially designed Honey Comb structure with reinforcements at top, bottom and stile surrounds. As per IS 3614 part-1 & part-2 for stability and integrity and Pressed Galvanized steel confirming to IS 277. Fire door should be tested at CBRI or ARAI for maximum rating of 2hrs with vision panel. Vision Glass panel should be 6mm thick clear glass provided in square in standard dimensions of 300mm x 300mm. Door Frame should be produced from 1.6 MM thick galvanized steel sheet formed to double rebate profile of size 143mm X 57mm (+/- 0.3mm) with a maximum bending radius of 1.4mm and fixed as per manufacturers specification. Including all approved type(Dorma Make) heavy duty fastenings and fixtures comprising of :S.S. Ball Bearing Butt hinges 3 mm thk, Mortise Sash Lock with Lever Handles, D handles, Mortise Dead Bolt, Mortise Latch, Door Closer, air seal gaskets between shutter and frame, etc complete.

4.2 The door frames and door shutters are primed with Zinc-Phosphate Stoving Primer and finished with Polyurethane Aliphatic grade or epoxy paint as per approved manufacturer specifications. (Supplier -Shakti Met-door or approved equivalent). (Note - Test certificates should be available for vision panels as part of the fire door assembly. Independent glass test certificates will not be accepted. Manufacturer test certificate shall cover doors both single and double leaf and all

doors supplied should be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.)

4.3 **Measurement**

Doors shall be measured by outer actual size of the assembly including the sub frame if any specified.

Measurement shall be Inclusive of all fixtures, Fastenings, glass, gasket, sealing along the external jams with sealant.

5. **PAINTING**

5.1 LUSTER PAINT

Providing and applying Luster of approved make and shade on all surfaces at all heights in three coats including scaffolding, preparing the surface by brushing and brooming down, applying primer two coats and final luster paint applying and leveling the surface with coat of Birla white putty before and after the primer coat and also after the first coat etc. complete. The dry/wet cleaning of floors/pipes/glass etc. after painting is to be carried out; protection of surfaces before painting is included in the item.

5.2 Materials: Glossy, Flat, Pearl Luster and Matt enamel paint shall conform to IS : 1932-1964 and M-44B.

5.3 Workmanship :

The materials required for work of painting work shall be obtained directly from approved manufacturers or approved dealer and brought to the site in maker's drums, cage etc. with seal unbroken.

All materials not in actual use shall be kept properly protected, lid of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. The materials which have become stale or flat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in smaller container. No left over paint shall be put back into stock tins when not in use. The paint shall be stirred thoroughly in its container before pouring into small containers.

If for any reasons, thinning is necessary, the brand of thinner recommended by the manufacturer shall be used.

The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt and grease shall be thoroughly removed before painting is started. No painting on exterior or other exposed

parts of the work shall be carried out in wet, damp or otherwise unfavorable weather and all the surfaces shall be thoroughly dry before painting work is started.

For Glossy, Flat, Pearl luster and Matt finish, painting of same specification shall be followed except that the type of paint shall be changed as per the direction of Architect/Customers representative and Engineer- in-charge, to give the desired finish.

5.4 Application:

Brushing operation are to be adjusted to the spreading capacity advised by the manufacturer of particular paint. The paint shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved from PMC & Engineer-in-charge before next coat is started.

Each coat shall be lightly rubbed down with sand paper of fine pumice stone and cleaned off dust before the next coat is applied. No hair marks from the brush or clogging of paint puddles in the corners of panels angles of moldings' etc. shall be left on the work.

Special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

Approved best quality brushes shall be used.

6. **PLASTERING**

Providing and laying minimum **12 mm. thick cement plaster** in single coat for walls and ceiling, in CM 1:4 with Neeru finish (finished with steel trowel) to concrete or brick surfaces, in all positions including scaffolding, curing, etc. complete.

6.1 Materials:

Water used shall be free from injurious amounts and deleterious materials. PH value of water shall generally be not less than 6.0.

6.2 Scaffolding: Wooden ballies, bamboo, planks, trestles and other Steel scaffolding shall be sound. These shall be properly examined before erection and use. Stage scaffolding shall be provided for ceiling plaster, which shall be independent of the walls.

6.3 Preparation of back ground:

The surface shall be cleaned of all dust, loose mortar droppings, traces of algae, efflorescence and other foreign matter by water or by brushing. Smooth surface shall be roughened by wire

brushing if it is not hard and by dense hacking if it is concrete. In case of concrete surface, if a chemical retarder or shuttering oil has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles shall be cleaned off and care shall be taken that none of the retarder is left on the surface. Trimming of projections on brick/concrete surface wherever necessary shall be carried out to get an even surface.

Raking of joints in case of masonry wherever necessary shall be allowed to dry out for sufficient period before carrying out the plasterwork.

Scaffolding for carrying out plastering work shall be double scaffolding having two sets of vertical supports so that the scaffolding is independent of the walls.

6.4 Preparation of Surface:

All putlog holes in brickwork and junction between concrete and brickwork shall be properly filled in advance. Joints in brickwork shall be raked about 10 mm. and concrete surface shall be hacked to provide grip to the plaster. Projecting burrs of mortars formed due to gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brush/coir brush to remove dirt, dust etc., and the surface thoroughly washed with clean water to remove efflorescence, grease and oil etc., and shall be kept wet for a minimum of two hours before application of plaster.

For external plaster, the plastering operation shall be started from the top floor and carried downwards. For internal plaster, the plastering operations may be started wherever the building frame and cladding work are ready and the temporary supporting ceiling resting on the wall of the floor have been removed. Ceiling plaster shall be completed before starting plaster to walls.

6.5 Applications of Plaster:

Plaster of cement mortar shall be laid in with somewhat more than 12mm thickness and pressed and leveled with wooden /aluminium roller to a finished thickness of 12mm. long straight edge shall be freely used to ensure a perfectly even surface. All corners and angles shall be perfectly plumb and soffits of arches true to the specified curve. All junctions of doors and windows and windows and other frames shall be neatly finished. All architectural paneling, grooves etc. to be shown in the thickness of the plaster shall be so worked. For Neeru finish the surface shall be finished with proper mixture of cement and neeru which is applied to the finished coat of cement plaster. Watering for curing shall be started soon after the initial set of the surface material to avoid damage.

Cement mortar shall be used within half an hour after addition of water. Any mortar or plaster which is partially set shall be rejected and removed from the site.

In suspending the work at the end of the day, the plaster shall be left out, clean to line both horizontally and vertically. While recommencing the plaster, the edges of the old work shall be scrapped clean and wetted with cement putty before plaster is applied to the adjacent areas to

enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of the wall and shall not be nearer than 15 cm. to any corners or arises. Horizontal joints in plasterwork shall not also occur on parapet tops and copings as these invariably lead to leakage. No portion of the surface shall be left out initially to be patched up later on.

6.6 Mode of Measurements & Payment:

The rates shall include for work at any height, position, and floor and for all necessary scaffolding, etc. as may be required. The rates shall also include for hacking and/or bush hammering to form key for plaster and for spatter dash treatment, as specified, as and where necessary.

The rates shall also include for all work in narrow width, arises, rounded angles, chamfered external angles, drip moulds, grooves and for making good after all trades.

The rate shall also include for Chicken Mesh to be formed in plaster at junction of slab and beam and slab and brick without any extra charge. The rate shall also include for similar grooves in plaster at the junction of masonry and wood or steel door/window/ventilator frame or at bottom of beam/lintels as drip moulds without extra charge.

All plastering shall be measured in $m^{2.}$ Unless otherwise specified. Length, breadth or height shall be measured correct to a centimeter.

Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooved or open joints in brick work, stone work, etc. or space between laths. Thickness of plaster shall be average thickness with minimum 10 mm, at any point on the surface.

The measurement of wall plastering shall be taken between the walls or partitions (dimensions before plastering being taken) for length and from the top of floor or skirting to ceiling for height. Depth of cover of cornices if any shall be deducted.

Soffits of stairs shall be measured as plastering on ceilings. Flowing/folding soffits shall be measured separately.

For jambs, soffits, sills, etc., openings exceeding 0.5 sqm and not exceeding 3.0 sqm, area deductions and additions shall be made in the following manner:

No deductions shall be made for end joints, beams, posts, etc. for openings not exceeding 0.5 sqm. Each and no addition shall be made for reels, jambs, soffits, sills, etc. of these opening for finish to plaster around ends of joints, beams, posts, etc.

Deduction for openings exceeds 0.5 sqm. But not exceeding 3.0 sqm. Each shall be made as follows and no addition shall be made for reveals, jambs, soffits, sills, etc. of these openings.

i) When both faces of any wall are plastered with same plaster, deduction shall be made for one face only.
ii) When two faces of any wall are plastered with different types of plasters or if one faces is plastered and the other pointed, deductions shall be made from the plaster or pointing

on the side of frame for door, windows, etc. on which width of reveals is less than that on the other side but no deductions shall be made on the other side. Where width of reveals on both faces of all is equal, deductions of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

For openings having door frames equal to projection beyond the thickness of wall, full deduction for opening shall be made from each plastered face of the wall.

In case of openings having area above 3.0 m2. Each, deduction shall be made for the opening but jambs, soffits, and sills shall be measured additionally.

The rate shall be for unit of one $m^{2.}$

7. STRUCTURAL STEEL WORKS –

1. INDIAN STANDARD CODES

Unless otherwise specified herein, materials and workmanship or the work shall conform to the latest editions of the following standards or their approved equivalents.

1.1 Indian Code of Practice for General Construction in steel, Indian Standard Institute IS: 800.

1.2 Code of Practice Use of Metal Arc Welding for General Construction in Mild Steel, Indian Standard Institute IS 816.

1.3 Specification for Structural Steel IS: 226 and when specified IS 2062.

1.4 Specification for Black Hexagonal Bolts and Nuts IS 1363.

1.5 Specification for Precision and Semi-precision Hexagonal Bolts and Nuts IS 1364.

1.6 Specification for covered Electrodes for Metal and Welding of Mild Steel IS : 8114.

2. FABRICATION:-

All structural steel work shall be in accordance with IS : 800 All materials shall be finished straight and shall be machined true and square where so specified material at the fabrication shop shall be kept clean and protected from weather. All holes and edges shall be free from burrs. Shearing and chipping shall be neatly and accurately done and all portions of work exposed to view shall be neatly finished.

3. STRAIGHTENING:-

All steel materials, before being worked shall be straight and free from bends or twists. If the sections are distorted or twisted they shall be straightened and flattened by methods that will not injure the material. (Heating and forging is not allowed). Contractor's lumps price shall be inclusive of the cost of all these operations involved in straightening as stated above.

4. CUTTING AND EDGE PLANEING: -

Cutting may be done by shearing, cropping, sawing, or mechanically controlled gas cutting torch as permitted by the Architect/Customers Representative/Engineer-in-charge. All re-entrant corners shall be shaped notch free to a radius of at least 12mm. Sheared or cropped edges shall be dressed to a neat finish and shall be free from distortion and burrs. Hand frame cutting shall be undertaken only if so permitted by the Engineer-in-charge and shall only be carried out by an expert in such work. Hand frame cut edges shall be ground smooth and straight Edge planning of sheared edge is not intended unless the sheared edges are such as to warrant it or specifically called for, by Engineer-in-charge whose decision shall be final and binding. Edges of cropped or gas cut edges shall be planned as directed by Engineer-in-charge.

5. Grinding:-

All the edges cut by flames shall be grounded before these are welded. Ends of all bearing stiffeners shall be ground to fit tightly at both top and bottom. In case of gantry girders, the bottom of the knife-edge support shall be accurately ground to provide effective bearing on the column bracket with a clearance not exceeding 0.1 mm locally at any place. The top surface of column bracket, struts and compression members shall be accurately ground and closely butted over the whole section with tolerance not exceeding 0.1 mm locally at any place. Notwithstanding the above full loads shall be transferred through welds. Column ends resting on bases shall be ground smooth and true to ensure minimum 85 % contact area with local gap not exceeding 0.1 mm.

The base plate shall be similarly ground over the bearing surfaces and shall have effective contact with the end of the shaft. The bearing face which is to be grouted direct to a foundation need not be ground if such face is true and parallel to the upper face. To facilitate grouting and escape or air holes shall be provided wherever necessary in column bases.

6. Bending:-

The bending of plates and sections to specially required shapes shall be done either on appropriate machine or by angles smithy and black smithy process.

7. Rolling and framing:-

Plates for chutes, hoppers etc shall be accurately laid off and rolled or formed to required profile shape as called for on the drawings. Adjacent sections shall be matched for facilitating accurate assembly, welding and erection in the field.

8. Drilling and Punching:-

Holes through more than one thickness of material for members such as compound stanchion and girders flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together sub punching may be permitted, by assembly provided the holes are punched 3 mm less in diameter than the required size and reamed after assembly to the full size. Punching shall not be adopted where the thickness of the materials to be punched together exceeds 16 mm.

Matching holes for black bolts shall register with each other so that a gauge of 1.0 mm lesser in diameter than the diameter of the hole will pass freely through the assembled members in a direction right angle to such members. Finished holes shall not be more than 1.5 mm or 2.0 mm (as the case may be depending upon the diameter of the bolt is less than or more than 25mm) larger in diameter than the diameter on the black bolt passing through them. Unless otherwise specified by the Engineer-in-charge.

Holes for bolts shall not be formed by gas cutting process.

Where reamed members are taken apart for shipping or handling the respective pieces reamed together shall also be marked that they may be re-assembled in the final setting up. No interchange of reamed parts will be permitted. Poor matching, over drilling and ovality in holes shall be a cause for rejection.

Burrs shall be removed after drilling holes, there ever horizontal member is likely to collect water, and suitable holes for drainage shall be provided.

9. Notches:-

The ends of all joints, beams and girders shall be cut truly square unless required otherwise and joint flanges shall be neatly cut away or notched away wherever necessary, the notches being kept as small as possible. Corners of such notches in flanges shall be shaped to a radius of 50 mm.

10. Assembly:-

The component parts shall assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified chamfer, if any is provided. In order to minimize distortion in a member, the component parts shall be positioned by clamps, jigs and other suitable means and fasteners. If the individual components are to be bolted, parallels and tapered drifts shall be used to align the parts so that the bolts can be accurately positioned. Items like roof trusses etc. shall be assembled keeping in view the actual site conditions, prior to dispatch to site of erection, so that they can conveniently pre-assembled during erection. Necessary match marks shall be made on these components before disassembling in the shop and dispatching.

11. Connections:-

The contractor shall plan out the work right from the preparation of fabrication drawings stage to have shop connections as well as field connections effected either by welding, or by black bolts as shown on the design / fabrication drawings or as specified.

12. Bolted Connections:-

Bolts, nuts and washers and other fastening material shall be stored in racks off the ground with coating of suitable protective oil.

Bolts shall be inserted in such a way that they may remain in position under gravity even before fixing the nut.

The length of the bolt shall be such that at least one thread of the bolt projects beyond nut. Bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials. When assembled, all joint surfaces including those adjacent to the washers shall be free of scales except tight mill scales. They shall be free of dirt, loose scales, burrs and other defects that would prevent solid seating of the parts. Contact surface shall be free of oil, paint, lacquer or galvanizing. Wherever necessary tapered washers or flat washers or spring washers shall be used under the nut so that no part of the treaded portion of the bolt is within the thickness of the parts bolted together.

Flat washers shall be circular of a diameter two and a half (2-1/2) times that of bolt and of suitable thickness. Where bolts head/nuts bear upon the be-leveled surfaces they shall be provided with square tapered washers of suitable thickness to afford a seating square with the axis of the belt. Flat washers shall be circular. All the bolts and nuts shall be of steel with well-formed hexagonal heads unless specified otherwise, forged from the solid and shall be dipped in hot linseed oil as soon as they are made.

Notwithstanding anything to the contrary contained in IS: 1363, IS: 1364, and IS: 1367, the unthreaded length of the bolt shall be equal to total thickness of metal being bolted together plus 2 mm. The threaded length shall be equal to at least the diameter of the bolt plus 6mm.Not more than one shop splice shall be provided to make up the full length of member. This splice shall be within full strength butt weld.

13. Welded Connections:-

Manual arc welding shall be used, except in case of continuous welds, use of automatic welding machine shall be necessary for ensuring satisfactory qualify of fabrication. Welding must be done by experienced and tested welders in proper sequence using necessary jigs and fixtures.

Welding shall be done by experts in the field who have been qualified by tests as specified in this specification. Surfaces to be welded shall be free from loose scales, slag, rust, grease, paint and any other foreign materials.

The members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3mm. If the separation is 1.5 mm or greater, the fillet weld size shall be increased by the amount of separation. This shall only apply if the surfaces are completely sealed by welds.

Before commencing fabrication of members in which welding is likely to result in distortion or locked up stresses a complete program of fabrication, assembly and welding shall be made and submitted to the Engineer for approval.

Web to flags connections shall be welded by continuous double fillet welds by automatic or semi-automatic electric arc welding process. All welds shall be free from defects like blow-holes, lack of penetration, slag and inclusions etc. All fillet welds shall be inspected for flaws. Butt welding in flange plates or web plates shall be complete before the flanges and webs are welded together. All main butt welds shall have complete penetration unless noted otherwise.

The contractor shall give timely notice to the engineer-in-charge before welding is taken up at the site. Approval of engineer-in-charge shall be undertaken in written before welding field connections.

14. Electrodes:-

The electrodes used for welding shall be of suitable type and size depending upon the specifications of the parent material, the method of welding , the position of the welding and the quality of welds, desired e.g. normal penetration welds or deep penetration welds and shall conform to IS : 814, IS : 1395 or IS: 1442 (latest edition) as per requirements.

Only those electrode which give radiographic quality welds shall be used. Suitable electrodes of Advani Oerlikon, Indian Oxygen or Philips or any approved make shall be used for the work. Specific approval of the Architect/Customers representative/Engineer-in-charge shall be taken by the contractor for the various electrodes proposed to be used on the work before any welding is started.

Were bare electrodes are used these shall correspond in specification to the parent material. The flux used for submerged are welding should be specifically manufactured for the purposes and should have such a composition which does not evolve any appreciable quantity of gases. The electrodes shall be stored in an oven strictly in accordance with the manufacturer's requirements as stipulated.

15. Welding:-

No welding shall be done when the surface of the member is wet, galvanized or painted, nor during high winds unless the welding operator and the work are properly protected.

All welds shall be free from defects like blow holes slag inclusion, lack of penetration, under cutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal, feather edges without overlap, freedom from porosity. The ends of the welds shall have full throat thickness. This shall be obtained on all main welds by the use of extension pieces adequately secured on either side of the main plates. Additional metal remaining after the removal of extension pieces shall be removed by matching or by other approved means and the ends and surface of the welds shall be smoothly finished.

The sequence of welding shall be carefully chosen to ensure that the components assembled by welding are free from distortion and large residual stresses are not developed. The distortion should be effectively controlled either by a counter effect or by counter distortion. The direction of welding should be away from the point of restraint and towards the point of maximum freedom

Each case shall be carefully studied before finally following a particular sequence of the welding.

Butt welds in flange plates and or web plates shall be completed before the flange and webs are welded together.

The beams and columns stiffeners shall preferably be welded to the webs before the webs and flanges are assembled, unless the web and flanges of the beam or column are assembled by automatic welding process.

Approval of welding sequence and the procedure shall not relieve the contractor of the responsibility for the correct welding and for minimizing the distortion in the finished structure which in no case shall exceed that laid down in Indian Standard.

All the welds shall be furnished full and made with correct number of runs, the welds being kept free from slag and other inclusion, all adhering slag being removed from exposed faces immediately after such run welding procedure, current voltage etc. shall be as per electrodes manufacturer's instructions.

All main butt welds shall have complete penetration and except where it is impracticable they shall be welded from both side. Back surface of the weld should be gauged and cleaned before first run of the weld is given from back to back.

Butt welds shall be terminated at the end of joint in a manner that will ensure soundness. Where abutting parts 20mm or more in thickness run on and run off plates with similar edge preparation and having a width not less than the thickness of the thicker part jointed shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the welds made smooth and flush with the abutting parts by machining or by other approved means. Where the abutting parts are thinner than 20mm the extension pieces may be omitted but the ends of the butt welds shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.

1.40.1.2 SPECIFIC MATERIAL GUIDE –

Luster paint	Asian, Nerolac ,Dulux
Sealants	GE / Hindustan Minaral / Sika / Fosrok/Dow-Corning
Raised Flooring	UNIFLOOR, KABEO or equivalent
Structural Steel/ Pipe	Sail/Jindal/Tata/ISPAT/ESSAR
Epoxy flooring	Sikka or equivalent
Steel and fire doors	Shaktimate/MPP
Door fixtures and fastenings	Dorma

BIL OF MATERIAL (BOM)

SR.NO	DISCREPTION	QUANTITY	UNIT
1a	**FALSE FLOORING …**		
	Providing and Fixing of Unifloor FS1000H access floor system shall be made from steel cementitious infill and provide for adequate fire properties, acoustic barrier and air leakage resistance. The system shall be able to withstand a UDL of 1670kg. Per sqm. And a point load of 450 kg. Panels shall be finished with High Performance Anti Static Laminate.		
	Panels shall be made from steel. The bottom of the panel shall be embossed in hemispherical shape to give strength and flexural rigidity. The top sheet shall be plain and resistant welded at various locations after the top and bottom sheets have been degreased and phostated to form a single composite unit. The entire panel shall be quoted with epoxy coating on the exposed surface and then the hollow panel shall have an infill of light weight cementitious material, panel shall remain flat through and stable unaffected by humidity or fluctuation in temp throughout its normal working life. Panel shall provide for impact resistance top surfaces minimal deflection, corrosion resistance properties and shall not be combustible or aid surface spread of flame, panels shall be insulated against heat and noise transfer. Panels shall provide qualities of concrete slabs; panels shall be of size 600x600mm and 35mm thick fully interchangeable with each other within the range of a specified lay out. Panels shall be free standing onto the structure.		
	Pedestal - Pedestals installed to support the panel shall be suitable to achieve a specified floor height from the existing floor level and shall be placed 600mm distance in both directions to form a grid of 600x600mm. Pedestal should have GI Base plate of 100 x100 x 2.5mm thk, GI Pipe 22 Dia x 2.2 mm Thk, check nut for level adjustment, 16 mm dia threaded stud with GI pedestal head of size 75 x 75 x 3.5 mm thk, stringer, all screws etc and design shall confirm speedy assembly and removal for relocation and maintenance. Pedestal assembly shall provide for easy adjustment of leveling and accurately align panels to ensure lateral restrain. For prevention of corrosion pedestals are either powder coated or zinc electroplated as required. Pedestal shall support an axial load of 2200kg. Without permanent deformation and an ultimate load of 3500kg. The pedestal flat head then shall receive the panel which shall be fastened by screws to the pedestal head to form a rigid grid to achieve FFH of 750mm. Mode of measurement : Cut tiles less than 300mm shall be considered as 300mm and more than300mm shall be considered as 600mm.		
a	High Performance Anti Static Laminate Panels	475.00	SQM
b	Raised Floor Pedestals including Stringer for panel support	500.00	SQM
c	Perforated Panel 26 % without damper	70.00	NOS

d	Panel Lifter - Heavy Duty	4.00	NOS
e	Grommets for cable Access	100.00	NOS
1b	**Item as Above but for**		
	i) For Height of 300 mm	20.00	SQM
	ii) For Height of 450 mm	20.00	SQM
2	**EPOXY FLOORING**	250.00	SQM
	Providing and laying 'SIKA' make self leveling type 2 mm thick epoxy screed flooring of approved color, over 4mm thick base coat as per manufacturer's instructions including surface preparation, building up the desired thickness with layers, top coat, cleaning, testing complete with 5 years guarantee.		
3	**ALUMINIUM CHEQURED PLATE ...**	250.00	SQM
	Providing fabricating and fixing Aluminium Chequred plate 6 mm thick for platform as per the detailed drawings including fabrication, fixing and placing in position, leveling etc. complete.		
4	**NEOPRENE ACOUSTICAL SHEET...**	250.00	SQM
	Providing and fixing Neoprene rubber sheets of 5 mm thk for Noise / Vibration Control Underlayed aluminium chequered Plate. Including Fixing and placing in position, leveling etc. complete.		
5	**MODULAR FALSE CEILING...**	500.00	SQM
	Providing and fixing false ceiling system manufactured by Armstrong or Equivalent make using hot dipped galvanized steel section, rotary stitched main tee of size 15mm x 42 mm web height, having 0.36 mm gauge at every 600 mm centre to centre maximum and rotary stitched cross tee of size 15 mm x 42 mm, having 0.33 mm gauge at every 600 mm. c/c. and wall angle of size 19 x 19 mm., having 0.35 mm gauge fixed to the periphery of the wall. The above grid is suspended at every 600mm c/c. in both directions using 2.0 mm. thick pre-straightened GI wire laying FINE FISSURED MICROLOOK WITH SILHOUETTE GRID(BLACK REVEAL) ceiling tiles manufactured by Armstrong or Equivalent make of size 600mm x 600mm x 15mm having NRC 0.55, Light reflectance of >84% (WT), thermal conductivity k = 0.052-0.057 W/m0K, Humidity Resistance of 99% , having Fire Performance CLASS O / CLASS 1 (BS 476) - 2 hr, surface having 3 coats of white paint with Fine Fissured, back of the tile duly sanded and finished with a coat of protective paint over the formed grid etc. complete		
6	**FIRE RATED PARTITION...**	285.00	SQM

	Providing and fixing Min. 2 Hour fire rated 132mm thick Gypsteel Ultra™ stud partition which includes two layers of tapered edge 15mm thick Gyproc® Fire line boards (conforming to IS:2095 – 1996-Part-I) is screw fixed with drywall screws of 25mm & 50mm at 300mm centers to either side of 70mm Gypsteel Ultra™ C stud (0.5mm thick having one flange of 34mm and another flange of 36mm made of GI Steel) placed at 610mm centre to centre in 72mm Gypsteel Ultra™ floor and ceiling channel (0.5mm thick have equal flanges of 32mm made of GI steel), which is anchored to the floor & true ceiling using suitable anchor fasteners. The boards are to be fixed to the framework with joints staggered to avoid leakage through joints. A Gypsteel Ultra 70mm Noggin channels has to be provided at the horizontal joints of the outer layer of boards screw fixed to the studs using metal to metal flat head screws.		
	Finally square and tapered edges of the boards are to be jointed and finished so as to have a flush look which includes filling and finishing with Gyproc Jointing compound, Gyproc Joint Paper tape and two coats of Drywall Top Coat (as per recommended practices of Saint- Gobain Gyproc India) . The junction of the partition with masonry & all penetration through the partition has to be treated with a intumescent fire sealant of equivalent fire rating.		
7	**FIRE RATED STEEL DOORS…**		
	providing and fixing 2 hr fire rated double skin steel door constructed from 1.25mm thick galvanized steel sheet formed to provide a 46mm thick fully flush door shell with lock seam joints at stile edges and the internal construction of the door is a specially designed Honey Comb structure with reinforcements at top, bottom and stile surrounds. As per IS 3614 part-1 & part-2 for stability and integrity and Pressed Galvanized steel confirming to IS 277. Fire door should be tested at CBRI or ARAI for maximum rating of 2hrs with vision panel. Vision Glass panel should be 6mm thick clear glass provided in square in standard dimensions of 300mm x 300mm. Door Frame should be produced from 1.6 MM thick galvanized steel sheet formed to double rebate profile of size 143mm X 57mm (+/- 0.3mm) with a maximum bending radius of 1.4mm and fixed as per manufacturers specification. Including all approved type(Dorma Make) heavy duty fastenings and fixtures comprising of :S.S. Ball Bearing Butt hinges 3 mm thk, Mortise Sash Lock with Lever Handles, D handles, Mortise Dead Bolt, Mortise Latch, Door Closer, air seal gaskets between shutter and frame, etc complete.		

	The door frames and door shutters are primed with Zinc-Phosphate Stoving Primer and finished with Polyurethane Aliphatic grade or epoxy paint as per approved manufacturer specifications. (Supplier -Shakti Met-dor or approved equivalent). (Note - Test certificates should be available for vision panels as part of the fire door assembly. Independent glass test certificates will not be accepted. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied should be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.)		
a	Single Leaf Door - 2 Hr Fire Rated		
	i) 1200 x 2100 with vision panel	1.00	NOS
	ii) 900 x 2100 without vision panel	10.00	NOS
b	Doubble Leaf Door - 2 Hr Fire Rated		
	i) 1800 x 2100 with vision panel	4.00	NOS
	ii) 1800x 2400 without vision panel	1.00	NOS
c	Doubble Leaf Door - 4 Hr Fire Rated		
	i) 1800 x 2100 with vision panel	R/O	NOS
8	Item same As Above but for 2 hr fire rated Sliding door with Vision panel		
	i) 1800 x 2100 with vision panel	1.00	NOS
9	**PANIC BARS ...**		
	Supplying and fixing Dorma or Equivalent make panic bar with all fittings etc complete.		
	i) for Single Leaf Door	2.00	NOS
	i) for Doubble Leaf Door	2.00	NOS
10	**LUSTER...**	1270.00	SQM
	Providing and applying Luster of approved make and shade on all surfaces at all heights in three coats including scaffolding, preparing the surface by brushing and brooming down, applying primer two coats and final luster paint applying and levelling the surface with coat of Birla white putty before and after the primer coat and also after the first coat etc. complete. The dry/wet cleaning of floors/pipes/glass etc. after painting is to be carried out, protection of surfaces before painting is included in the item.		
11	**FIRE PAINT...**	200.00	SQM

	Providing and applying 2 hr fire rated paint of approved make and shade on all surfaces as per manufacturers specifications at all heights including scaffolding, preparing the surface by brushing and brooming down, applying primer coat and top coat, applying and levelling the surface with coat of Birla white putty before primer. The dry/wet cleaning of floors/pipes/glass etc. after painting is to be carried out, protection of surfaces before painting is included in the item. Flat area in horizontal and vertical plane will be measured for payment. No additional payment will be made for grooves, cornices, vatta, moulding etc complete.		
12	**FIRE EXPANDING FOAM...**	5.00	SQM
	Providing and applying fire Expanding Foam having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 and UL 1479 for horizontal and vertical openings in RCC slabs, Beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The service lines could be of various types like electrical cables, cable trays or metal pipes etc. The foam shall have Acoustic property as per DIN 4109 and Smoke and Air Seal. The Foam should have the feature of Repenetrability for future maintance or repair activities. item includes scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 620/3M or approved equivalent)		
13	**FIRE BARRIER MORTAR...**	5.00	SQM
	Providing & applying fire Barrier Mortar having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 and UL 1479 for horizontal and vertical openings in RCC slabs,beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The mortar shall have minimum hardened density of 0.8 g/cm3 and compressive strength of 2.9N/Sq mm . The service lines could be of various types like electrical cable trays , metal pipes, GI Ducts for AC etc. It should be Smoke & Air Seal. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 636/3M or approved equivalent)		
14	**WATER SOLUBLE CABLE COATING...**	50.00	RMT
	Providing & applying water soluble cable coating applied with brush or airless spray to prevent the propagation of fires along internal electrical cables. Should be suitable for protectiing against spread of flame on timber panels and tested as per IEC 332 part 3 standard for reduced spread of flame & tested as per FM Class 3971. It should have no derating effect on cables, free from fibre,asbestos, odourless and solvent free, flexible when dry after application. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti /3M or approved equivalent)		

15	**FIRE RESISTANT BOARD SYSTEM...**	5.00	SQM
	Providing & fixing fire resistant board system having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 for horizontal and vertical openings in RCC slabs,beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The fire resistant board system shall comprise of a mineral wool board having a minimum density of 160kg/m3 coated with an ablative coating at 0.7mm dft. All contact surfaces and cavities shall be sealed with an firestop filler. The service lines could be of various types like electrical cables trays, metal pipes, etc.The Mineral Wool Board should also have the Acoustic property ,Air and Smoke seal. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 678/3M or approved equivalent)		
16	**GRAPHITE BASED INTUMESCENT FIRESTOP SEALANT...**	5.00	SQM
	Providing & applying graphite based intumescent firestop sealant having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 suitale for annular space for combustible pipes and cables.It should expand in fire , protecting pipe and cable penetration and must be halogen, solvent free and odourless. Firestop sealent should have property of Accoustic, Smoke and Air sealing. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 611 A/3M or approved equivalent)		
17	**MAKING THROUGH HOLES...**		
	Making through holes in plain or reinforced cement concrete with Diamond core drilling system by using Bosch power tools.of following diameters. Rate in Dia/mm		
	a) 52 mm	1500.00	Dia/mm
	b) 82 mm	3000.00	Dia/mm
	c) 112 mm	2000.00	Dia/mm
	d) 122 mm	4000.00	Dia/mm
	e) 152 mm	4000.00	Dia/mm
	f) 202 mm	4000.00	Dia/mm
18	**SOFT BOARD WITH FIRE RATED FABRIC...**	5.00	SQM

	Providing and Fixing approved shade and make FR grade Polyester-Cotton fabric over 12mm thick softborad of required size, on partition/wall etc. The fabric shall be certified to pass Surface Abrasion test of no yarn breakage after abrasion test across 10000 cycles; Fire Retardant finish as per BS EN 1021-1:1994, BS 7176:1995 low hazard section, IS 15061-2002 Clause 3.3 annex. B (Vertical test) and water repellent as per standard AATCC-118. Item to include all accessories, tools & labour, getting mock-up for approved by Architect/Engineer in charge; with Protecting with min. 20 micron polythene sheet cover till handover of facility, item complete with tight wrinkle free wrapping around soft board or approved boarding substrate, finished cleaned complete. The board shall be fixed on prepared surface with necessary hardware fittings etc. complete. Rate quoted shall be for the complete finished work including all the materials and labour mentioned above. Item to be completed in all respects as per instructions from Project- in-charge.		
19	**White board-Portable**	5.00	SQM
	Providing and placing on location Portable framed Magnetic Glossy finish type White board avg. 900 x 1200 size, as per approved model and make, with particle board backer and encasing. Item to include all fixing accessories, a marker/duster tray, including keeping in packaged condition till handover, cleaned complete. The item shall be supplied with necessary accessories such as magnetic symbols, magnetic letters, magnetic strips, magnetic eraser, magnetic dry marker 4 Nos., spare felt for eraser, board fixing clips etc. complete and all as per manufacturer's specification and as directed by the EIC / Architect.		
20	**EXECUTIVE TABLES**	1.00	NO
	Providing & fixing in position Executive tables with 18 mm MDF with drawers & storages, should have 1 mm thick Laminte of approved quality and shade of Laminate for all exposed surface .All unlaminated faces should have a melamine polish of matching shade of Laminate. Polish and chamfered for edge. The cost includes all necessary hardware like brass hinges/ locks, drawer channel, provision of cable manager, preparation of mockup etc complete. (For keeping keyboard special fixtures like INNOFITT or Equivelent to be provided)		
a	TRAVEL DESK (1350L x 750W x 750H)		
21	**LOW BACK CHAIRS**	3.00	NO

	Providing and supplying in position revolving chairs having 5 prong FR nylon in black finish or 5 prong aluminium in chrome finish with castors. The seat should be having gas lift adjustment with gas stroke. The mechanism for the chair should be synchronized tilt mechanism with multiple locking position. The seat and back of the chair should be made up of injection moulding PU foam with 12mm thick double ply backing. The seat and back should have fabric upholstry in specified colour and texture. The chair should have adjustable seat depth. The back rest should be made up of poly propylene with height adjustment. The arm rest should have height adjustment and to be made up of injection moulded PU foam and should be supported on a polypropylene hand rest assembled to the main body of the chair which is made up of polypropylene with fabric/rexine upholstry of approved color & texture. The colour of the fabric/rexine should be as specified by Architect. The chair should confirm the ANSI/BIFMA X5.1 standard. The cost of the chair includes preparation of mock up etc. complete. (The density of the foam should be 45 Kg/m3)		
22	**Room Signages/ Manager Cabins/ Utility Rooms(150x300)**	10.00	NOS
	Providing & fixing Aluminium Modular Signage using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish. **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Photo paper Insert		
23	**Way Finding Sign/Department Identification (150x600)**	10.00	NOS
	Providing & fixing Aluminium Modular Signage using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish. **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Photo paper Insert		
24	**Fire Evacuation Map (400x300)**	2.00	NOS

	Providing 7 fixing Aluminium Modular Signage , fire evacuation map using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Night Glow Vinyl with clear film Printing		
25	**Structural steelwork in hot rolled tubular sections...**	4.50	MT
	Providing fabricating & erecting structural steelwork in hot rolled tubular Sections for trusses, purlins etc. with all bracings, gusset plates etc. as per detailed drawing or as directed at all heights and levels including removing the scales & burrs, cleaning with phosphoric acid ,marking, Cutting, fabrication, hoisting, erecting & fixing in position, making alignment of members making welded / bolted / riveted connections with one coat of approved red-oxide paint etc complete		
26	**Structural steelwork in hot rolled sections...**	1.50	MT
	Providing fabricating & erecting structural steelwork in hot rolled sections (ISMB, ISMC, ISA) For columns, tie beams, trusses, purlins, gantry, monorail columns, plates, cable trays, pipe racks, castellated beams, staircase & other structural members with all bracings,gusset plates etc.as per detailed drawing or as directed at all heights and levels including removing the scales & burrs, cleaning with Phosphoric acid, marking, cutting, fabrication, hoisting, erecting & fixing in position, making alignment of members making welded / bolted / riveted Connections and finishing with two coats of synthetic enamel paint of approved quality and colour over one coat of approved red-oxide paint etc complete. Yield Stress FY = 250Mpa as per IS 2062		
27	**Auto Clave Masonry (Light weight blocks Masonry)**	40.00	SQM
	Providing and constructing 200 mm thick Auto clave block masonry at all elevations and heights in cement mortar 1:4 using (150 x 300 x 600)size with required size block bats , including all scaffolding, staging, racking the joints, curing etc., at all heights, elevations above and below finished floor level etc., all complete shall be as per specification and laid as directed.		
28	**Internal cement plaster (neeru finish)...**	80.00	SQM

	Providing and applying Plastering of internal walls and ceiling with cement mortar 1:4, 12 - 15 mm thick with Neeru finish according to specifications. Rate includes providing & fixing in position expanded metal plaster mesh [Arpitha make] or equivalent minimum 6" wide strips at the junctions of R.C.C columns/ beams/slab with brick work or wherever necessary, properly fixed, abutting the wall surfaces so as to get the plaster in line and plumb, necessary staging, scaffolding and curing at all levels and elevations etc. complete as directed.		
29	**Granite stone, skirting, treads, risers...**	8.00	SQM
	Providing and laying high polished approved quality and shade 20 mm thick Granite stone for treads, risers and skirting in line and level on a bed of 1:4 cement plaster including cement float, filling joints with matching color Cement slurry, curing, edge high polishing, chamfering, cleaning, etc. complete. (Basic Rate - 150 Sqft)		
30	**Fire Rated Vision Glass Window...**	10.00	SQM
	Min. 2 hr Fire Rated Vision Glass Window with all Framing & Fixtures (Note - Fire Rating should be for Hole Assembly ie Glass + framing)		

Sr. No.	Function	AI	DI	AO	DO		
	24 Hrs. Operation with 175 TR Chiller 3 Nos. Air-cooled						
1	Chiller On / Off command				3	Potential free contact from DDC	
2	Chiller Run Status		3			Potential free contact from DDC	
3	Chiller local / remote status		3			Potential free contact from DDC	
4	Chiller Trip / Fault status		3			Potential free contact from DDC	
5	Chilled water supply header temperature	1				Immersion Temperature sensor by BMS Vendor (Daikin)	
6	Chilled water return header temperature	1				Immersion Temperature sensor by BMS Vendor (Daikin)	
7	Chilled water return header flow rate	1				Flow meters by BMS vendor (VKHVAC)	
8	Chiller isolation valves open / close command				3	Potential free contact from DDC	
9	Chiller out valves open / close status		3			Potential free contact from Valve Actuator	
11	Outside air relative humidity monitoring	1				Outside Air Humidity Sensor to be supplied by BMS vendor	Through Plant manager
12	Outside air temp monitoring	1				Outside Air Temperature Sensor to be supplied by BMS vendor	
	Primary Pump						
1	Pump Start/Stop Command				4	Potential free contact from DDC	
2	Pump Auto/Manual Status		4			Potential free contact from Pump panel	
3	Pump Run Status		4			Potential free contact from Pump panel	
4	Pump Trip Status		4			Potential free contact from Pump panel	
5	Differential Pressure Snsor	4				DP sensor in CHW Line by BMS vendor (VKHVAC and DAIKIN)	
6	VFD Speed Control		4			0-10V DC control Signal form VFD (VKHVAC)	
	Condenser Coil fan Section						
1	Condenser Fan Auto/Manual Status		3			Potential free contact from Pump panel	
2	Condenser Fan Run Status		3			Potential free contact from Pump panel	
3	Condenser Fan Trip Status		3			Potential free contact from Pump panel	
4	Condenser Isolation Valve Command				3	Potential free contact from DDC	
5	Condenser Isolation Valve Open/Close status		3			Potential free contact from Valve Actuator	
6	Condenser Fan VFD Speed Control	3	3	3		0-10V DC control Signal form VFD	
	Valves						
1	Motorized isolation valves for main chiller header		3		3	Potential free contact	
2	**2 way motorized valves**		4		4	Potential free contact	
III	**Comfort AC for Electrical, UPS and BMS room**						
2	Ductable units ON/OFF Command		10		10	Volt Free Contact from BMS to AHU Starter Panel.	
3	Ductable units TRIP STATUS		28			Volt Free Contact from ACB to BMS	
4	Room temperature and RH Sensor	4				Temperature + RH Sensor by BMS	
5	Humidity Sensor	6				Humidity Sensor by BMS	
6	Battery room exhaust fan		2				
C	**Electrical System**						
I	**Main Power Panel HT, Main LT**						
1	Air Circuit Breaker On/Off and Status		30		30	Volt Free Contact from ACB to BMS	
2	Air Circuit Breaker TRIP Status		30			Volt Free Contact from ACB to BMS	
II	**UPS Input Panel 1 & UPS Output Panel 2 and non-IT UPS panel : 4 nos**						
1	Air Circuit Breaker and MCCB On/Off/TRIP Status		30		30	Volt Free Contact from ACB to BMS	
2	ACB/ MCCB TRIP Status		30			Volt Free Contact from MCCB to BMS	
III	**Chiller panels, pump, secondary pump panels**						
1	Air Circuit Breaker On/Off/ Status		30		30	Volt Free Contact from ACB to BMS	
2	ACB /MCCB TRIP Status		30			Volt Free Contact from MCCB to BMS	
III	**PAHU , PAHU fan,lightning, emergency lighting**						

	panels						
1	MCCB On/Off/ and status		10		10	Volt Free Contact from MCCB to BMS	
2	MCCB TRIP Status		10			Volt Free Contact from MCCB to BMS	
	DG Breaker 1 ,2 ,3 4 and 5 in synch Panel		30				
	HT breaker 1 ,2 and 3		18				
	Underground Diesel Storage Tank - Pump 1 W and 1 SB		8		4		
	Level Sensor - HSD	4					
	Transformer 1 and 2		12				
	Miscellaneous						
1	RH and Temp sensors	10				Sensors in BMS vendor scope	
2	CO2 Analysers	2				CO2 analyszers in BMS vendor scope	
7	VFD fans for Battery rooms	3			3		
8	Exhaust fans for Utility room ground floor and first floor (on/0ff/ and trip): 10 fans		5	5			
9	Hydrozen PPM meter integration	2				sensor in BMS vendor scope	
	Total	**43**	**363**	**8**	**137**		
	Spare @20%	**9**	**73**	**2**	**27**		
	Total hardware points	**52**	**436**	**10**	**164**		
D	**Integration**						**Software Points**
1	Integration of Chiller Plant Manager to BMS on MODBUS RTU on RS485					3Nos. Chiller's supplied by HVAC vendor. (105 Points)	105
2	DG 1 ,2 and 3						90
3	DG flow meter 1,2,3 and 4						60
	Load Manager						120
	ATS panel 1 and Panel -2						30
3	Integration of UPS' s on BACNet/IP / MODBUS RTU					8 Static UPS by UPS vendor (160 Points)	160
4	Integration of PAC' s on BACNet/IP / MODBUS RTU					3 Nos. of PAC's by PAC vendor (45 points)	45
5	Integration of PDU's on BACNet/IP / MODBUS RTU					8 Nos. of PDU's by PDU vendor (48 points)	
6	Integration of EA on MODBUS RTU on RS485					60 EA supplied by Electrical vendor (240 points)	240
7							
8	Integration with addressable Fire alarm system					Software level Seamless integration with BMS (200 points)	200
9	Access Control system					Software level Seamless integration with BMS on Same platform. Unlock the main doors in case of emergency.	50
10	WATER LEAK DETECTION					MODBUS inetrface with BMS/ Hardwire Interface thru DDC	50
11	VESDA					MODBUS inetrface with BMS/ Hardwire Interface thru DDC	75
12	Gas supression system status					hardwired	2
13	Rodent repellant					MODBUS inetrface with BMS/ Hardwire Interface thru DDC	20
	Total Software points						**1247**
	Spare of 20%						249.4
	Total software points						**1496**

Total Hardwaired Points	661
Total Software Points	1496
Total Hardwired and Softwired Points	**2158**

Note- DG , Transformer , LT breaker , ATS , HT panels are in the sunstation area . Local PLC panel (I/O Panel) needs to be considered , This data to be bundled and transmit on MOd Bus by TCP /IP / Ethernet to main BMS server by Cat 6 (Armoured) located in ground floor BMS room.Approximate cable length will be 250 meters.

Ditailed Technical Specification

22 kV HT PANEL

TECHNICAL SPECIFICATIONS

TECHNICAL SPECIFICATION

1. ELECTRICAL SYSTEM DETAILS

INDIAN INSTITUTE OF TROPICAL METEOROLOGYhaving 22KV HT Supply, We have to tapped 22 KV supply from Existing RMU situated in CTPT Room.

2 STANDARD

The HT Switchgear shall conform to the requirements of the following but not limited to, latest revision of relevant Indian Standards or equivalent British or any other International Standard Specifications.

IS-5	Colours for ready mixed paints and enamels.
IS-722	AC electricity meters.
IS-1248	Direct acting Indicating analogue electrical measuring instruments and their accessories.
IS-2705	Current Transformers. Part I to IV
IS-3156	Voltage Transformers.
IS-3231	Electrical relays for power system protection.
IS-3427	Metal enclosed switchgear and control gear for voltage above 1000V but not exceeding 11000V.
IS-3618	Phosphate treatment of iron and steel for protection against corrosion.
IS-4483	Preferred panel cut out dimensions for electrical relays - flush mounting IDMTL relays.
IS-5082	Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes.
IS-5578	Guide for marking of insulated conductors.
IS-6005	Code of practice for phosphating of iron and steel.
IS-6875	Control switches (switching devices for control and auxiliary circuits including contactors relays) for voltages upto and including 1000V AC and 1200V DC - Push Button and related control switches.
IS-9046	AC contactors of voltages above 1000V upto and including 11000V.
IS-13118	High Voltage alternating current circuit breakers.
IEC-298	MV metal-enclosed switchgear
IEC-265	MV Switches
IEC-129	AC Disconnections and Eathing Switches
IEC-56	MV AC Circuit Breakers
IEC-801	Monitoring and Control
IS 1388 IEC 56	Circuit Breakers
IS:2544	Busbar support insulators
IS:13947, IS:3427,	Degree of Protection
IS:9385, IEC:282	High Voltage Fuses
IS:722	AC Electricity Meters
IS:4171, IEC:694	Copper Busbars

IEC:129	Offload isolators
IS:6005	Code of Practice for Phosphating Iron and Steel
IS:9224	HRC Fuses

A. 22kV Vacuum Circuit Breaker

CONSTRUCTION

The switchboard shall be sheet steel fabricated, free standing, dust and vermin proof, totally enclosed, fully compartmentalised, floor mounted type. The circuit breaker panels shall be draw out, multi-panel unit type unless otherwise specified. The unit shall be robust design to withstand the stresses encountered in the event of an electrical fault.
The switchboard shall be constructed in suitable shipping sections for the purpose of shipping to site and correct re-erection on prepared foundations.
Adequate lifting facilities such as hooks for ease of handling at site shall be provided. These hooks when removed shall not leave any openings in the switchgear.
Front / Rear access shall be available to all components in each cubicle which requires adjustment, maintenance or replacement.
Rear access shall be available to all cable boxes and glands and multi-core terminal blocks. Rear side of cable chamber shall be provided with additional wire-mesh with high voltage danger notice board.
Each unit of switchgear shall have necessary interior sheet metal barriers to form separate compartments for buses, switching devices, entering cable connections, etc. Each compartment must be constructed and segregated to confine the damage caused by an internal fault to that compartment.
Automatic safety shutters shall be provided to shroud bus side and cable side main disconnecting contacts of the circuit breaker when the circuit breaker is taken to test position. Bus bar shutter shall be Permalli / Hylams of minimum 4.75 mm and shall have red paint

The instrument / control chamber shall incorporate the indicating instruments, lamps and components of the control circuit. The instrument chamber shall be provided with a separate door, which can be opened when the circuit breaker is `ON'. The instrument chamber shall also be totally segregated from the rest of the panel. Wherever equipments are mounted on the door, the wiring shall be with flexible wires. The wires shall be neatly bunched and clamped and shall be sufficiently long so that the door can be opened without causing unnecessary stress on the terminations at the instruments. All instrument and relays belonging to one panel shall be mounted on the same panel.

Pressure release plates/valves shall be provided for different compartments.

Doors of all switchgears shall be provided Synthetic or neoprene gaskets to prevent entry of vermin and dust. Steel screws, bolts and washers shall be plated.

240V 15A SPN Industrial socket outlet complete with switch and HRC fuse shall be provided in each cubicle and lamp should be provided in each cubicle.

The switchgear shall be fully draw-out, metal clad type and shall have Vacuum circuit breaker
One vertical panel shall include one feeder. Extension chambers at rear portion shall be considered for termination of large size / number cables, if required. Necessary dummy cubicles complete with horizontal busbars, space heaters, power, control and annunciation, busbars / cables shall be included to avoid interference of beams with cable openings wherever required.

- **PAINTING AND FINISHING**

  All metal surfaces shall be thoroughly cleaned and degreased, pickled and phosphate and chrome passivated pre-treated should be carried out. Panel shall be powdered coated in RAL-7032/35 (MAT-Finish)

- **BUSBARS**

  All bus bars and their main current carrying connections shall have the same sectional area throughout their length. Bus bars shall be sized to continuously carry the rated current without exceeding the final temperature of 85 Deg. o C. and the same shall be capable of withstanding the full fault level without any deformation. The rating of bus bars shall be same as that of incoming breaker rating. Bus bars shall be of aluminium (unless otherwise mentioned in specific requirements) with proper plating at joints. The bus bars shall be provided with cast epoxy sleeving or nylon film of suitable insulation class throughout their lengths and vertical droppers and colour coded. Joints in bus bars shall be provided with shrouds. For long bus bars, suitable expansion joints may be provided.

  The bus bars shall be supported by insulators of non-carbonising material resistant to acid and alkali and having non-hygroscopic characteristics and braced to withstand the fault level specified.

  The clearance between live parts and the earth shall be as per the Indian Standard. In case of copper to aluminium connections, proper treatment shall be given to minimize the bimetallic effect.

  Bus bars and connections shall be secured in such a manner that the insulators are not subjected to bending forces under short circuit conditions. Dynamic stresses shall be calculated on the basis of peak short circuit current.

  The vertical droppers shall be sized to carry continuously at least the rated current of the connected circuit breaker.

  It shall be possible to extend the bus bars at either end of the switchboard for addition of future units. Both ends of bus bars must be suitably drilled for this purpose.

  Where bus bars are taken through the partitions of adjacent cubicles, shrouding shall be provided to prevent spread of fire from one unit to the next.

  Thermal design of the bus bars shall be based on installation of the switchgear in poorly ventilated conditions. The cooling air volume shall take into account only the bus enclosure.

- **EARTHING**

  A copper / aluminium earth bus of sizeof suitable .Aluminum bus bar shall be provided at the bottom extending through the entire length of switchgear. Each stationary unit of the cubicle shall be earthed directly to the earth bus through a contact bar so that the carriage is earthed at all times except when the primary disconnects are separated by a safe distance. Suitable clamp type connectors shall be provided at both ends of earth bus to suit external earthing conductor. Also hinged doors of the cubicle base plate of C/T and P/T shall be effectively earthed.Earth bus shall protrude outside the extreme end panels and by at least by 100 mm.

  One set of earthing accessories shall be supplied with the switchgear for earthing of the outgoing side of a feeder or 3 phase bus bars of the switchgear either through earthing facility comprises truck to be inserted in place of circuit breakers, separate earthing trucks shall be supplied where earthing is achieved through circuit the earth device unless the circuit breaker is in open and isolated position.

- **SEGREGATION OF EQUIPMENT**

For safety reasons, each panel (Vertical Section) shall be divided into compartments to keep main equipment segregated.

- Partitions / separate compartments will be provided for:
- Bus bar compartment
- Cable termination compartment and instrument transformers.
- Circuit breaker
- Metering & Relaying Devices

Bus bar compartment shall have degree of protection of IP-41. All other compartments shall have degree of protection of IP-41.

Circuit breaker shall have Service-Test - Fully isolated positions with positive indication for each position.

- **SAFETY INTERLOCKS**

Switchgear shall be provided with all necessary safety interlocks and features.

Mechanical safety interlock shall be provided to prevent circuit breaker from following operations:-

1. Racking in or out of the service position when the breaker is closed. Racking in or out shall be possible when the front door is closed and breaker in open position. Operation of the breaker shall be possible in the service, test and isolated positions.
2. Racking in unless self-aligning control contacts / control plug is fully engaged.
3. Closing in any intermediate position between test & service position.
4. Automatic safety shutters shall fully cover the female primary disconnects when the breaker is with drawn to test position.

- **POTENTIAL TRANSFORMERS**

All PT’s shall be epoxy cast resin type

All PT's shall be draw out type and connections between the bus bars and PT shall be completely shrouded. Automatic shutter shall be provided to shroud the bus bars when PT is taken out. For Incomer feeders PT may be mounted on circuit breaker truck and shall be of fixed type since the same are connected on the incoming cable side.
It shall be possible to remove voltage transformer from the circuit breaker whenever required

HRC fuse protection shall be provided on primary as well as secondary side. The primary connection shall be disconnected before PT or its primary fuses become accessible.

- **CURRENT TRANSFORMERS**

All current transformers shall be epoxy cast resin type.

All current transformers shall be capable of withstanding dynamic and thermal stresses originated by short circuit fault current for one second.

Terminals shall be provided with plastic covers to prevent inadvertent contact.

- **CABLETERMINATION**

HT CABLE

HT switchgear will be connected to transformers or other equipment by PVC / PILC / 240Sqmm. HT XLPE cables. All power and control cables shall enter the switchgear from bottom. Sufficient space and support arrangement shall be provided in the cubicles to accommodate cables. The number of cables per circuit sizes and types shall be intimated to the supplier. If the required number of cable terminals cannot be accommodated in the circuit breaker chamber, additional dummy panel with bus extension suitable for the number of cables to be terminated shall be provided.
The cable sockets shall be at such angle that the cable tails may be brought up for termination with minimum bending and setting.

Terminals shall be located sufficiently away from gland plates or cable boxes to facilitate easy connection. If distance is not sufficient, adaptor panels shall be provided.

Minimum distance between gland plate and termination shall be 700 mm. Additional termination points shall be provided in the outgoing bus links for power factor correction capacitor cable termination.

In case cable terminations cannot be accommodated inside panel a suitable box for mounting of bottom/rear panel shall be supplied by vendor. Earth strip shall also be brought to this box. In lieu of this a dummy panel may be provided.

The switchboard shall be supplied complete with supports for clamping outgoing and incoming cables. Terminal blocks shall not be used to support cables.

CONTROL CABLES

Control cables shall enter the switchgear from the bottom. Separate And adequate space shall be provided for termination. Supporting facilities shall be provided for clamping the control cables. All control cables shall be 2.5 sq.mm Cu conductors.

- **WIRING AND FERRULES**

All control signalling, protection and metering wiring shall be by PVC insulated, 650 KV grade, copper stranded conductor wires of min. 2.5-sq.mm section. For CT secondary circuit wires of 2.5 sq.mm copper conductor min. shall be used. Wiring shall run in enclosed channel and shall leave at least 25% spare space for future use. Wires for connection between moving parts shall be flexible stranded copper conductors and the same shall be soldered at the ends before connections are made.

At least 10% spare terminals shall be provided in each terminal strips.

The switchgear Supplier shall do all inter-panel control wiring. The inter-panel wiring shall be taken through PVC sleeves or suitable rubber grommets.

- **CONTROL SUPPLY**

External DC control supply shall be provided for tripping and closing circuits to one panel. Also external AC control supply shall be provided for auxiliary power and heater circuits to one panel. Supplier shall provide suitable control switch and fuse at the point of receiving control supply. Supplier shall be required to loop both these supply to all the panels in case of multi breaker panels forming one unit. Each panel shall also have control supply switch and HRC fuses or MCBs for isolation. One DC feeder shall be provided for each bus section. The bus coupler panel may be fed from any of the two supplies.

b. 24V DC supply (Internal Power Pack)
c. 240V AC supply shall be provided for feeding space heaters, etc.

- **SPACE HEATERS**

The cubicles shall be provided with space heaters to prevent moisture condensation and maintain cubicle temperature 5o C above the ambient. The space heaters shall be located at the bottom of the switchboards and shall be controlled through a thermostat with an adjustable setting, a manually operated switch. The thermostat shall preferably be located in the metering / relay chamber.

- **VACUUM INTERRUPTER**

Circuit breakers shall have completely sealed interrupting units for interruption of arc inside the vacuum. It shall be possible to isolate easily the vacuum interrupter unit from the breaker operating mechanism for mechanical testing of the interrupter to check loss of vacuum.

The circuit breakers shall be complete with surge arrestors to provide protection to the equipment controlled by the breaker, against switching surges. Over voltage produced by the circuit breaker during switching off induction motor or switching on / off of transformer shall be limited to 2.5 times the peak value of rated phase to neutral voltage. Surge absorbers of either Z or Cr type with nonflammable, nontoxic liquid filled capacitors shall be used and located in switchgear cubicle if the over voltage limit exceeds. Surge diverters shall be provided for vacuum circuit breakers.

- **CIRCUIT BREAKER OPERATING MECHANISM**

1. Circuit breaker shall be power operated by a motor charged spring operated mechanism. It shall be strong, rigid, positive and fast in operation to ensure that the pole discrepancy does not exceed 10ms.
2. Mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and will not cause tripping or closing operation of the power operated closing devices.
3. When the circuit breaker is already closed, failure of any auxiliary spring shall not cause damage to the circuit breaker or endanger the operator.
4. The closing release shall operate correctly at all values of voltage between 85% and 110% of the rated voltage. A shunt trip shall operate correctly under all operating conditions of the circuit breaker up to the rated breaking capacity of the circuit breaker and all values of supply voltage between 70% and 110% of rated voltage.
5. Auxiliary switches mounted on the fixed portion of the cubicles and directly operated from the breaker operating mechanism on each breaker having 6 'NO' and 6 'NC' potential-free contacts rated for 10 amp, 240V AC and 0.5 amp (inductive breaking) 220V AC shall be provided. The contacts shall be in addition to those utilised in control circuit of each breaker and shall be exclusively meant for EMPLOYER use in external interlocks and controls.

- **SPRING OPERATED MECHANISM**

1. Spring operated mechanism, shall be complete with motor of adequate rating, opening spring, closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.
2. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.
3. Operating mechanism shall normally be operated locally, when the breaker is in "Service" position. Electrical tripping shall be performed by shunt trip coils. Provision also shall be made for local electrical control when the breaker is in "Test" position by a control switch on the switchgear cubicle door. Also, "Local / Remote" selector switch lockable in "Local" position shall be provided on the cubicle door. 'Red' and 'Green' indicating lamps shall be provided on cubicle door to indicate breaker close and open positions. Breaker "Service" and "Test" positions shall be indicated by separate indicating lamps on the cubicle door, in case mechanical indication of "Service" and "Test" positions are not available on the cubicle door.

- **INSTRUMENT TRANSFORMERS**

CTs and VTs shall be of cast resin type (with winding insulation of class E) and shall be able to withstand the thermal and mechanical stress resulting from the rated short time withstand and peak withstand current ratings of the switchgear. These shall be completely encapsulated.

CTs and VTs shall have polarity marks indelibly marked on each transformer and at the associated terminal block. Secondary connections of CTs & VTs will be made through disconnecting type terminals with necessary shorting and earthing facility.

VTs shall be of single phase type. VTs shall be protected on their primary and secondary sides by current limiting fuses. Interrupting rating on primary shall correspond to breaker rating. Provision shall be made such that the primary fuses can be handled only in the de-energised position. Drawout contacts for Phase and Neutral terminals shall be identical.

Metering CTs

For metering, main CTs and auxiliary CTs, if used, the accuracy class shall be normally 1.0.

All metering CTs shall have a adequate burden.

Instrument security factor shall be less than 5 unless otherwise specified.

Protection CTs

Protection CTs shall have class of accuracy of 5P10 and minimum burden 15VA.

Core balance CTs shall be such that the earth fault relay should be able to operate over its entire range.

CTs to be used for REF and Differential Protection will be PS Class.

CURRENT TRANSFORMER DETAILS

Type, Voltage & frequency	:	Cast resin, 22kv, 50 Hz
Class of Insulator	:	Class F or Better and Temp limited to B
Short time rating kA	:	26KA for 1 Sec. for CTs 100A & 125A 26kA for 3 Sec. for CTs rated above 125A
Dynamic rating kA (peak)	:	100
Withstand Test Voltage	:	
(a) One minute power frequency	:	28 kV (rms)
(b) 1.2/50 sec. Impulse withstand	:	75 kV (Peak)

VOLTAGE TRANSFORMER DETAILS

Type	:	Cast resin, 3Nos. single phase, Single / Dual Secondary
Voltage ratio (Primary / Secondary)	:	22000 / √3 /110/√3 / 110/√3
Method of Primary connection Secondary SI /S2	:	Star / Star
Rated Voltage Factor	:	Continuous
Class of Insulation	:	Class 'E' or Better

One Min. power frequency withstand:

Voltage kV (rms) : 28

1.2/50 micro sec. Impulse : 75

withstand voltage kV (peak)

- **INSTRUMENTS & RELAYS**

Meters shall be provided as per single line diagram.

Indicating instruments

Unless otherwise specified, all electrical indicating instruments will be 96 mm square, with 240 degree scale (Taut band type). They shall be suitable for semi-flush with only flanges projecting on vertical panels.

Instruments shall have accuracy class of 1.5 or better. The design of the scales shall be such that it can read to a resolution corresponding to 50% of the accuracy class index.

Recording instruments

Recording instruments will be square or rectangular in shape and shall be suitable for semi-flush mounting on panels with only flanges projecting. They shall be of non-drawout type

Trivector meter shall be L&T ER300P with RS485 port or equivalent type

- **PROTECTIVE RELAYS AND FUSES**

Relays and fuses shall be provided as per single line diagram

Relay cat numbers are indicated are ANSI/ALSTOM cat numbers. Vendor shall select the and specify equivalent relay

The protective relays shall conform to standard requirements. Type of relays shall be of numerical/static type which meet the various performance requirements are considered acceptable.

All relays shall be adequately protected against external voltage surges and noise signals. In addition to this, all the input circuit of relays will include their own auxiliary current and voltage transformers with screened windings. Where auxiliary interposing transformers are not feasible

in the input circuit, relays would have special surge suppression circuits to suppress external noise and surges.

Relays shall have at least the following electrically independent output contacts for the following purposes

a) Tripping circuit

b) Remote / local annunciation

If the main relay does not have sufficient number of output contacts inherently, these shall be multiplied using auxiliary relays. These auxiliary relays shall be used for annunciation, indication, etc. only. For tripping, only the contact of main relay shall be used directly.

Relays shall have display of currents, trip data and trip history for analysis and trouble shooting Built in self supervision and self testing to ensure continuous reliability ,Separate indication for power ON and programming mode or relay fault Separate fault indication Communication with computer and breaker control through RS 485 port Site selectable trip time character CT secondary site selectable Display of currents, trip count, self supervisionetc Drawout

HV Fuses

Fuses shall be provided as per single line diagram.

Type	:	HRC
Voltage Class	:	22 kV
Rated current	:	2 A
Symmetrical interrupting rating in kA peak	:	25

WIRING AND ACCESSORIES

Cubicles shall be completely wired up to equipment / terminal block. Inter-panel and inter-cubicle looping of control and cubicle space heating supplies to be carried out by CONTRACTOR. Wiring to be carried out with 650V grade single core PVC insulated stranded copper conductor of following sizes:

a)	All circuits except CT circuit	:	1.5	Sq.mm.
b)	CT circuit	:	2.5	Sq.mm.

Longitudinal troughs extending throughout the full length of the panels to be provided for inter-panel wiring, AC-DC supplies, PT circuits, annunciator circuits, etc. Ferrules for wire termination to be provided. Wire connected to trip circuit will have red coloured ferrule.

TERMINAL BLOCKS

Terminals blocks for CT and PT secondary leads shall be provided with test links and isolating facilities.

All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

Terminal blocks to be suitable for connecting the following conductors of the cables on each side:

(a)	All circuits except CT circuit	Minimum of two 1.5 mm2 copper
(b)	CT Circuits	Minimum of four 2.5 mm2 copper

CABLE BOXES AND GLANDS

Connecting leads of adequate size with terminal clamps for connecting cable terminal kit to switchgear equipment terminals shall be included. Cable box shall withstand the short circuit rating of the switchgear. The switchgear shall be provided with cable entry facilities at top / bottom as per the layout requirement with 3 mm thick removable gland plates, with double compression cable glands. For single core cables, the gland plates shall be non-magnetic

ACCESSORIES

Space heater supply for the switchgear shall be obtained from Distribution boards by cross connecting. Cubicle space heaters with Thermostat for automatic switching and 15A, 3 pin receptacle suitable for 240V, 1 phase, 50HZ AC supply controlled by 15A single pole miniature circuit breaker of 10kA. Breaking capacity to be provided in each cubicle. Also one light fitting with 20W fluorescent tube and switch to be provided in each cubicle

AUXILIARY SYSTEM

It is proposed to have the status of 22kV feeder in the switchgear from remote. For this purpose, following contacts will be made available in switchgear.

(i) Breaker 'ON'

(ii) Breaker 'OFF'

(iii) Breaker 'TRIP'

(iv) Breaker 'Service'

(v) Breaker 'Test'

(vi) Breaker 'Remote'

(vii) Breaker Spring charged position

LIST OF MAKES FOR BROUGHT OUT COMPONENTS

Protective relays:	Siemens/Schneider/ABB
Auxiliary contractor:	Siemens/ABB/Schneider
Power / Control switches:	Siemens/ABB/Schneider
CTs / PTs:	AE / PRAGATI / KAPPA
Meters:	kWh - SECURE /ABB
Load Manager –	Conzerv with Maximum Demand Indicator
Terminals:	WAGO / ELMEX/Phoenix
Indicating Lamps (LED-Type):	Altos/

TECHNICAL DATA FOR HT Panel (1 IN+2 OUT + EXTENDABLE PROVISION)

1	Incomer	1 630A VCB.
2	Outgoing Feeders	630 A VCB to feed Transformer-1(2500 KVA).
		630 A VCB to feed Transformer-2(2500 KVA).
3	Circuit Breaker	Vacuum Circuit Breaker
	Rating	22kV, 630Amps, 50Hz with Power Pack (30 min. Back up)

	Type	Draw-out type
	Rated Insulation Level	
	Rated Shot Circuit Breaking Current	26kA (rms)
	Short Time Withstand Current	1 sec
	Spring Charging motor	24V DC
	Shunt Released (Tripping Coil)	24V DC
	Closing Released (Closing Coil)	24V DC
	Under voltage Released (Under voltage coil)	24V DC
	Locking /Interlocking	
	Door Interlocking Mechanism	Required
	Main contact Position Indicator	Required
	Operation counter	Required
	Earthing Switch	Required
	Metering	KWh (Class-1) & Load Manager
	Protective Relays for outgoing VCB feeders (Numerical Type Only)	A. Over-current & Earth Fault Relay (50,50N, 51,51N) B. Auxiliary Relay C. Master Trip Relay (86). D. Trip Supervision Relay. E. Antipumping Relay. F. Restricted Earth Fault Relay (64 R)
	Transformer Protection Relay for VCBs	Bucholz Alarm and Trip. WTI Alarm and Trip. OTI Alarm and Trip.
4	Current Transformers-for Incoming Feeder.	

	Core-1 Metering	Cl.1.0 100VA, 150/5A
	Core-2 Protection	CL5P10 100VA, 150/5A
5	Current Transformer for outgoing VCB feeders	
	Core-1 Metering	Class-0.5 20VA 75/5A
	Core-2 Protection	5P10 Class 20VA 75/5A
6	Potential Transformers	Class-1 25VA, 22kV/110V
7	Indications	a. Breaker 'On' b. Breaker 'Off' c. Breaker in test Position d. Breaker in service Posit
8	Annunciations	16 Window Annunciation for following parameters viz. As shown in SLD
9	Aux.Contacts	4NO+4NC

Sl.No.	ITEM	UNIT	
1.0	GENERAL	–	
1.1	Manufacturer's Name	–	
1.2	Applicable Standard (S)	–	
1.3	Type of Circuit Breaker	–	VACCUM
1.4	Nominal System Voltage	kV	

1.5	Type Test Report	–	☐ Enclosed ☐ Not Enclosed
1.6	Compliance with Specification	–	☐ Yes ☐ No Deviations Attached
2.0	CONSTRUCTIONAL FEATURES	–	
2.1	Dimensions	–	
	a) Switchgear Cubicle	mm	L x W x D
	b) Adapter Panel	mm	L x W x D
	c) Overall Based on (a) & (b)	mm	L x W x D
2.2	Minimum Clear. Required	mm	Front : Rear :
2.2.1	Cubicle Weight with Circuit Breaker	Kg.	
2.2.2	Total Switchgear Weight	Kg.	
2.3	Dynamic Loading per Cubicle	Kg.	
3.0	BUSBARS	–	
3.1	Material	–	Al-Alloy/Copper
3.2	Applicable Standard	–	
3.3	Busbar Insulation	–	
3.5	Minimum Clearance :	–	
	A) Phase to Phase	Mm	
	B) Phase to Earth	Mm	
4.0	CIRCUIT BREAKERS	–	Compliance with Spec. ☐ Yes ☐ No, Deviations Attached
4.1	Feeder Ratings	Amps	As Per Spec. ☐ YES ☐ NO Details Attached
4.2	Switching over voltage		

	a) Switching Off Unloaded Transformer	PU / ms	Amps
4.2.1	Maximum Permissible Chopping Current.	–	
4.3	External Switching over voltage Limiting Devices Required	–	☐ Yes ☐ No
4.3.1	Details of Voltage Limiting Device :	–	
	a) Type & Voltage	–	
	b) Continuous withstand Voltage between Line and Earth	–	Volts
	c) Residual Voltage at Discharge Current of	–	
	100A / 500A / 1000A	–	Volts
4.4	MAIN CONTACTS :		
	a) Type / Material	–	
	b) Silver Facing Provided	–	Yes / No
4.5	ARCING CONTACTS :	–	
	a) Type / Material	–	
	b) Silver Facing provided	–	Yes / No
4.6	Trip Coil consumption at Rated Voltage	Watts	
4.7	Satisfactory Operation of closing between 80% - 100% of Rated Control Voltage	–	☐ Yes ☐ No
4.8	VACUUM BREAKERS	–	
	a) Pressure Inside the Interrupter	Mm. Hg.	
	b) Mechanical facility for checking Loss of Vacuum Provided	–	☐ Yes ☐ No Reason Given
	c) Vacuum Monitoring Relay provided	–	☐ Yes ☐ No Reason Given

	d) Adequate Shielding Against X-Ray Radiations Provided	–	☐ Yes ☐ No Reason Given
4.9	Type Test Report	–	☐ Enclosed ☐ Not Enclosed
5.0	CIRCUIT BREAKER OPERATING MECHANISM	–	
5.1	Type of closing Mechanism	–	
5.2	Spring Charging Mechanism :	–	
	a) Spring Charging Motor :	–	
	i) Rated Voltage	Volts	
	ii) Rating	Watts	
	Iii) Speed	RPM	
	iv) Class Of Insulation	–	
	v) Satisfactory Operation of Spring Charging Motor Between 80% - 100% of Rated Voltage	–	☐ Yes ☐ No, Deviation Given
	vi) Time Required to charging the Spring from fully Discharged Condition	SEC.	
	vii) Overload and Short Circuit Protection Particulars	–	
	b) Mechanical Indication for Spring Charged Condition Provided	–	☐ Yes ☐ No, Reason Given
	c) Whether Slow Closing/Opening is Feasible for Maintenance Testing	–	☐ Yes ☐ No, Reason Given
5.3	Method of closing During Power Supply Failure	–	
6.0	ISTUMENT TRANSFORMERS	–	
6.1	Current Transformers – Metering and Protection	–	Compliance with Specification & Project Dwgs

			☐ Yes ☐ No, Deviations Attached
6.1.1	Make	–	
6.1.2	Type (Bar / Wound / Any Other)	–	
6.1.3	Applicable Standard	–	
6.1.4	Class of Insulation	–	
6.1.5	Type Test Report for All CT Designs	–	☐ Enclosed ☐ Not Enclosed
6.2	VOLTAGE TRANSFORMERS	–	Compliance with Spec. Project Dwgs ☐ Yes ☐ No Deviations Attached
6.2.1	Make	–	
6.2.2	Type	–	
6.2.3	Applicable Standard	–	
6.2.4	Type of Insulation	–	
6.3	Type Test Report	–	☐ Enclosed ☐ Not Enclosed
7.0	INDICATING METERS	–	Compliance with Spec. /Dwgs ☐ Yes ☐ No, Deviations Attached
7.1		–	
7.1.1	General Make	–	
7.1.2	Applicable Standard	–	
7.1.3	Mounting, Flush type other	–	
7.1.4	Range as per Specification	–	☐ Yes ☐ No, Deviations Attached
7.2	WATT HOUR METER	–	
7.2.1	Make	–	

7.2.2	Type	–	
7.2.3	Standard to which it conforms	–	
7.2.4	Maximum number of digits	–	
7.2.5	Voltage Coil Rating	Volts	
7.2.6	Current Rating	Amps.	
7.2.7	VA Burden	VA	
7.2.8	Accuracy	–	
7.2.9	Range as per specification	–	☐ Yes ☐ No Deviation Attached
7.2.10	Test Plug/Test blocks testing terminals with links	–	
8.0		–	MAKE TYPE
	Protection RelayVendor to list all relays	–	
9.0	TERMINATION / WIRING	–	Compliance with Spec. ☐ Yes ☐ No Deviations Attached
9.1	Colour coding for wires for :	–	
	a) D.C. Control Circuits	–	
	b) A.C. Auxiliary Power Circuit Like Panel Space Heater, Panel Illumination Etc.	–	
	c) A.C. Metering Circuit	–	
	d) Earthing	–	
9.2	TERMINALS :	–	
	a) Make	–	
	b) Current Rating	Amps	
	c) Bolt Type	–	

	d) Moulded Inter-Terminal Barriers Provided	–	☐ Yes	☐ No
	e) Maximum conductor size and number of conductors which it can receive	sq.mm		
	f) Disconnecting type for CT circuits	–	☐ Yes	☐ No
	i) 10% Spare Terminal provided	–	☐ Yes	☐ No
10.0	SPARES	–		
10.1	List of recommended spares for normal maintenance for a period of 3 years furnished	–	☐ Yes	☐ No
11.0	TESTS			
11.1	All Test Certificates Furnished	–	☐ Yes	☐ No
11.2	List of routine tests to be carried out attached	–	☐ Yes	☐ No
12.0	DRAWINGS AND DATA			
12.1	Drawings submitted along with Bid	–	☐ Yes	☐ No

DATA TO BE FURNISHED BY THE VENDOR

1.0 **LIST OF DRAWINGS (TO BE SUBMITTED ALONG WITH THE OFFER)**

1.1 1. Switchgear cubicles : Outline dimensions and general arrangement

1.2 2. Switchgear layout plan including floor openings and fixing arrangement

2.0 3. TEST CERTIFICATES (TO BE SUBMITTED ALONG WITH THE OFFER)

The vendor shall furnish the following type test certificates

2.1 A) Circuit Breakers, B) Disconnects, C) CTs, D) VTs, E) Relays, F) Bushing and Insulators

3.0 **SWITCHGEAR CUBICLE DETAILS (TO BE SUBMITTED AFTER AWARD OF CONTRACT)**

3.1 Final dimensions (L x W x D) mm _____ mm

a) Minimum space required in front for drawing out the circuit breaker _____ mm

b) Minimum space required at the back _____ mm

Largest package for transport (L x W x D) mm _____ mm

3.2 WEIGHTS

a) Circuit breaker with operating mechanism, oil etc _____ Kg.

b) Cubicle without breaker truck _____ Kg.

c) Cubicle complete with breaker _____ Kg.

d) Impact loading for foundation design to include the dead load plus impact due to breaker operation in terms of the equivalent dead load _____ Kg./BKR.

e) Heaviest package for transport _____ Kg.

4.0 LIST OF DRAWINGS (TO BE SUBMITTED AFTER AWARD OF CONTRACT)

4.1 Switchgear Cubicles : Final outline dimensions and general arrangement, including plan, front elevation, rear elevation, side elevation and relevant cross-sectional views.

4.2 **Schematic Control Circuit Diagrams**

4.3 Detailed wiring diagrams including terminal block numbers, ferrule numbers and cable connections

4.4 Relay and instrument panel general arrangement

4.5 Inter panel interconnection wiring diagram.

5.0 **TEST CERTIFICATES (TO BE SUBMITTED AFTER AWARD OF CONTRACT)**

5.1 A) Circuit Breakers, B) Disconnects, C) CTs, D) VTs, E) Relays

F) Bushing and Insulators

6.0 Equipment shall not be despatched unless the test certificate are duly approved by the IITM / engineer

7.0 At least 5 (five) sets of compiled and approved test certificates shall be submitted within one month of dispatch of the equipment

8.0 INSTRUCTION MANUALS(TO BE SUBMITTED AFTER AWARD OF CONTRACT)

The vendor shall furnish specified number of copies of the instruction manual which would contain detailed step by step instructions for

All erection, operational and maintenance requirements. The manual shall include, among other informations, the following aspects :

8.1 Storage for prolonged duration _____

8.2 Unpacking _____

8.3 Handling at site _____

8.4 Erection _____

8.5 Precommissioning tests _____

8.6 Operating procedures _____

8.7 Maintenance procedures

8.8 Precautions to be taken during operation and maintenance work _____

8.9 Outline dimension drawings showing relevant cross-sectional views and constructional features

8.10 Catalogue numbers of all components liable to be replaced during the life of the switchgear.

DEVIATIONS FROM GENERALCONDITIONS OF CONTRACT

All deviations from General Conditions of Contract shall be filled in hereby the Tenderer.

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from general conditions of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

DEVIATIONS FROM TECHNICAL SPECIFICATIONS OF CONTRACT

All deviations from Technical Specifications shall be filled in hereby the Tenderer.

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from Technical Specifications of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

LT PANELS TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS

1. SCOPE

1.1 This Specification covers the requirements of Design, Fabrication, Assembly, Inspection, Testing and Delivery of 433V indoor; metal clad, cubicle type switchboards. Vendor shall furnish clause-by-clause acceptance / comments. Any deviations shall be brought out clearly in the quotation.

1.2 The project under consideration is PROPOSED NEW RUBBER STOPPER PLANT OF NIPRO INDIA CORP, SHIRVAL.

2 SYSTEM DETAILS

Design Temp. - 45^0 C.

HT Supply: 22kV +/- 10%, 50Hz +/- 3%

LT Supply: 3 Phase - 433/415VAC, +/- 10%, 1 Phase – 240VAC, +/- 10%, 50Hz+/- 3%

3 STANDARDS

The Equipment shall conform to the requirements of the following but not limited to latest revision of relevant Indian Standards or equivalent British or any other International Standard Specifications.

1)	IS-375	:	Marking and arrangement for switchgear bus bars, main connection and auxiliary wiring.
2)	IS-722 Part - I	:	AC Electricity Meters Part - I General requirements and tests
3)	IS-1248	:	Direct acting indicating analogue electrical measuring instruments and their accessories.
4)	IS-1822	:	AC Motor starters, of voltage not exceeding 1000 volts.
5)	IS-2147	:	Degrees of protection provided by enclosures for low voltage switchgear and control gear.
6)	IS-2208	:	HRC cartridge fuse links for voltage above 650V.
7)	IS-2419	:	Dimensions for panel mounting indicating and recording electrical instruments.
8)	IS-2516	:	Circuit Breakers - Requirements and Test voltages not exceeding 1000V AC or 1200V DC.
9)	IS-2607	:	Air break isolators for voltages not exceeding 1000 volts.
10)	IS-2705	:	Current Transformer - General Requirements

	Part-I		
	Part - II		Current Transformer - Measuring Current Transformers.
	Part - III		Current Transformer - Protective Current Transformers.
	Part - IV		Current Transformer - Protective Current Transformers for special purpose applications.
11)	IS-2959	:	Contactors for voltages not exceeding 1000V AC or 1200V DC
12)	IS-3072	:	Code of practice for installation and maintenance of switchgear.
13)	IS-3106	:	Code of practice for selection, installation, maintenance of fuses (voltage not exceeding 650V).
14)	IS-3156, Part - I	:	Voltage Transformer - General Requirements.
	Part - II	:	Voltage Transformer - Measuring Voltage Transformers.
	Part - III	:	Voltage Transformer - Protective Voltage Transformers.
15)	IS-3231	:	Electrical Relays for Power System Protection.
16)	IS-3914	:	Code of practice for selection of AC Induction Motor Starters (Voltage not exceeding 1000V)
17)	IS-4047	:	Heavy-duty air-break switches and composite units of air-break switches and fuses for voltages not exceeding 1000 Volts.
18)	IS-4064	:	Air break switches, air break disconnectors, air break switch disconnectors and fuse combination units for voltages not exceeding 1000V AC or 1200V DC.
	Part - I	:	Part I - General Requirements.
19)	IS-4146	:	Application guide for Voltage Transformers.
20)	IS-4201	:	Application guide for Current Transformers.
21)	IS-4237	:	General Requirements for Switchgear and Control Gear for Voltages not exceeding 1000V AC or 1200V DC.
22)	IS-4483	:	Preferred panel cut-out dimensions for electrical relays - flush mounting IDMTL relays.
23)	IS-4794, Part - I	:	Push Button Switches - General Requirement and Tests.
24)	IS-5082	:	Wrought aluminium & aluminium alloy bars, rode, tubes and sections for electrical purposes.
25)	IS-5987	:	Code of practice for selection of switches (Voltage not exceeding 1000V).
26)	IS-6236	:	Direct recording electrical measuring instruments.

27) IS-6875 : Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200V DC.

28) IS-8623 : Factory built assemblies of switchgear and control gear for voltages up to and including 1000V AC and 1200V DC.

4 DESIGN AND PERFORMANCE REQUIREMENT

All the 433V AC, devices/equipment like bus support insulators, circuit breakers, VTs, etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions:

i) Variation in supply voltage : + 10%

ii) Variation in supply frequency : + 5%

iii) Combined voltage and frequency

Variation : 10%

The breaker ratings indicated refer to the nominal rating of the breaker. However breaker shall be capable of carrying continuously at least 120% of circuit current at an ambient temperature of 40 deg.C and with breaker mounted inside the panel. If a higher rated breaker is necessary to meet this, the same shall be offered.

5 CONSTRUCTION

5.1 The switchboard shall be totally enclosed, metal clad, sheet steel fabricated, compartmentalised, dead front type, dust and vermin-proof, freestanding, floor mounting type. It shall be of unit construction suitable for splitting into sections for shipping to site and to be correctly re-erected on prepared foundations without skilled supervision. The individual shipping section length shall not preferably exceed 2 metres. Provisions shall be made for addition of future units on either ends of a switchgear line-up after its installation on site. End busbarfishplates shall be provided.

5.2 The switchgear shall be easily extensible on either side by the addition of vertical sections. It shall be possible to extend the switchgear, irrespective of the type of end panel and the design shall be such as to permit addition of extension panels of a type other than the type of end panel. Any adapter panels required shall be included in the basic price and indicated clearly in the technical particulars furnished.

5.3 The degree of protection shall be IP-42.

5.4 The switchboard shall be fabricated preferably from cold rolled sheet steel of minimum thickness 14/16 gauge.

5.5 The height of the switchboard shall be constant throughout its length, but not exceeding 2300 mm.

5.6 Adequate lifting facilities such as hooks for ease of handling on site shall be provided. These hooks when removed shall not leave any openings in the switchgear.

5.7 Front access shall be available to all components in each cubicle, which require adjustment, maintenance or replacement. Checking and removal of components shall be possible without disturbing adjacent equipment. All auxiliary equipment shall be easily accessible. Setting of relays shall be possible without de-energizing other equipment.

5.8 Rear access shall be available to all cable glands and multicore terminal blocks by means of sheet steel hinged doors, designed to give the maximum possible access to the cable terminations. The cable alley door shall be provided with bolts, which can be opened with special keys by authorised persons.

5.9 Each unit of switchgear shall have necessary interior barriers to form separate compartments for buses, switching devices entering cable connection etc. All barriers shall be manufactured from non-inflammable material, preferably of sheet steel.

5.10 Each compartment shall be constructed and segregated to confine any damage caused by an internal fault to that compartment.

5.11 Adequate barriers shall permit personnel to work safely within an empty switching device compartment or one from which the switching device assembly has been temporarily removed with bus energized.

5.12 The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders.

5.13 The arrangement of the feeders shall ensure that operating handle of the switch / breaker shall be above 300 mm but below 1800 mm from ground level.

5.14 Removable type undrilled gland plates shall be provided on bottom/top of the panel. Gland plates shall be 3 mm thick sheet steel.

5.15 Suitable provision shall be made for clamping cables inside the switchboard.

5.16 The cable terminations inside the cable alley shall be completely shrouded so that it shall be possible to work on any one of the terminations by switching OFF the corresponding feeder switch only.

5.17 All bezels, handles, screws, bolts, washers, hinges and other embellishments shall be of the best quality electro galvanised or passivated to withstand attack from corrosive atmosphere.

5.18 The fabricated parts shall undergo a **7 Tank treatment** of degreasing, pickling and two coats of primer before being given the stoved enamel finish. The final finish shall be of colour shade 631 as per IS-5 or **RAL-7032/5.** Two coats of final paint shall be applied. Proper care shall be taken to grind the welded joints to give a smooth appearance after painting.

5.19 The external finish of the board shall be of the highest standard.

5.20 The external and internal surface of the board shall be stove enamelled finish unless otherwise specified.

5.21 Adequate packaging against damage and deterioration shall be provided for transportation to site and subsequent storage prior to re-assembly.

5.22 Horizontal busbar chambers shall be at the top of the board. Bus bars shall be completely shrouded to prevent metal pieces falling on the busbar during maintenance.

5.23 The bus bars shall be of aluminium with continuous rating as given in the SLD. All bus bars and their main current carrying connections shall have preferably the same sectional area throughout their length. The bus bars shall be colour coded.

Following minimum clearances shall be adhered to while such designs.

1. Between phases	:	35 mm
2. Between phase & neutral	:	25 mm
3. Between phase & earth	:	25 mm
4. Between neutral & earth	:	25 mm

5.24 The busbar sizes shall be determined taking into consideration the continuous rating without exceeding the final temperature of 45^{o}C over maximum ambient temperature and the fault level specified. The bus bars shall be supported by insulators on non-carbonizing material resistant to acid and alkali and having non-hygroscopic characteristics and braced to withstand the fault level specified.

5.25 Auxiliary bus bars each of minimum size 18 sq mm copper shall be provided for following applications. Exact number of bus bars shall depend on various control, metering and auxiliary power distribution requirements specified in specific requirements.

a) Panel / Motor space heater supply.

b) AC / DC control supply for breaker tripping closing and indication circuits.

c) AC / DC control supply for breaker spring charging motors.

d) AC control supply for motor starter control and indication circuits.

e) AC potential supply for KWH meters.

5.26 Earthing - Two earth terminals shall be provided on each switch cubicle, at the back, near the floor. An earth bar of at least 50 x 6 mm copper shall be fixed to these terminals. The earth bar shall be electrically continuous and shall run the full extent of each board. Each unit shall be constructed to ensure satisfactory electrical continuity between all metal parts not intended to be alive and earth terminals of the unit. Suitable holes with bolts and lugs shall be provided at each end of earth bar of switchgear for connection to a main earthing grid of 76x 10 mm GI bus. The earth bar shall be accessible in each cable entering compartment either directly or through a branch extension to ground the cable armour and shields.

5.27 Bus bars and connections shall be secured in such a manner that the insulators are not subjected to bending forces under short circuit conditions. The vertical dropper shall be sized to carry continuously at least the rated current of the connected switching devices. When multiple switching devices are combined in tiers for a vertical unit, the droppers shall be able to carry the total current resulting from the combination of all switching devices. The vertical bus bars shall be completely shrouded with the cut-out for connection tappings.

5.28 In case of copper to aluminium connections, proper treatment shall be given to minimise the bimetallic effect. That is, all joint surfaces at aluminium to copper joints shall be silver / tin plated, alternatively Cu-Al. washers (bimetallic washers) may be used.

5.29 Any unused circuit breaker compartment shall be fully equipped and provided with compartment door, vertical bus bars and control terminals / wiring, etc., such that the same could be used for housing outgoing breakers in future without any modifications to the panel. All quotations must indicate the number of circuit breakers, which could be provided in unused space for each switchboard line up. Unit price for providing such outgoing circuit breakers shall be quoted which could be considered during placement of order.

5.30 The arrangement of feeders in the switchboard shall take into consideration the number and size of cables required for the feeders.

5.31 Incomer and Bus Coupler ACB shall be limited to one per panel.

5.32 Nameplate or polyester adhesive stickers shall be provided for each equipment (lamps, push buttons, switches, relays, auxiliary contactors, etc.) mounted on the

switchboard. Special warning plates one each on each front of a shipping section shall be provided on removable covers of doors giving access to cable terminals and bus bars. Special warning labels shall be provided inside the switchboard also, wherever considered necessary. Identification tags shall be provided inside the panels matching with those shown on the circuit diagram.

5.33 Engraved nameplates shall preferably be of 3 ply (Black-White Black) lamicoid sheets or anodized aluminium. Nameplates shall be fastened by screws and not by adhesives.

5.34 ACB feeders for outgoing shall be limited three per panel subject to owner's approval on GA diagram.

5.35 SFU feeders for outgoing shall be limited to three per panel.

5.36 The feeders shall be arranged in the ascending order of alphabets followed by ascending order of equipment, e.g. A33801, M3402, and P211.

5.37 Manufacturer shall furnish the general arrangement drawing of switchboard along with the quotation. The General Arrangement drawing of switchboard shall be subject to Owner's approval.

5.38 All indications shall be LED type.

5.39 Panel SLD (Mimic Diagram) to be pasted inside/outside the Panel.

5.40 All Switchgear models should same version (no mixing old and new types)

6 CIRCUIT BREAKERS

6.1 The circuit breaker shall be air break and draw out type. ALL ACBs with same rating and same frame sizes should be interchangeable.

6.2 All ACB's unless otherwise specified shall be provided with built in microprocessor based SC / EF / OC with variable settings and fault indications shunt release, Auxiliary contact block, manual operating handle, Positive position indication on facia.

6.3 All ACB's in the main LT panel should be four pole Type unless otherwise specified.

6.4 The charging mechanism of the circuit breaker shall be motor operated spring charged independent type. The close / trip control switch to be interlocked to trip before close. The closing and tripping circuits shall be self-opening on completion of their respective functions irrespective of the position of the control switch. Manual closing devices shall also be provided.

6.5 The circuit breaker shall be electrically and mechanically trip free.

Air circuit breakers (ACB) shall comply with standards IS/IEC 60947-1 & 2.

The breakers shall be tested & certified at CPRI/ERDA.

6.6 For all electrical circuit breakers anti-pumping device shall be incorporated.

6.7 The breaker shall be provided with minimum 6NO + 6NC auxiliary contacts. 20% auxiliary contacts (Min. 3 NO + 3 NC) shall be provided for Owner's exclusive use. All spare contacts shall be wired up to terminal blocks. Auxiliary contactor or relay shall be used to multiply contacts.

6.8 The auxiliary contact for the shunt trip shall be of advanced nature such that the auxiliary contact close before main contacts.

6.9 The main and secondary isolating contacts of the circuit breaker shall be of self-aligning type.

6.10 The main isolating contact shall have continuous rating equal to the rating of the breaker.

6.11 The secondary isolating contact shall be of wiping contact type.

6.12 The fixed portion of the circuit breaker shall have rail arrangement over which the chassis can move smoothly.

6.13 It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.

6.14 The breaker shall have 3 distinct positions, such as "SERVICE", "TEST" and "ISOLATED".

6.15 Proper mechanical indication shall be provided to locate these three positions without opening the compartment door.

6.16 It shall be possible to further withdraw the breaker from isolated position for inspection of the circuit breaker "withdrawn" position.

6.17 A stop block shall be provided on the slide rails to prevent the forward movement of the circuit breaker when it reaches the isolated position so that any accidental fall can be avoided. Provision shall be provided to padlock the breaker in all the three positions.

6.18 The following interlocks shall be provided on the circuit breaker:

a) It shall not be possible to withdraw the circuit breaker from the service position with the contacts of the breaker closed.

b) It shall not be possible to close the circuit breaker unless any one of the three positions is located, the service position, a definitely located test position, or isolated position.

c) It shall not be possible to open the compartment door when the circuit breaker is ON.

d) It shall not be possible to push breaker in if either set of safety shutter is not free and not in its normal closed position.

e) The circuit breaker can be padlocked in OFF position.

f) The castell interlocking shall be provided as per the SLD.

6.19 The circuit breaker shall be provided with mechanical ON/OFF, TRIP and SPRING CHARGED indication, mechanical trip push button, operating handle or `close' push button, in case of electrically operated circuit breaker and padlocking facility wherever specified.

6.20 In case of electrically operated breaker, emergency operating handle shall be provided.

6.21 It shall be possible to close the circuit breaker with the emergency operating handle without opening the compartment door.

6.22 Wherever cut-outs are provided for the control box, proper gaskets shall be provided. Provision shall be made for closing the cut-out provided for the control boxes when the C.B. is taken out of the compartment.

6.23 The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches `isolated' position the main isolating contacts are completely shrouded.

6.24 The circuit breaker compartment shall be so designed that hot gases produced shall be lead away from the operator.

6.25 The protective relays and instruments shall be mounted as near to the circuit breaker as possible. Separate compartment for the instruments and relays shall be provided.

6.26 When the circuit breaker compartment door is open, it must not be possible to touch the live parts.

6.27 All removable covers protecting live parts shall be clearly labelled with warning notices reading "LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER'.

6.28 It shall be possible to readily remove the arc chutes for routine inspection of the contacts with the circuit breaker in the "withdrawn" position.

6.29 All circuit breakers of same rating shall be identical in all respects and shall be interchangeable.

6.30 All the non-conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding contacts shall be arranged to make before power plug in and interrupt after power draw out.

7 MOULDED CASE CIRCUIT BREAKER

7.1 All MCCB’s shall be universal mounting line load interchangeable and with door interlock & handle.

7.2 All MCCB’s with microprocessor based release on Main LT Panel & PDB incomer only.

7.3 Door handles will be provided with pad locking arrangement.

7.4 All MCCB’s on main panel shall be provided with shunt release and Auxiliary contact block.

7.5 All MCCB’s shall be provided with suitable spreader links on both sided for bus bar and cable connections.

7.6 All MCCB’s used, as incomers to PDB’s shall be provided with shunt release & Aux contact Block.

7.7 MCCB’s shall have clear ON, OFF & TRIP positions.

8 SWITCHES

8.1 The switches shall be quick-make, quick-break heavy-duty type.

8.2 The switches shall be able to make and break 300% of the rated current at 0.3 P.F. as required by IS-4047.

8.3 The operating handle shall be mounted on the door of the compartment housing the switches. The switches shall be provided with an interlocking arrangement such that when the switch is ON it shall not be possible to open the compartment door.

8.4 It shall also be ensured that closing of the switch when the compartment door is open shall not be possible.

8.5 To facilitate closing of switch with door open during maintenance / testing, interlock defeat mechanism shall be provided.

8.6 The castell interlock shall be provided, wherever specified in the SLD.

8.7 In case of switch fuse feeders, the switch rating shall be equal or greater than the fuse rating.

8.8 The switch shall be provided with padlocking facility in OFF position.

8.9 All removable covers protecting live parts shall be clearly labelled with warning notices reading "LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER".

8.10 Rating of the switches shall be as given in the SLD.

9 MINIATURE CIRCUIT BREAKER

All MCB's used in panels & DB's shall be din rail mounted, 50 KA Breaking capacity, 'D' characteristic unless others wise specified. Terminals of MCB's shall be suitable for connecting proper size Cu / Al cables with lugs. Multiple MCB's shall be provided with common fixed operating handle.

10 HRC FUSES

10.1 Fuses provided shall have rupturing capacity greater than the fault level specified.

10.2 Fuses shall be of link type and shall conform to the relevant Indian Standards. They shall be of class 3 AC duty.

10.3 Fuses for motor feeders shall be decided taking into consideration bimetal relay characteristics provided.

10.4 Rating of the fuses shall be as given in the SLD.

10.5 Delayed action fuses shall be preferred for motor feeders.

10.6 Indication shall be provided in the fuses to indicate the fuse has operated. Operating indicator shall be visible without removal of fuses from service. Removal of fuses, however, must be possible, although full voltage may exist at the terminals. Fuses shall be pressure fitted type.

10.7 Fuse handle shall be supplied along with switchboard.

9. A CONTACTORS

The air break contactors shall be of triple pole type. Contactor shall have at least 2NO + 2NC contacts for owner's use. The auxiliary contacts shall be wired to the terminals. The contactor coil shall be suitable for control voltage of 230V AC. The coils shall have grade 'E' insulation and shall be suitable for use in the ambient temperature. The design of the contactor shall ensure easy access to auxiliary contacts and coil. Mechanical ON-OFF indication shall be provided for the contactors. Wherever mechanical indications are not provided, indicating lamps shall be provided for ON indication of the contactor. The contactor shall pick up at 85% of the control voltage and shall not drop out for voltage upto 45%. The

control voltage for motor starter circuit shall be 240V, single phase, 50 Hz, unless otherwise specified.

11 RTPFC CONTROLLER, CAPACITORS, REACTORS AND THYRISTORS -

RTPFC panel shall be so designed to accommodate all components including capacitors.

Adequate ventilation provision shall be made in panel design. Forced ventilation shall be considered for capacitor compartment if necessary.

MICROPROCESSOR BASED CONTROLLER-

1. Input-Suitable for 3 CT (1A/5A) input thyristor switched RTPFC Panel.
2. Protections- Shall have inbuilt Under-Over Voltage, Under-Over Load protection, Capacitive current protection, Current THD protection, Temperature rise protection, Load unbalance protection.
3. Steps- Digital output commends for 16 Steps.
4. Modes of operation – Manual and Auto.
5. Serial communication-Shall have RS 485 serial communication port and optional Mod bus Connectivity.
6. Memory- Data logging and Internal memory shall be capable of data logging for 2months for hourly records, fault record and Electrical parameters.
7. Editable parameters- General parameters, P.T. Ratio, C.T. Ratio, Upper P.F. and lower P.F. Setting, Fault parameters of Pt.2, Fixed bank setting, Step parameters including Step response and Correction time.
8. Display Parameters- Overall per Phase RMS Values, power parameters ,Energy parameters, Harmonic Parameters up to 15th harmonic, KVAR for each step connected in circuit, internal and External Temper sure , time and date.

CAPACITOR -

Capacitor shall be 3 Phase Delta connected capacitor banks of appropriate ratings either APP only. Individual capacitor shall have protection and shall have provision for proper connector box & connector for connecting external cable.

Capacitors should be suitable to any kind of loads and load variation & should be able to sustain high harmonic distortion.

Capacitors shall be of low loss design with watt loss less than 0.5 W / KVAR and guarantee capacitance loss of less than 10% over life period. In rush current limiting arrangement shall be provided to limit inrush current to 1.7 (line current) (In).

Capacitors when provided with series reactors to provide filters shall be of appropriate higher withstand voltage depending on 7% reactance. Also the KVAR indicated in the panel

SLD shall be effective KVAR at 415 volts.

The fixed capacitor bank shown in SLD should be mounted below Incomer breaker of the MLTP and it should not result in Increase in panel Size.

Minimum Voltage for Capacitors shall not be less than 480 V.

SERIES REACTOR -

1. Construction should be as per As per IS5553-1990/IEC 60289.

2. Output upto 100 KVAR.

3. Filter Factor- 7%.

4. Temp class- F

5. Copper wound.

6. Cooling-AN.

7. Temp rise should not be more than 55 Degree C. above ambient with 10 % Harmonic Current.

8. Type- Detuned, Copper wound, iron core dry type.

THYRISTOR MODULES -

1. Zero Differential voltage switching of Thyristors with precise automatic zero detection Logic.

2. Smooth, fast , transient free switching of capacitors.

3. Fine correction for reactive power.

4. Immediate response to reactive power demand for fast varying inductive and non linear load.

5. Low reaction time (5ms.)

6. Modules Should have adequate protection to protect the Thyristors from Fast changing non linear load having high inrush ,DV/Dt , DI/Dt and harmonics.

PROTECTION -

Since This Power factor Correction unit is to be installed in Industrial premises having High inrush motors, Non linear drives and Harmonic Environment Panel needs to be Designed considering extreme Conditions as mentioned above and adequately selected MCCBS/SFUs can be implemented for protection.

12 RELAYS

12.1 The relays shall conform to the requirements of IS-3231 and IS-4483 and shall be Alstom make.

12.2 All relays specified shall be flush mounted in dust proof cases and shall match the appearance of the instruments mounted on the same panel.

12.3 Protective relays shall be of the easy withdraw able type. Trip circuits shall be automatically broken and current transformer secondary circuits shorted, when a relay is withdrawn from its case. A marking strip shall be provided in front of each terminal block and a diagram plate at the back of each case to identify connections.

12.4 Relays contacts shall withstand repeated operation and shall make or break the maximum currents in their circuits without deterioration. All spare contacts shall also be wired up to the external terminals.

12.5 Relay coils shall carry their normal currents indefinitely and such currents as can occur under fault conditions. Relay mechanisms shall not be affected by vibration or magnetic fields, which may occur in normal operation.

12.6 All relays in tripping circuits shall have mechanically operated flag indications. Indicators shall be capable of being reset without opening the relay case. It shall not be possible to operate any relay by hand or to alter its setting without opening the case. For relays with combined functions such as inverse time and instantaneous trip, separate indications of each function as specified shall be provided.

12.7 Master tripping relay (Lock-out Relay) shall be of the hand reset type and shall have a reasonable number of spare contacts, both normally open and normally closed, in addition to those required by the protection and tripping scheme.

12.8 Provision shall be made for insertion of test plug at the front for testing and calibration using external source of power without disconnecting permanent wiring. Test plugs shall permit the shorting of any current transformer circuit.

12.9 Relay covers shall be of non-ignitable materials. Relays on which the function of a contact may be changed from NC to NO and vice-versa by simply changing the contact arrangement are preferred.

12.10 All relays pertaining to a feeder shall be accommodated in the same vertical section.

12.11 **BIMETAL RELAYS**

Bimetal relays shall be heavy duty, (wherever mentioned) ambient temperature compensated type. The selection of bimetal relays shall be based on the absorbed horsepower of motor given in the data sheet. Proper co-ordination shall be ensured between bimetal relay and the back-up HRC fuse provided. The bimetal relay shall be of hand reset type preferably with facility to change to self-reset at site, if necessary. The bimetal relay shall be provided with changeover contact for alarm indication. It shall be possible to reset the relay only after opening the

compartment door, if so specified. BMRs shall be with built in single phasing protection. Equipment like fans, blowers, etc., shall be provided with suitable saturable CT operated BMR. For saturable CT operated BMR, Single Phasing Protection Relay shall be separate, if specified.

12.12 SINGLE PHASING PREVENTER RELAY (SPPR)

12.12.1 If specified Single Phasing Protections shall be provided in all motor starter modules with contactor rating of 200 Amps and above. The Single Phasing Protection shall be of the current operated type and shall operate on the principle of sensing negative sequence of current.

12.12.2 In case of single phasing, the Single Phasing Protection shall operate after a time delay of 2 to 3 sec. The relay shall be of the hand reset type and visual indication of the relay operation shall be available.

12.12.3 The Single Phasing Protection shall be suitable for protection of the non-reversible and reversible motors.

12.12.4 Current transformer operated Single Phasing Protection Relay shall be provided for feeders, if specified.

12.12.5 Thermal overload relays shall be provided with minimum 1NO + 1NC contacts with a rating of 5 Amps at 240V, 1 phase, 50 Hz AC and 1.3 Amps at 110 V DC (inductive load).

13 MULTIFUNCTION METERS

13.1 Applicable Standards

The meters shall conform in all respects to International standards – IEC 61557-12, IEC 62053-22, IEC 62053-23 or the relevant Indian standards with latest amendments thereof.

13.2 General Requirements

- The meter shall be suitable for operation in single - or multi- phase networks, balanced as well as unbalanced load
- It shall be possible to use the multifunction meter directly in 690V networks
- The current inputs shall be configurable at site for measuring on x/1 A or x/5 A current transformers
- The multifunction meters shall be suitable for operation up to 55 Deg C
- The meters shall be suitable for operation with AC auxiliary power and shall have wide tolerance band of 95V to 240 V (±10%)
- The multifunction meters shall have high degree of protection (IP65 from the front) against ingress of dust & water
- The multifunction meters shall have backlit LCD display with adjustable contrast
- The meter shall be tamper-proof (password protected) to avoid mishandling by unauthorized person
- All Main & DG incomers and important feeders shall be provided with Digital LOAD MANAGERS unless otherwise specified instead of regular meters. LOAD MANAGERS shall provide minimum voltages, currents, KW, KVA, KWH, KVA Rh, frequency, Cos Ø % harmonics, Maximum demand KVA reading with scrolling. These will be with RS 485 port for down loading data. LOAD MANAGER should be able to store last 8 days data, which can be downloaded. Necessary software for Load Manager shall be provided.

13.3 Measured Values requirement -All metered values will be in "true RMS" values. The monitor shall include a keypad allowing for the viewing of different selected values. The monitor shall display the following values

Voltages	Phase-phase / phase-neutral
Currents	Per phase
Apparent, active and reactive power	Per phase and total
Power factor	Per phase and total
Frequency	45...64 Hz
THD for voltage and current	Per phase
Min. / max. values	Voltage - phase-phase, phase-neutral, Current / Power / Power factor / THD per phase, Frequency, Three phase average voltage and current
Average values	Voltage - phase-phase, phase-neutral Voltage min. / max. for phase-phase, phase-neutral Current Current min. / max.
Active energy	Import / export; high / low tariff
Reactive energy	Positive / negative; high / low tariff
Apparent energy	High / low tariff
Energy demand per measuring period	Three phase average rating for active and reactive power: 1 to 60 min.
Min. / max. rating values within the measuring period	Should be possible to be measured
Meter running counter	Uptime in hours
Universal counter	Pulse counting of external devices like water, gas, etc.

13.4 Measurement Accuracy

The multifunction meters shall be of high accuracy type and shall have the following levels of accuracy.

Voltage	± 0.3 %
Current	± 0.2 %
Power	± 0.5 %
Power factor	± 0.5 %
Active energy	Class 0.5S in accordance with IEC 62053-22:2003-01
Reactive energy	Class 2 in accordance with IEC 62053-23:2003-01

13.5 The meter shall have at least 1 Digital Input and 1 Digital Output as standard. It shall be possible to switch between High-tariff and Low-tariff via the digital input or the communication interfaces.

13.6 The device shall allow for monitoring of upper or lower limit values for parameters like V, I, pf etc. It should be also possible to build in logics so that multiple limit criteria are addressed. In case of limit violation, it shall be possible for triggering specified actions through the digital output of the meter

13.7 Communication

The meters shall be capable of communicating the measured parameters via high speed (preferably 1.5mbps) open protocol bus system like profibus. It shall be possible to parameterize the device either by the keys on the device or through parameterization software.

14 INDICATING INSTRUMENTS AND METERS

14.1 All indicating instruments and meters shall be capable of carrying continuously their full load currents and full voltage across their pressure coils. They shall not be damaged by the passage of fault currents or the existence of over pressure on the primary side of their instrument transformers for the maximum permitted duration of fault conditions, which may occur during normal operation. All instruments and meters shall be back connected.

14.2 For incoming feeders, measuring instruments shall be of 96 x 96 mm square pattern, flush mounting type, 72 x 72 mm instruments shall be used for outgoing feeders. Instruments shall be provided wherever indicated in specific requirements. All auxiliary equipment such as shunts, transducers, CTs, VTs that are required shall be included in the supply of the switchboard.

14.3 All AC ammeters, voltmeters. KW meters shall be of moving iron type for AC and permanent magnet type for DC. Accuracy class shall be 1.0 for KW / KWH meters and 1.5 for ammeters and voltmeters as per IS: 1248. The range shall be as indicated in the SLD. Ammeters for motor feeders shall have non-linear

compressed scale at the end to indicate motor starting current. Voltmeter shall be suitable for direct line connection.

14.4 KWH meters and KVARH meters shall be of registering type and shall be installed inside unit but readable without opening doors. KWH meters shall be with maximum demand indicator in KVA.

14.5 KW, KWH and power factor meters shall be suitable for 3 phases, 4 wire unbalanced system with voltage coil suitable for 230V AC. The current coils shall also be suitable as given in SLD.

14.6 Instruments shall be mounted above 900 mm but below 2000 mm from the base channel of the switchboard.

14.7 They shall be provided with zero adjusting devices for external operation.

14.8 Indicating instruments and protective relay for respective feeder shall be located either in the same panel or in adjoining panel and shall be grouped together.

15 CURRENT TRANSFORMERS

15.1 The Current Transformers shall be Resin cast bar primary / wound primary type. The burden ratio shall be minimum as indicated in Specific Requirements. However, current transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on drawings with their accuracy classification. Separate cores shall be used for metering and protection.

15.2 Current transformers for instruments shall have an accuracy class 1.0 and accuracy limit factor less than 5.0. However, accuracy class 3.0 is acceptable for ammeters only. If a metering load is fed from a protection CT, suitable 1/1 or 5/5 ratio saturable interposing CTs shall be used.

15.3 The current transformers shall be capable to withstand dynamic and thermal stresses originated by the fault current.

15.4 The CTs shall be suitably insulated and the mounting of the CTs shall facilitate easy maintenance.

15.5 The CTs shall be mounted in stationary part of switchgear.

15.6 The secondary of the CTs for metering when wired to terminals, shorting links shall be provided. Shorting links shall be of removable type of Wago make.

15.7 For proper relaying, one side of current transformer secondary shall be grounded in the compartment with the meters or relays, which they serve, and each CT group shall be grounded with a separate identified lead, which may be disconnected for testing.

16 POTENTIAL TRANSFORMERS

16.1 The potential transformers wherever provided shall be epoxy cast resin type and shall have class of burden minimum as given in the SLD. However, potential transformers shall have sufficient capacity to operate with the burden imposed by the devices shown on the drawing with their accuracy classification.

16.2 The voltage transformers shall have an accuracy class 3.0 from 50% to 110% of normal voltage and class 1.0 from 80% to 120% of normal voltage with burdens varying between 25% to 100% of the rated value at 0.8 PF lagging.

The primary of the voltage transformers shall be rated for 415 volts and the secondary for 110 volts.

16.3 The PT shall be provided with HRC fuse on the primary side and secondary side.

16.4 The PT shall be mounted in a separate compartment complete with its accessories.

16.5 For proper relaying, one side of PT secondary shall be grounded at the transformer and the ground connection shall be identified and removable for testing.

16.6 Test terminals shall be provided for PT circuits.

17 TIMERS

17.1 For reacceleration duty, timers unless otherwise stated, shall be pneumatic type and shall have adjustable time setting of 0 - 60 secs. The time settings, where specified shall be accurately set before despatch of the switchboard.

17.2 Timers for auto-transfer schemes shall be of static type with timing ranges suitable for the scheme employed.

18 INDICATING LAMPS

18.1 Indicating lamps shall be filament type with series resistance. The domes of the fittings shall be heat resistant.

18.2 The lamp shall be suitable for the voltage supply as given in SLD.

18.3 It shall be possible to replace the indicating lamp without opening the compartment door.

18.4 Screwed type lamps are preferred to bayonet cap lamps.

19 CONTROL SWITCHES

All circuit breaker operating switches shall be of the pistol grip type, spring return to neutral and lockable in that position.

They shall be arranged to close the breaker by being turned clockwise and to trip it by being turned anti-clockwise. The trip, neutral and close positions shall be clearly indicated. The movement shall be such that the switch cannot be operated inadvertently and that it is mechanically interlocked to trip before close. The operating switch shall be located preferably on the centre line at about 1.5 M from the floor level. The switch shall be GE make.

20 TVSS SPECIFICATIONS

1.	Protection	Electronics & cables
2.	Response time	<0.5ns
3.	Let-through Voltage	600V-800V
4.	Status indication	On-line LED
5.	Technology	MOV with fusing Elements
6.	Surge Capacitors	Yes
7.	Failure Testing	Yes Safe Failure
8.	MCOV	320V (max. continuous Operating voltage)

21 WIRING, TERMINATION AND FERRULING

21.1 All control conductors insulating material shall be of the PVC type.

21.2 Control, signalling, protection and metering wiring shall be by PVC insulated, 1.1 KV grade copper conductor wires of minimum 1.5 sq mm section, for CT secondary circuit wires of 2.5 sq mm copper conductor minimum shall be used.

21.3 Flexible conductor ends shall be fitted with suitable crimped thimble for efficient termination.

21.4 All control wires shall be properly bunched, cleated and supported on panel frames.

21.5 Where it is necessary to use a large number of conductors in one run, they shall be divided into two or more cable runs in enclosed channels.

21.6 Conductors shall only be carried over or bent around sharp corners or edges where this is unavoidable, in which case a suitable insulating strip shall be fixed to the sharp edge.

21.7 Sharp bends shall be avoided.

21.8 Conductors carried across a hinged portion of a chassis or door shall be flexible stranded copper conductors and the same shall be soldered crimped at ends before connections are made.

21.9 Suitable means of protection against abrasion shall be provided.

21.10 Sufficient slack shall be left at conductor ends to allow components to which the conductors are attached to be removed for inspection and servicing.

21.11 Conductors passing through holes in chassis or screens shall be fully protected by correctly fitted grommets or bushes.

21.12 Control and main wiring shall be kept separate as far as practically possible.

21.13 Colour coding for wiring shall be used and shall be indicated on the drawing.

21.14 Terminal strips for connecting entering control cables shall be Wago make plug in type of adequate size, shall be located conveniently for easy accessibility, without danger of contact with live part, ease of connection, and shall be separated by barriers from power circuits. At least 10% spare terminals shall be provided in terminal strips. Sufficient terminals shall be provided on each terminal strip to ensure that not more than one outgoing wire is connected per terminal.

21.15 The wire shall be identified by numbered ferrules at each end all in accordance with the connection diagram. All ferrules shall be made of non-deteriorating materials. The ferrules shall be universal triangular type so that they cannot move freely on the wire.

22 CABLE TERMINATION

Incoming feeders of 415V switchgear will be connected with transformers by busduct (with aluminium bus bars) from top and other feeders by cables. The bus enclosure and flanges shall match the through openings on the switchgear. All power and control cables shall enter the switchgear from bottom. Sufficient space and support arrangement shall be provided in the cubicles to accommodate cables. The number of cables per circuit, sizes and types shall be as specified in SLD. The cables shall be terminated through cable gland.

23 GLANDS

23.1 It shall be preferable to have all the glands on the removable bottom gland plate. Gland plate shall be 3 mm thick M.S. sheet.

23.2 Suitable provision for cable clamping shall be given alley for bringing cables to the respective compartments.

24 PANEL SPACE HEATERS

Wherever specified in specific requirements all switchgear shall be provided with space heaters in each vertical units to prevent condensation and the same shall be equipped with differential thermostat to automatically cut in and cut off the heater, so as to maintain interior temperature 5 DEG C above the ambient and shall also have manual disconnect switch and fuse for protection.

25 LABEL DETAILS

25.1 Labels of 3-ply laminate shall have black lettering on yellow background provided for following:

25.1.1 Main nameplate for the PCC as per description given in SLD in centre on top side on front of the PCC.

25.1.2 Name plates for all incomers and outgoing feeders indicating description, rating, equipment no., feeder no., etc.

25.1.3 Nameplates for all door mounted components.

25.1.4 Name plates for panel numbers on front and rear.

25.1.5 Warning labels for interlocks.

25.2 Danger labels shall be provided for interlocks.

25.2.1 Danger labels for the PCC as per statutory regulations.

25.2.2 Danger labels for busbar chamber.

25.2.3 Danger labels for cable alley housing live terminals.

25.3 All components shall be provided with components identification stickers.

25.4 Every component shall be provided with label on inside of the door indicating following information:

- Switch / Breaker Rating
- Fuse Rating
- BMR Rating
- Contactor Rating
- CT Rating
- Rating of other major components

25.5 All nameplates shall be fastened by means of screws to the panel.

26 LIMITS OF SUPPLY

The supply of switchgear shall include the switchgear itself complete with all normal components and devices required for full and proper operation of the equipment even though such components or devices may not be shown in detail on drawings.

Switchgear shall be in working order provided with the following auxiliary components necessary for normal and safe maintenance and operation.

- Special tools - Complete set of special tools shall include all necessary devices for lifting, installing, withdrawing, testing and maintaining the circuit breakers, contactors, fuses, relays and other components of the switchgear.
- 2 Nos. handles for removing fuses shall be delivered with each switchgear.
- 6 Nos. lamp grips for removing and replacing of indicating lamps.
- 1 No. test plug for Relays.

27 COMMISSIONING AND START-UP SUPERVISION

Commissioning and start-up supervision shall be provided by the manufacturer at site, and charges for the same shall be quoted separately.

28 SWITCHGEAR AND EQUIPMENT CERTIFICATION

Manufacturer shall state in its bid whether proposed circuit breakers and switchgears have been tested by an independent recognized testing organization. Copy of such test certificates shall be attached to the bid.

29 PACKING

29.1 The switchboard shall be shipped to site packed in wooden crates. They shall be wrapped in polyethylene sheets before being placed in crates to prevent damage to the finish. Crates shall have skid bottoms for handling.

29.2 The packing cases shall be marked as per the details given in the purchase order.

29.3 Each case shall have the reference to the vendor general arrangement drawing and shall normally indicate the sections of the switchgear.

29.4 The packing cases shall contain one set of all the drawings for easy inspection at site.

30 STATUTORY REGULATIONS

The switchgear shall be manufactured as per the requirements of Indian Electricity Rules. The switchgear shall be acceptable to the local statutory authorities such as Electrical Inspectorate and Fire Insurance Council. The switchgear shall have approval of Tariff Advisory Committee and relevant certificates shall be furnished in six sets for records.

31 SPARES

Manufacturer shall quote for recommended spares for 2 years and for spare fuses.

32 TESTING

32.1 415V switchgear shall be tested as per relevant Indian Standards and will include the following:

g) Visual and dimensional inspection as per general arrangement drawing.

h) Checking for provision of feeders as per general arrangement drawing.

i) Checking for provision of components as per bill of material.

j) Operation test.

k) IR measurement before and after HV test.

l) HV test.

32.2 The testing will be witnessed by Client's Engineer. Six copies of Test Certificates shall be furnished to Owner for approval before despatch.

33 DRAWINGS

33.1 In general, the manufacturer shall supply six sets of prints of drawings / documents as below.

33.2 All the above drawings shall incorporate the following information:

a) Client's Name

b) IIITM's order reference

c) Vendor's order reference

d) Reference to our specification / single line diagram and relevant drawings.

33.3 Electrical scheme drawing for each equipment shall be submitted separately. These need not be submitted at the time of first submission or approval stage. Once the drawing is approved, separate scheme drawing for each equipment shall be furnished.

33.4 As part of documentation two complete set of manual consisting of the following minimum as listed under.

"Contents" shall be furnished for approval. After approval, the record prints shall be furnished.

All the information shall be clearly indexed, flapped and filed in a folder of the Quality, which is expected for final Documentation.

Vendor to note that his final invoice will be cleared only after submission and acceptance of final record documentation. 5% of the order value is considered for above.

CONTENTS

Vendor shall note that the above list is given only for guidance. Vendor shall suitably edit the above list so that all relevant catalogues of each component is made available.

34 Automatic Transfer Switches

PART 1 GENERAL

1.01 Scope

A. Furnish and install automatic transfer switches (ATS) with number of poles, amperage, voltage, withstand and close-on ratings as shown on the plans. Each automatic transfer shall consist of an inherently double throw power transfer switch mechanism and a microprocessor controller to provide automatic operation. All transfer switches and controllers shall be the products of the same manufacturer.

1.02 Codes and Standards

The automatic transfer switches and controls shall conform to the requirements of all the below mentioned standards. 3rd party test certificates from independent laboratory MUST be produced on demand.

A. UL 1008 - Standard for Transfer Switch Equipment

B. Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment-AC 33A utilization category for Mix Load Application.

C. NFPA 70 - National Electrical Code

D. NFPA 99 - Essential Electrical Systems for Health Care Facilities

E. NFPA 110 - Emergency and Standby Power Systems

F. IEEE Standard 446 - IEEE Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications

G. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches

H. UL 508 Industrial Control Equipment

1.03 Acceptable Manufacturers

The manufacturer should have a minimum of 5 years installed base in India and must comply fully with the tender specs.

PART 2 PRODUCTS

2.01 Mechanically Held Transfer Switch

A. The transfer switch shall be electrically operated and mechanically held. The electrical operator shall be a momentarily energized, single-solenoid mechanism. Main operators which include over current disconnect devices, linear motors or gears shall not be acceptable. The switch shall be mechanically interlocked to ensure only two possible positions, normal or emergency.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. Where neutral conductors must be switched as shown on the plans, the ATS shall be provided with fully rated complete overlapping neutral transfer contacts. The neutrals of the normal and emergency power sources shall be connected together only during the transfer and retransfer operation and remain connected together until power source contacts close on the source to which the transfer is being made. The overlapping neutral contacts shall not overlap for a period greater than 100 milliseconds. Neutral switching contacts which do not overlap are not acceptable.

H. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

2.02 Microprocessor Controller

A. The controller's sensing and logic shall be provided by a single built-in microprocessor for maximum reliability, minimum maintenance, and the ability to communicate serially through an optional serial communication module.

B. A single controller shall provide twelve selectable nominal voltages for maximum application flexibility and minimal spare part requirements. Voltage sensing shall be true RMS type and shall be accurate to $\pm$ 1% of nominal voltage. Frequency sensing shall be accurate to $\pm$ 0.2%. The panel shall be capable of operating over a temperature range of -20 to +60 degrees C and storage from -55 to +85 degrees C.

C. The controller shall be connected to the transfer switch by an interconnecting wiring harness. The harness shall include a keyed disconnect plug to enable the controller to be disconnected from the transfer switch for routine maintenance. Sensing and control logic shall be provided on multi-layer printed circuit boards.

Interfacing relays shall be industrial grade plug-in type with dust covers. The panel shall be enclosed with a protective cover and be mounted separately from the transfer switch unit for safety and ease of maintenance. The protective cover shall include a built-in pocket for storage of the operator's manuals.

D. All customer connections shall be wired to a common terminal block to simplify field-wiring connections.

E. The controller shall meet or exceed the requirements for Electromagnetic Compatibility (EMC) as follows tested by 3rd party at an independent laboratory:

1.	EN 55011:1991	Emission standard - Group 1, Class A
2.	EN 50082-2:1995	Generic immunity standard, from which:
	EN 61000-4-2:1995	Electrostatic discharge (ESD) immunity
	ENV 50140:1993	Radiated Electro-Magnetic field immunity
	EN 61000-4-4:1995	Electrical fast transient (EFT) immunity
	EN 61000-4-5:1995	Surge transient immunity
	EN 61000-4-6:1996	Conducted Radio-Frequency field immunity

3. IEEE472 (ANSI C37.90A) Ring Wave Test.

PART 3 OPERATION

3.01 Controller Display and Keypad

A. A four line, 20 character LCD display and keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the serial communications input port. The following parameters shall only be adjustable via DIP switches on the controller:

1. Nominal line voltage and frequency
2. Single or three phase sensing
3. Operating parameter protection
4. Transfer operating mode configuration
   (Open transition, Closed transition, or Delayed transition)

All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

3.02 Voltage, Frequency and Phase Rotation Sensing

A. Voltage and frequency on both the normal and emergency sources (as noted below) shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

Parameter	Sources	Dropout / Trip	Pickup / Reset
Under voltage	N&E,3ϕ	70 to 98%	85 to 100%
Overvoltage	N&E,3ϕ	102 to 115%	2% below trip
Under frequency	N&E	85 to 98%	90 to 100%
Over frequency	N&E	102 to 110%	2% below trip
Voltage unbalance	N&E	5 to 20%	1% below dropout

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 60°C.

C. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via serial communications port access.

D. The controller shall be capable (when activated by the keypad or through the serial port) of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or CBA).

E. Source status screens shall be provided for both normal & emergency to pro-vide digital readout of voltage on all 3 phases, frequency, and phase rotation.

3.03 Time Delays

A. An adjustable time delay of 0 to 6 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals. Capability shall be provided to extend this time delay to 60 minutes by providing an external 24 VDC power supply.

B. A time delay shall be provided on transfer to emergency, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. Two time delay modes (which are independently adjustable) shall be provided on re-transfer to normal. One time delay shall be for actual normal power failures and the other for the test mode function. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive an external relay(s) for selective load disconnect control. The controller shall have the ability to activate an adjustable 0 to 5 minute time delay in any of the following modes:

1. Prior to transfer only.

2. Prior to and after transfer.

3. Normal to emergency only.

4. Emergency to normal only.

5. Normal to emergency and emergency to normal.

6. All transfer conditions or only when both sources are available.

F. The controller shall also include the following built-in time delays for optional Closed Transition and Delayed Transition operation:

1. 1 to 5 minute time delay on failure to synchronize normal and emergency sources prior to closed transition transfer.

2. 0.1 to 9.99 second time delay on an extended parallel condition of both power sources during closed transition operation.

3. 0 to 5 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments, except the extended parallel time, which shall be adjustable in .01 second increments.

H. All time delays shall be adjustable by using the LCD display and keypad or with a remote device connected to the serial communications port.

3.04 Additional Features

A. A three position momentary-type test switch shall be provided for the test / automatic / reset modes. The test position will simulate a normal source failure. The reset position shall bypass the time delays on either transfer to emergency or retransfer to normal.

B. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

C. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of one contact, closed when the ATS is connected to the normal source and one contact closed, when the ATS is connected to the emergency source.

D. LED indicating lights (16 mm industrial grade, type 12) shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

E. LED indicating lights (16 mm industrial grade, type 12) shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal and emergency sources, as determined by the voltage sensing trip and reset settings for each source.

The following features shall be built-in to the controller, but capable of being activated through keypad programming or the serial port only when required by the user:

F. Provide the ability to select "commit/no commit to transfer" to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

G. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which open to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or serial port.

H. An In phase monitor shall be provided in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in phase monitor shall be specifically designed for and be the product of the ATS manufacturer.

I. The controller shall be capable of accepting a normally open contact that will allow the transfer switch to function in a non-automatic mode using an external control device.

J. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to seven different exercise routines. For each routine, the user shall be able to:

1. Enable or disable the routine.

2. Enable or disable transfer of the load during routine.

3. Set the start time, .

   - time of day

   - day of week

   - week of month (1st, 2nd, 3rd, 4th, alternate or every)

4. Set the duration of the run.

At the end of the specified duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. A 10-year life battery that supplies power to the real time clock in the event of a power loss will maintain all time and date information.

K. System Status - The controller LCD display shall include a "System Status" screen which shall be readily accessible from any point in the menu by depressing the "ESC" key a maximum of two times. This screen shall display a clear description of the active operating sequence and switch position. For example,

Normal Failed

Load on Normal

TD Normal to Emerg 2min15s

Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator's manual, are not permissible.

L. Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

M. Communications Interface – The controller shall be capable of interfacing, through an optional serial communication module, with a network of transfer switches, locally (up to 4000 ft.) or remotely through modem serial communications. Standard software specific for transfer switch applications shall be available by the transfer switch manufacturer. This software shall allow for the monitoring, control and setup of parameters.

N. Data Logging – The controller shall have the ability to log data and to maintain the last 99 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory:

1. Event Logging

1. Data and time and reason for transfer normal to emergency.

2. Data and time and reason for transfer emergency to normal.

3. Data and time and reason for engine start.

4. Data and time engine stopped.

5. Data and time emergency source available.

6. Data and time emergency source not available.

2. Statistical Data

1. Total number of transfers.

2. Total number of transfers due to source failure.

3. Total number of days controller is energized.

4. Total number of hours both normal and emergency sources are available.

Communications Module - A full duplex RS485 interface shall be installed in the ATS controller to enable serial communications. The serial communications shall be capable of a direct connect or multi-drop configured network. This module shall allow for the seamless integration of existing or new communication transfer devices.

External DC Power Supply – An optional provision shall be available to connect an external 24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead.

PART 4 ADDITIONAL REQUIREMENTS

4.01 Withstand and Closing Ratings

A. The ATS shall be rated to close on and withstand the available RMS symmetrical short circuit current at the ATS terminals with the type of over current protection shown on the plans.

B. The ATS shall be UL listed in accordance with UL 1008 and be labeled in accordance with that standard's 1½ and 3 cycle, long-time ratings. ATSs which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable. The ATS upto 600A should be tested for any breaker rating. The ATS from 800A to 4000A should have short time withstand capacity as follows

800A to 1200A….36KA for 18 cycles

1600A to 3200A….42KA for 18 cycles

4000A……..65 KA for 30 cycles.

4.02 Tests and Certification

A. The complete ATS shall be factory tested to ensure proper operation of the individual components and correct overall sequence of operation and to ensure that the operating transfer time, voltage, frequency and time delay settings are in compliance with the specification requirements.

B. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards, and withstand and closing ratings. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

C. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001.

4.03 Service Representation

A. The ATS manufacturer shall maintain a national service organization of company-employed personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

35 AL BUS TRUNKING SYSTEM

1.0 SCOPE

This specification covers the design, manufacture, testing and inspection at manufacturer's works, loading, transport to site, unloading, installation, testing and commissioning of the following:

4000A, 433V, 3-phase, 4-wire, 50kA for 1sec short circuit rated, naturally cooled, totally enclosed, compact (Sandwiched) Busduct of aluminium busbar, with suitable bends, end flanges, cover plates, copper flexible cables, bolts, nuts & washers with complete accessories and supports for the connection between panels as per sld. For more details refer drawing. The equipment to be offered under this specification shall be of proven design by way of commercial operation for at least three years in similar project.

2.0 CODES AND STANDARDS

The equipment specified in this specification shall be designed, manufactured and tested in accordance with latest relevant Indian standards or IEC codes. In the event of any contradiction between this specification and IS/IEC codes then the more stringent of the two shall govern

IS 8084-1976: Interconnecting bus bars for AC voltages

IS 8623 (part-2):Factory built assemblies-particular requirements of Bus bar Trunking systems.

IEC 439 (part-2): Particular requirements of bus bar Trunking systems.

3.0 DESIGN AND CONSTRUCTION REQUIREMENTS

GENERAL

433 V, 3 phase, 4 Wire, 50 Hz, self-cooled, bus duct as per the specific requirements shall be supplied. Quantities specified are indicative only. The same are subjected to change during detailed engineering.

BUSBARS

Bus bars shall be made of high conductivity electrical grade aluminium alloy.Bus bars shall be of adequate size to withstand the system fault current for the specified time duration.

Tenderer shall submit the busbar sizing calculations for short circuit withstand capability and maximum temperature, rise indicating the derating factors clearly for the approval of IIITM. Busbars shall be designed for bolted connections throughout the run. Flexible connections shall be provided between bus sections to allow for expansion and contraction of the conductor. Flexible connections shall also be provided at all equipment terminations. Busbar shall be colour coded/taped with red, yellow, and blue and black as applicable for easy identification.

ENCLOSURE

The bus bars shall be enclosed in a self-cooled, weatherproof, dust tight, mild steel sheet minimum 3mm thickness with epoxy-based paint. The degree of protection shall be of category IP 64 for outdoor and IP 54 for indoor application

Circumferential neoprene rubber gaskets shall be provided for dust tight joints with adjacent enclosure sections.

All outdoor bus enclosures shall be so designed and manufactured as to prevent the accumulation of rainwater on top sheet. Suitably sloping canopy shall be provided. The arrangement proposed shall be clearly brought out by the supplier in the bid.

Seal off bushings along with wall frame and support plates shall be provided where the busduct penetrates the building wall.

The busduct shall be designed to withstand vibrations caused by transformers / DG Sets. Neoprene rubber bellows to be provided in all end termination for transformers.

Removable bolted disconnect links shall be provided in the bus wherever required for the purpose of isolation.

All matching flanges, seal-off bushings, fittings, hardware and supports required for termination of bus duct at switchgears, transformers should be supplied.

BUS SUPPORT INSULATORS

Bus support insulators for 433 V bus duct shall be of high strength, good quality fibre reinforced plastic or SMC, with high anti-tracking index and non-hygroscopic.

The insulator mounting plate shall be designed for cantilever loading to withstand the short circuit forces.

Insulators shall be mounted in such a way so as to permit easy removal and replacement without disassembly of the bus.

GROUNDING

Two separately run 50 x 10 mm G.I flat shall be run along the length of the bus duct as earth bus. All parts of the bus enclosure, supporting structures and equipment frames shall be bonded to the ground bus.

3.6 NAME PLATE

3.6.1 Suitable nameplate shall be provided for each piece equipment for easy identification of bus duct.

3.6.2 Material of the nameplate shall be plastic, 3 mm thick or approved equivalent. Letters shall be white on black background.

3.7 PAINT FINISH

The interior surface of the enclosure shall be given matt black finish.

The outside surface finish shall be epoxy based Pebble grey shade RAL 7032.

4.0 TESTS & INSPECTION

All the fabricated and fully assembled busduct sections shall be routine tested as per relevant Indian Standard in presence of IIITM.

Charges for conducting heat run and impulse tests if and shall also be indicated by the bidder.

The certificates of all the type tests to be carried out as per relevant Indian standards shall be submitted to the IIITM for verification.

5.0 PACKING AND DESPATCH

All equipment covered under this specification including all accessories shall be properly packed and delivered at the IIITM's site in order to prevent any damage during transit and in storage at site.

SPECIFIC REQUIREMENTS FOR NON-PHASE SEGRAGATED BUS DUCT

System nominal voltage	-	433 V
System frequency	-	50 Hz
Number of phases	-	TPN
Rated Continuous current	-	
Quantity required		-

Bill of Quantities for each set of busduct : (Bidders to quote for unit rate of all these items separately.)

Straight run (Indoor)	-	
90° bends	-	
Copper flexible at eqpt. end	-	
Chamber	-	
Switchgear end connection Chamber	-	
Phase cross over chamber	-	
Wall sealing unit	-	
a) Minimum phase to phase	-	As per standards
Clearance (clear)		
b) Phase to body clearance (clear)	-	As per standards
c) Phase to neutral (clear)	-	As per standards
Neutral Grounding	-	As per standards
Insulation level		

a) 1 min dry power frequency Withstand voltage	-	2.5 kV rms
b) Impulse withstand voltage	-	
Short time rating (Sym. KA)-(1 sec)	-	Refer SLD
Dynamic withstand current	-	100 kA peak
Cooling	-	Self-cooled
Design ambient temperature	-	50°C
Location	-	Indoor/outdoor
Degree of protection	-	IP 52/IP64
Maximum temperature rise (over 50 deg. C ambient)		
a) Bus conductor	-	35°C
b) Bus enclosure and support Structures	-	20°C
Material		
a) Busbar	-	Cu
b) Enclosure 3mm. (CRCA)	-	MS of minimum thickness
a) Bus bar Joints	-	Bolted type
b) Flexible / expansion equipment	-	To be provided at all joints
Terminations and between bus sections if the Length of the section exceeds 7Mtr.		
i) Material	-	Tinned Cu
ii) Type	-	Braided
iii) Short circuit & continuous rating	-	same as main busbar
c) Cover over chamber	-	Required
Enclosure joints	-	Circumferential neo-prene rubber gaskets shall be provided for dust tight joints.

Disconnecting link	-	Required
Insulators	-	Non-hygroscopic
FRP/SMC with high Anti-tracking index. not acceptable.)		(Hylam Sheet support of any grade is
Creepage distance	-	As per standards
Seal off Bushing at wall entries	-	Required
a) Ground bus	-	2 run of 50x10mm GI flat
		On either side.
b) Grounding terminal	-	To be provided to suit above
		Ground bus.

Heating - Thermostat controlled space heater wired by means of 650V HRPVC 2.5 sq.mm. Copper wire.

Paint finish

a) Inside	-	Matt black
b) Outside	-	Pebble Grey Shade RAL 7032
		For MS enclosure.
c) Coating Thickness	-	100 microns.
Silica gel breather and drain plugs	-	Required
Applicable standards	-	IS 8084 IEC 439 IS 8623
Acceptance tests	-	As per IS:8084 IS 8623
Inspection	-	Before dispatch
Time schedule	-	Technical particulars to be submitted with bid.
	-	All drawings within 2 weeks from LOI.
Dispatch particulars	-	Shall be intimated later.

Drawings/documents to be furnished by the successful bidder:

Bus bar sizing calculation for Continuous current carrying capacity

Temperature rise.

Short circuit withstands capability.

Layout of individual busduct set along with B.O.M.

Wiring diagram for space heaters.

Detailed fabrication drawing.

DATA SHEET FOR BUSDUCT

(The bidder shall fill respective data; Supplement catalogue, write-up technical literature etc., shall not be referred as alternative)

Make :

Type :

Rated voltage :

Number of phases :

Frequency :

Insulation level

a) 1 min P.F.withstand voltage :

b) Impulse withstands voltage :

Rated continuous current :

Maximum temperature rise over50 deg. C ambient :

Rated short time current

a) Symmetrical for 1 sec :

b) Momentary :

Busbar

a) Material & grade :

b) Conductivity :

c) Size :

ENCLOSURE

a) Material :

b) Thickness :

c) Phase to phase spacing :

d) Phase to earth spacing :

e) Phase to neutral spacing :

f) Neutral to earth spacing :

g) Overall dimensions :

D.C. Resistance in micro

Ohm/metre/phase (Guaranteed)

a) 20 deg. C :

b) 85 deg. C :

Skin effect Ratio :

50 Cycle Reactance Ohm/metre/Phase :

Capacitance to ground :

Losses in watts/metre/phase :

INSULATORS:

Make :

Material :

Number per support :

Voltage class :

Creepage distance :

Compression strength :

Cantilever strength :

Size and material of ground bus :

Supporting steel structure :

WHETHER THE FOLLOWING HAVE BEEN PROVIDED

i) Thermostat controlled space heater :

ii) Silica gel breather :

iii) Filtered drains :

iv) Neoprene rubber gaskets at joints :

PAINTING SHADE

a) Interior surface :

b) Outer surface :

Painting Thickness :

Tests and Inspection :

Photo copies of type test reports enclosed :

G.A Drawing shall be enclosed. :

Notes: -

The Quantities are subjected to variation and the actual quantity shall be as per the requirement of the finally engineered system

36 MAKES OF COMPONENTS

Unless approved in writing equipment / components of switchgear shall be of following make only:

SR. NO	ITEM DESCRITION	RECOMMENDED MAKES	PROVIDED BY BIDDER
1	ACB	Schneider/ Siemens/ABB/L & T	
2	MCCBs	Schneider/ Siemens/ABB/L & T	
3	ATS	Siemens/Eaton/Emerson(ASCO)	
4	Timers, Temp Controllers etc	Selectron / ABB	
5	Contactors	Schneider MG / Siemens	
6	Capacitors Banks (APP/MD)	Subodhan/Epcos/ABB/Vishay/ Meher	
7	Load Managers	Conserv /Socomec	
8	SDF Unit	Siemens / ABB/ Merlin Gerin/L&T	
9	ELCB / RCCB /MCB	Legrand/MerlinGerin/ Siemens/Hager/ABB	
10	Starters	Siemens/ Schneider	
11	Relays (OL & EF)	Alstom/Siemens/ABB /Areva	
12	RTPFC Relay	Alstom/Sycon/Beluk/Ducati(RMI)/ABB/EPCOS	
13	Energy meter	L&T/Enercon/Krycard/ AE/Socomec/Elmeasure /Conzerv	
14	Indicating meter(Digital)	Enercon/AE/ Socomec/Elmeasure	
15	Control fuses	EE/Siemens/ Merlin Gerin	
16	Indicating lamps (LED based)	ALTOS/Teknic/Siemens/ Schneider/Vaishno/ESBEE	
17	Push buttons	Siemens/BCH/Teknic/ LEGRAND	
18	TVSS	Schneider / Phoenix	

19	Current/Voltage transformers	Kappa/ C & S/AE /Jyoti / L&T / Siemens/Newtec	
20	Ammeter/Voltmeter selector switch	Kaycee/Salzer	
21	Electrical Panel	Block Set/Sivacon 8PU/MNS	

37 DATA TO BE FURNISHED BY THE VENDOR

LIST OF DRAWINGS

The CONTRACTOR shall furnish the following drawings for the switchgear:

Overall outline dimensions and general arrangement including plan, front elevation, rear & side elevations, clearances recommended in front and back.

Switchgear layout plan including floor openings, fixing arrangements and loading details.

Schematic control diagrams to cover controls, protection, interlocks, instruments, space heaters, etc. for each type of module.

(a) Detailed internal wiring diagram of each type of module, including terminal block numbers,
Ferrule numbers and the external cable connection designations

(b) Item wise bill of material for each module, listing all devices mounted and also otherwise
Furnished like cable glands, indicating the MANUFACTURER's type, rating, quantity & special
notes, if any.

Interpanel interconnection wiring diagram including terminal numbers and ferrule numbers.

Each type of protection relay and circuit breaker release characteristics

36.1 NOTES:

(a) The CONTRACTOR shall be entirely responsible for the correctness of the internal wiring diagrams

(b) The CONTRACTOR shall ensure that the characteristics of the CTs, fuses, protection relays, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.

TEST CERTIFICATES

Type test certificates of all standard component parts, e.g. contactors, breakers, switches, fuses, relays, CTs, VTs, and for the standard factory built assembly shall be submitted by the CONTRACTOR.

INSTRUCTION MANUALS

The CONTRACTOR shall furnish specified number of copies of the instruction manual which would contain detailed instructions for all operational & maintenance requirement. The manual shall be furnished at the time of despatch of the equipment and shall include the following aspects:

a) Outline dimension drawings showing relevant cross-sectional views, earthing details and constructional features.

b) Rated voltages, current, duty-cycle and all other technical information which may be necessary for correct operation of the switchgear.

c) Catalogue numbers of all components liable to be replaced during the life of the switchgear.

d) Storage for prolonged duration.

e) Unpacking.

f) Handling at site.

g) Erection.

h) Precommissioning tests.

i) Operating procedures.

j) Maintenance procedures.

k) Precautions to be taken during operation and maintenance work.

DEVIATIONS FROM GENERAL CONDITIONS OF CONTRACT

All deviations from General Conditions of Contract shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from general conditions of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

DEVIATIONS FROM TECHNICAL SPECIFICATIONS OF CONTRACT

All deviations from Technical Specifications shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from Technical Specifications of contract of enquiry.

DATE:

Signature & Seal of Tenderer

2.5 MVA 22/0.433 KV TRANSFORMER TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS

1. ELECTRICAL SYSTEM DETAILS

Transformers fed with 22kV, 3phase, 50Hz. Fault Level assumed @ 500 MVA.

2. CODES AND STANDARDS

The Transformer and Accessories shall conform to the requirements of the following but not limited to, latest revision of all relevant Indian Standards or International Standards.

Colour of paint	IS 5
Ready mix paint, brushing Zinc Chrome plaster	IS 104
Ready mix paint, brushing,Priming plaster	IS 109
insulating oil	IS 335
Testing of steel sheets and strips For magnetic circuits	IS 649
Solid press boards for electrical purposes	IS 1575
Code of practice for maintenance Of mineral insulating oil in equipment	IS 1866
Impulse Voltage testing	IS 2070
High voltage testing	IS 2071
Porcelain bushings	IS 2099
Determination of water contents in oil	IS 2362
Painting of Transformer	IS 2932
Porcelain Transformer bushings	IS 3347
Gs operated relays	IS 3637
Application guide for gas operated relays	IS 3638
Fittings and accessories for power transformers	IS 3639
Clamping arrangements for porcelain transformer bushings	IS 4275
Electric power connectors	IS 5561
Testing of specific resistance of Electrical insulating liquid	IS 6262
Method of test for power factor and	IS 6262
Dielectric constant of electrical insulating liquid	IS 8468
Guide for loading of oil immersed transformer	IS 6600
Determination of electric strength of Insulating oils	IS 6792
Oil impregnated paper insulated condenser Bushings	IS 12676
Degree of protection	IS 2147
Electrical insulation classified by Thermal stability	IS 1271
OLTC	IS 8468
Installation and maintenance of transformer	IS 10028
New Insulating Oils	IS-335
Thermal evaluation and Classification of Electrical Insulation	IS-1271
Code of practice for installation and maintenance of transformers	IS-10028
Power Transformer	IS-2026
Part I Power Transformer - General	
Part II Power Transformer - Temperature Rise	

Part III Power Transformer - Insulation levels and di-electric tests	
Part IV Power Transformer - Terminal markings, tapings and connections.	
Bushings for alternating voltages above 1000 V.	IS-2099
Fittings and accessories for power transformers.	IS-3639
Guide for loading of oil-immersed transformers.	IS-6600

3. DESIGN AND PERFORMANCE REQUIREMENTS

Power transformer shall be oil filled type ONAN cooled. The transformer shall be in compliance with relevant standards.

Transformers shall operate without injurious heating at the rated capacity within +10 percent of the rated voltage of that particular tap.

Transformers shall be capable of delivering the rated current at a voltage equal to 105 percent of the rated voltage without exceeding the limiting temperature rise.
Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, or other auxiliary equipment shall apply.Transformers, complete with bushings / cable boxes, shall be designed and constructed to withstand without damage, the effects of external short circuits as per the specified standards

4. CONSTRUCTION

4.1. TANKS

The tanks shall be fabricated from mild steel plates and shall be designed to withstand the pressure, which will be encountered under normal operation and abnormal conditions such as short circuit. Base channels shall be suitably reinforced to prevent any distortion during lifting. Oil tight gaskets shall be provided between the joints. The tank and other accessories shall be painted with heat resistant synthetic enamel paint of approved shade. Robust skid under base and fixing angles shall be provided to prevent bulging / warping.

Tanks shall be mounted on bi-directional rollers. When detachable radiators are fitted, isolating valves shall be provided to permit removal of any radiator unit without emptying the tank. Radiators shall be securely braced to prevent undue

vibration. In case of separate cooling units, isolating valves shall be fitted in both top and bottom of connecting pipes. Tanks shall be shot-blasted internally and externally to remove rust and welding scale. All tanks shall be tested at a pressure of 0.35 kg/sq.cm. in addition to the normal oil head. Immediately after shot-blasting, the exterior of the tank shall be given a coat of Zinc Chromate primer incorporating a rust inhibitor. All fasteners and bolts, etc. shall be galvanized or Zinc passivated.

All transformers rated up to and including 500 KVA rating shall have fixed radiators, Transformers rated above 630 KVA shall have detachable type radiators.

Each transformer shall be provided with following valves on the tank:

Drain valves so located as to completely drain the tank
Combined filling and filter valve at top of the tank of 50mm size

Oil sampling valves
One 15mm air release filing

4.2. **CORE**

The core shall be assembled from special scale free high grade cold-rolled grain oriented silicon steel with minimum loss with heat and oil resistant insulation. The cores and windings shall be suitably braced to prevent displacement or distortion of the coil during short circuit. Core clamping bolts shall be insulated with synthetic resin bonded paper or equivalent. Mitred joints of lamination shall be adopted.

All parts of magnetic circuit shall be bonded to earth system.

4.3. **COPPER WINDING**

All coils shall be wound from high conductivity copper annealed to remove spring tension. The design and arrangement of winding and their insulation shall be to ensure uniform distribution of voltage surges among all coils and windings.

The windings shall be subject to thorough shrinking and seasoning process to avoid absorption of moisture.

The windings shall be properly insulated from the core and between themselves.

The coils shall be axially and radially supported in such a way that deformation does not take place under short circuit

Adequate axial strips and blocks, number of spacer rows and number of anchoring and bracing tapes etc. shall be judiciously selected.

The core windings shall be initially dried under vacuum and then be placed in their tank and shall be treated in a vacuum Drying oven. Initially the heating shall be continued until the winding attain a temperature of about 1000C determined by measurement of winding resistance. The transformer shall be then subjected to vacuum. After obtaining satisfactory results, hot oil shall be allowed into the transformer under vacuum. This oil shall be then circulated through the transformer by the oil de-gasing plant until all gases trapped in the core and windings and insulation are removed and to ensure a high degree of stability in the insulation structure and early attainment of mature condition of insulation concerning di-electric strength.

4.4. **TERMINAL BOXES**

Windings shall be brought out and terminated on outdoor bushings, cable boxes or bus duct chamber, which will be located as specified on data sheets. The orientation and location of winding terminals shall be indicated in specific requirement. When outdoor bushings are specified they shall be supplied complete with adjustable spark gap and terminal connectors suitable for specified size of ACSR conductors.
The cable box shall be complete with gaskets between the joints. The cable boxes shall be provided with disconnecting chamber wherever specified in the data sheet.

Cable box for termination of high voltage PVC / XLPE cables shall be suitably dimensioned for air insulated termination. The air insulated terminal box shall be sized to permit use of all type of end termination kit including "PUSH-ON" type end termination kit. Such cable box shall also have arrangements for grounding the armour of PVC / XLPE cables inside the cable box.
Terminal chamber for bus duct termination shall have gasketted cover plate bolted to it. A separate inspection cover shall be provided to facilitate connection and inspection.
For transformers having provision for terminations TPN bus duct on 433V side neutral of star connected secondary winding shall be brought out to a secondary terminal chamber. A CT shall be mounted at the neutral terminal with CT secondary wired up to the marshalling box.
An extra neutral bushing shall be provided for neutral grounding of transformers having secondary voltage of 433 V. In such cases, neutral CT shall be mounted before bifurcation of neutral.

4.5. **MARSHALLING BOX**

Weather proof type marshalling box shall be provided on the front side of the transformer tank and not on radiator. It shall be provided with terminals for oil temperature indicator, winding temperature indicator, magnetic oil gauge and Buchholz Relay and other control terminals as applicable. The box shall be complete with wiring up to terminal box. Whenever the control voltage is specified as D.C, the marshalling box shall be complete with D.C. Contactors and wiring. The gaskets provided shall be non deteriorating type and suitable for outdoor installation. The box shall have hinged door with locking arrangement. The marshaling box shall have removable undrilled gland plate at bottom. Inside the marshalling box, all the instruments shall be wired with 1.5sq.mm. PVC wires. Marshalling box shall be mounted at readable / approachable level.

4.6. **RATING PLATES**

All transformers shall be provided with rating plates conforming to Indian Standards. The rating plates shall be provided on the front side of the transformer.

4.7. **OIL**

The transformer shall be supplied complete with first filling of oil. The oil shall conform to relevant Indian Standards. In case the Conservator / Radiator / Cooling tubes of the transformer are sent separately, sufficient quantity of oil shall be sent loose including 10% additional oil in non returnable sealed drum. The transformer oil shall conform to IS-335.

4.7.1. The transformer and all associated oil filled equipment shall be supplied along with sufficient quantity of oil, free from moisture and having uniform quality throughout for first filling of the tank, coolers and radiators along with 10% extra oil for topping up in non returnable containers, suitable for outdoor storage. No inhibitor shall be used in the oil.

4.7.2. The design and materials used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

4.8. **BUCHHOLZ RELAY**

The transformer shall be complete with Buchholz Relay of double float type with isolating valves on either side and distance pipe. The relay shall be complete with independent voltage free alarm and trip contacts.

Separate buchholz relay shall be provided for main tank and OLTC chamber. For OLTC chamber the relay should be single float type with one normally open and one normally close contact.

4.9. **OIL AND WINDING TEMPERATURE INDICATORS AND MAGNETIC OIL GAUGE**

Oil temperature indicator shall be complete with maximum reading pointers, alarm and trip contacts. The indicators shall be of 150 mm dia. circular type and shall be mounted inside Marshalling Box. They shall be complete with setting keys. The transformer shall be provided with 150 mm dia. magnetic oil gauge indicator with low level alarm contacts and minimum / maximum level marking on front side of the transformers. The minimum oil gauge indicator shall be provided on the conservator side.

Winding temperature indicator (wherever called for in specific requirements) shall be provided. This shall be 150 mm dia. and having maximum reading pointer, alarm contacts and trip contacts.

All these contacts shall be wired up to terminals provided in Marshalling Box.

All contacts shall be suitable for making and breaking D.C. inductive current. Minimum rating shall be 2 Amp, 110V D.C.

4.10. **COOLING METHOD**

All transformers shall be mineral oil immersed and natural air cool type (ONAN).

4.11. **TAPPINGS AND CONTROL**

Tapping shall be provided on high voltage side and shall be capable of carrying the external short circuit current. Percentage and Number of Taps shall be as specified in specific requirements.

Off circuit, tap-changing gear shall have an external operating handle mounted on the transformer side with locking arrangement and position indicator.

4.12. **AXLES AND WHEELS**

The transformer shall be provided with bi – directional plain rollers and axles of suitable dimensions and so support that under service conditions, they shall not deflect sufficiently to interfere with the movement of the

transformer. Suitable locking arrangement shall be provided to prevent the accidental movement of the transformer. All wheels should be detachable and shall be made of cast iron or steel.

5. DUTY REQUIREMENT

5.1. The Transformer and all its accessories like current transformers etc. Shall be designed to withstand without injury, the thermal and mechanical effects of any external shot circuit to earth and of short circuits at the terminals of any winding for a period of two seconds. Transformer shall be capable of withstanding thermal and mechanical stresses caused by symmetrical or asymmetrical faults on any winding.

5.2. The transformer shall be capable of being loaded in accordance with IS: 6600. There shall be no limitations imposed by bushing, tap-changers, etc.

5.3. The overload capacity of the transformer and their emergency short time ratings call for any schedule shall be furnished.

5.4. The transformer shall be suitable for continuous operation with frequency variation of +/- 5% without exceeding the specified temperature rise.

5.5. The transformer shall be capable of being operated without danger on any tapping at the rated MVA with voltage variation of +/- 15% corresponding to the voltage of that tapping and at the same time with a frequency variation of +/- 5% below normal.

5.6. Similar ratio transformers shall operate satisfactorily in parallel with each other.

5.7. Radio interference and noise level:

5.7.1. The transformer shall be designed with particular attention to the suppression of maximum harmonic voltages, especially the third and fifth, so as to minimize interference with communication circuits.

5.7.2. The noise level, when energized at normal voltage and frequency, shall not exceed, when measured under standard conditions, the value specified by NEMA.

5.8. The maximum flux density in any part of the core and yoke at normal voltage and frequency shall be such that the flux density under over voltage conditions shall not exceed the maximum permissible values for the type of core and yoke material used. The type of material and values of flux density in the core/yoke for the 100%, 110%, 125% and 140% and the hysteresis characteristics curves shall be submitted.

5.9. Transformer shall be capable of operate below the knee of the saturation curve at 110% voltage to preclude Ferro – resonance and non-linear oscillations.

5.10. Transformer shall be capable of operating under natural cooled condition to the specified capacity. Transformer shall be capable of operating continuously in accordance with the application standard loading guide at their rated MVA and at any of the specified voltage ratio ratios.

6. CENTRE OF GRAVITY

The Centre of gravity of the assembled transformer shall be low and as near the vertical centreline as possible. The transformer shall be stable with or without oil. If

the centre of gravity is eccentric, relative to track either with or without oil, its location shall be shown in the 'Outline' drawing.

7. TESTS

Transformers shall be completely assembled at Works to ascertain that all parts fit correctly.

Routine Tests

Routine tests as per specified standards shall be performed on all transformers. The following additional points may be noted

i) 2kV withstand test for all wiring.

ii) Zero phase sequence impedance test

i) Dissolved gas analysis

iv) Temperature rise test

v) Voltage ratio at all taps

vi) Resistance of each winding of each phase shall be measured at principal and at all the taps and corrected to 75 deg. C.

vii) No load loss and exciting current shall be measured at rated frequency at 90%, 100% and 110% rated voltage. These tests shall be done after impulse tests if the latter is conducted. Exciting current shall be measured on each phase and recorded. Form factor shall be noted during the test and included in the test report.

viii) Magnetic balance test.

ix) Calibration of temperature indicators and relays.

Type Tests

CONTRACTOR shall furnish type test certificates along with the Tender. In the absence of the same, CONTRACTOR shall carry out the type tests without any cost implication to the EMPLOYER. Test certificates for shot circuit test and Impulse test conducted for similar transformer shall be furnished.

Test Reports

Test results shall be corrected to a reference temperature of 75 deg.C.

Two copies of preliminary test results shall be submitted for the EMPLOYER'S approval before despatch of transformer.

Additional bound copies of complete test results including all tests on transformers, auxiliaries, and current transformer characteristics shall be furnished with the transformer

8. LOSSES

Tenders will be evaluated based as mentioned below:

No load losses:

Load losses:

For the purpose of evaluation of Tenders, the quoted load losses and iron losses will be increased to take into consideration tolerance as permitted by applicable standards, in the event the losses are indicated exclusive of tolerance.

Should the losses as measured on the transformer after manufacture be found in excess of the guaranteed losses with plus tolerance, the CONTRACTOR shall pay to the EMPLOYER, penalty charges based on the capitalisation of cost indicated above

9. ON LOAD TAP CHANGER (OLTC)

9.1. Whenever specifically specified, high speed on load tap changing gear shall be mounted on the transformer. The OLTC gear shall have diverter resistance or reactance and the current diverting contacts shall be housed in a separate oil chamber segregated from the main tank of the transformer. The contacts shall be accessible for inspection and shall be replaceable type. Separate Buchholz Relay shall be provided for OLTC tank.

Oil filled compartment shall be provided with filling plug, design valve with plug air release vent, inspection opening with gasketed and bolted cover.

9.2. OLTC driving mechanism shall consist of

a) Suitable motor rated for 433V, 3 phase, 50 Hz AC squirrel cage with gear.

b) Energy accumulator with springs.

c) Selector wheel and arm limit switches to prevent motor over travel in either direction.

d) Slip clutch.

9.3. OLTC shall be provided with following modes of control.

a) Manual and Electrical mode from local on the transformer itself.

b) Electric mode from remote manually.

c) Electric mode from remote automatically through voltage sensitive relay.

d) Individual / Parallel control on a master / follower.

9.4. Following technical features shall be incorporated in OLTC.

a) Device to ensure positive and full completion of tap change once it is initiated even if power fails.

b) Interlock to cut off electrical control automatically in case manual mechanical control is initiated and vice-a-versa.

c) Interlock to cut off a counter impulse for a reverse tap change, being initiated during a progressive tap change and until the mechanism comes to rest and resets circuits for a fresh operation.

9.5. **LOCAL PANEL FOR OLTC (INTEGRAL TO OLTC)**

Local OLTC panel shall be suitable for outdoor location. Local panel to be mounted on the transformer tank for operation of OLTC and shall consist of:

a) High torque electric motor suitable for 433 volts, three phase.

b) Motor drive and energy accumulator.

c) Phase and neutral isolator, fuse, forward and reverse contactors and overload relay.

d) Local remote selector switch (lockable in both positions)

e) Raise / Lower push buttons.

f) Raise / Lower limit switches.

g) Auxiliary transformer, if required.

h) Indicating lamps shall be provided to indicate following faults. One common fault condition shall be wired for remote annunciator.

i) AC Failure.

ii) Drive motor auto trip.

iii) Tap change delayed.

i) 240V, 50 Hz, AC space heater with switch and HRC fuses.

j) Mechanical digital operations counter with resetting arrangement.

k) Interior lighting fixture with switch and HRC fuse.

l) Mechanical tap position indicator.

m) Necessary relays, contactors, etc. for remote control of OLTC (relay shall be EE make)

n) Terminal blocks, internal wiring for power and control cables.

o) Gasketted and hinged door with locking arrangements.

p) Removable undrilled gland plate for cable entry.

q) Interlock between manual and electric operation.

r) Stepping relay.

It shall be possible to operate tap changer manually by handle. A micro switch shall be provided which shall cut off electrical operator in the manual mode.

9.6. REMOTE TAP CHANGER CUBICLE (RTCC)

A separate indoor mounted remote tap changer cubicle shall consist of following:

a) Control supply transformer with suitable isolators and HRC fuses on either sides.

b) Supply on indicating lamp.

c) Auto manual selector switch.

d) Raise lower push buttons.

e) Digital tap position indicator.

f) Master follower sequence selector switch.

g) Out of step relay.

h) Automatic voltage regulating relay with time delay element.

i) Lamp for tap changes in progress with suitable bell or alarm other than the one provided for annunciating faults.

j) Voltmeter with HRC fuses.

k) Annunciation windows with alarm and alarm cancellation to indicate following faults:

i) Drive motor auto tripped.

ii) Tap change delayed.

iii) Lower limit reached.

iv) Upper limit reached

v) Out of step

vi) AC failure

vii) Buchholz relay alarm on OLTC

l) 240V, 50 Hz, AC space heaters with switch and HRC fuses.

m) Interior lighting fixtures with ON-OFF switch and fuses.

n) Terminal blocks, internal wiring for power and control cables.

o) Gasketed and hinged doors with locking arrangement.

p) Removable undrilled gland plate for cable entry.

q) Sequence selector switch for parallel operation.

9.7. Any other components / equipments required for OLTC's operation shall be deemed included.

10. JACKING PADS

The Jacking Pad base extension shall be such that it shall be possible to locate a 3-ton Jack below the Pad. IITM will design foundation suitably to accept 3 ton Jack.

11. DRAWING AND DOCUMENTS

The Supplier will be required to furnish all the necessary drawings, data etc. of the equipment with appropriate "status" stamp in adequate number of copies as indicated below.

All drawings submitted for approval shall contain the name of the IITM, Name of the Consultant, Project Title, Drawing Title, Scale, and Supplier Drawing Number, Date of Drawing etc. in the lower right hand corner.

The submission of drawings and data shall be as per the manufacturer's standard and to the satisfaction of the client.

While submitting Documents, the information shall be clearly indexed, flapped and filed in a folder of the Quality, which is expected for final Documentation.

Vendor to note that his final invoice will be cleared only after submission and acceptance of final record documentation. 5% of the order value is considered for above.

11.1. DRAWINGS & DOCUMENTS SCHEDULE

Following drawings/documents shall be provided along with order acceptance for approval/review to IITM/Consultant:

a. General Arrangement drawing. – 3 Sets

b. Connection diagram - 3 Sets

c. Type Tests certificates for Information – 3 Sets

11.2. Operation maintenance manual & Inspection Tests Certificates (Routine Tests) - 3 Sets for Reference & Records along with final invoice.

12. SPARES

12.1. Commissioning Spares

The Supplier shall include the commissioning spares along with the main equipment as per the Supplier's experience, for replacement of damaged or unserviceable during commissioning at site.

12.2. Supplier shall quote spares separately for two years Operation & Maintenance of equipment.

12.3. Supplier will provide one set of special tools & tackles required for operation maintenance & inspection of the equipment along with the delivery of the equipment.

12.4. The Supplier will provide the IITM with all the addresses and particulars of his Sub-Suppliers while placing the order on vendors for equipment covered under the Contract and will further ensure with his vendors that the IITM, if so desires, will have the right to place order for spares directly on them on mutually agreed terms based on offers of such vendors.

Vendor shall quote for recommended spares for two years of satisfactory operation with unit price.

13. STATUTORY REGULATIONS

All transformers shall conform to the requirement and shall be acceptable to local statutory authorities including Electrical Inspectorate.

14. SPECIFIC REQUIREMENTS

Specific requirements shall be additionally to that indicated in the Single Line diagram. Vendor shall furnish Technical Particulars for transformer for client's approval.

15. REJECTION

Owner may reject any transformer if during tests any of the following conditions arise:

Load loss exceeds the guaranteed value by 20% or more.
Impedance value differs the guaranteed value by + 10% or more.
Oil or winding temperature rise exceeds the specified value by 5oC.
Transformer fails on impulse test.
Transformer fails on power frequency voltage withstand test.
Transformer is proved to have been manufactured not in accordance with the agreed specification

16. DATA TO BE FURNISHED BY THE VENDOR ALONG WITH OFFER

Positive Sequence impedance at maximum voltage tap.

Positive Sequence impedance at minimum voltage tap.

Zero sequence impedance at principal tap.

Efficiency at 750C winding temperature

At full load
At 75% full load
At 50% full load.

Maximum efficiency and load at which it occurs

Regulation at full load at 750C winding temperature at

Unity power factor

0.85 power factor lag.

Resistance per phase at

Primary winding: ohms

Secondary winding: ohms

Conductor area (sq. mm) and current density (amp / cm2)

Primary winding

Secondary winding

Type of winding

Primary

Secondary

Insulating materials for inter turn insulation

Primary winding

Secondary winding

Insulating materials for inter winding insulation

Insulating materials between

Winding and core

Laminations of core

Make, type, dial size, number of contacts and contact ratings current and voltage rating for following items

Magnetic oil level gauge

Dial type thermometer

Winding temperature indicator

Gas and oil actuated relay

Thermal withstand capability under full short circuit conditions, in terms of number of times of occurrence of short circuit and corresponding anticipated percentage reduction in transformer life. Relevant calculation shall be submitted.

DRAWINGS

The following drawings shall be submitted for the EMPLOYER'S approval in the stipulated time

General outline drawings as submitted with the bid

General outline drawings showing plan, front elevation, and side elevation, with all

fittings and accessories, locating dimensions of cable entries, earthing terminals, foundation/floor fixing details, jacking pads and weights of the following

Marshalling box

Cable boxes

Disconnecting chambers

Bushings

Plan, elevation, terminal details, mounting details, make and type number, current and voltage rating, creepage distances and principal characteristics.

Rating and diagram plates

Marshalling box terminal connections wiring diagram.

17. TECHNICAL DATA

A. For 2000KVA Distribution Transformer.

Sr. No	Description	Distribution Transformer
1	No. of Transformers	2
2	Maximum Continuous Rating (KVA) with ONAN cooling	2500KVA
3	Temperature raise above ambient of 50Deg.C	
	a. Winding	55
	b. Oil	50
4	Maximum flux density in any part of core of rated voltage and frequency	1.7 Tesla
5	Over fluxing withstand requirements	
	a. 110%	Continuous
	b. 125%	10 Sec.
6	Rated Voltage in kV	
	a. HV winding	22
	b. LV winding	0.433
	Voltage Variation	+/- 10%
7	Vector Group	Dyn11
8	Rated Frequency	50Hz

	Frequency Variation	+/- 3%
9	Neutral Earthing	Effectively Earthed.

10	Tap Changer	
	a. Type	On load
	b. Tapping Range	+/- 15% in Step of 1.25.
	c. Make	
11	Percentage Impedance	6.25 %
12	Insulating Oil	Confirming to IS :335
13	Insulation Level In kV	
	(Highest/ Power frequency/Impulse)	
	a. H V	24/50/125
	b. L V	1/3
14	Maximum current Density of winding	300 Amps/Sq.cm
15	Termination arrangement	
	a. H V	Cable Box
	b. L V	4000A Al. Sandwich Busduct
16	Supply of Neutral bushing CT rating	Yes

DATA SHEET

(To be submitted by Supplier along with offer in this format only)

Sr. No	Description	2 X 2500KVA Dist. Transformer
1	Name of the Supplier	
2	Make	
3	Address	
4	Contact Person	
5	Rating of transformer Offered	
	a. Primary Voltage	
	b. Secondary voltage	
	c. Rating	
	d. Type	
	e. Vector Group	
6	Connection	
	a. Primary winding	
	b. Secondary winding	
7	Flux density considered	

8	Insulation Level	
	a. Primary winding	
	b. Secondary winding	
9	Impedance	
10	Temperature raise	
11	Tap changing arrangement	
12	Percentage regulation	
	a. At 0.8 lag power factor	
	b. At unity power factor	
13	Efficiency	
	a. At 50% Load at Unity Power Factor	
	b. At 50% Load at 0.8 lag Power Factor	
	c. At 75% Load at Unity Power Factor	
	d. At 75% Load at 0.8 lag Power Factor	
	e. At 100% Load at Unity Power Factor	
	f. At 100% Load at 0.8 lag Power Factor	
14	Loss in kW	
	a. No Load loss	
	b. Full Load loss at unity power factor	
	c. Full Load loss at 0.8 lag power factor	
15	Make of Oil	

16	Quantity of Oil	
17	Class of insulation	
18	Neutral bushing CT rating	……../5A CL. PS
19	Capitalization formulae for evaluation of loss	
20	Accessories and fitting offered	
21	Transformer Size - Over all dimensions/weight	
22	Hours of operation per year	
23	Life of equipment	
24	Temp. correction factor	

TEST REPORTS

Test results shall be corrected to a reference temperature of 750C.

20.1 Two copies of test results shall be submitted for EMPLOYER approval before dispatch of transformer.

20.2 Additional bound copies, as required by the EMPLOYER of complete test results including all tests on transformer, bushing, shall be furnished

NOTES TO SUPPLIER

Specific requirement of the transformer is indicated elsewhere. Supplier to furnish / confirm Technical Particulars for transformer attached as Annexure to Specific Requirements.

ALL DATA REQUESTED FOR IN TECHNICAL PARTICULARS SHALL BE FURNISHED. STATEMENTS LIKE "AS PER IS" AGAINST ITEMS IN TECHNICAL PARTICULARS ARE NOT ACCEPTABLE AND OFFER IS LIABLE FOR REJECTION IF DATA IS NOT FURNISHED.

DEVIATIONS FROM GENERAL CONDITIONS OF CONTRACT

All deviations from General Conditions of Contract shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from general conditions of contract of enquiry.

DATE: **Signature & Seal of Tenderer**

DEVIATIONS FROM TECHNICAL SPECIFICATIONS OF CONTRACT

All deviations from Technical Specifications shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from Technical Specifications of contract of enquiry.

DATE:

Signature & Seal of Tenderer

6 X 625 KVA, 415V DG SYSTEM

TECHNICAL SPECIFICATIONS

1. SCOPE

1.1 This specification covers the requirements of Design, Assembly, Testing, Supply and Commissioning of LT diesel Generator set along with AMF cum synchronizing panel with associated switchgears and control panels and exhaust piping as per CPCB norms.

1.2 Generator set shall have prime power rating based on power factor of 0.8 lagging**.**

1.3 Generator shall be capable of operating continuously on an unbalanced system within limit described in section 6 of IEC 60034.1

1.4 Generator shall be capable to withstand the over speed requirements specified in Table 15 of IEC 60064.1

1.5 Generator shall be capable of withstanding a current equal to 1.5 times of rated current for a period of not less than 30 sec. A stipulated by IEC 60034.1

1.6 Generator shall be supplied with weather proof acoustic canopy / enclosure as per CPCB norms.

2. DG sets shall comprise of following items/accessories as specified-

1.1 Diesel engine shall be suitable to deliver required BHP.

1.2 Base frame, AVM pads &other standard accessories.

1.3 Microprocessor based integrated DG set controller with inbuilt logic for auto start, Auto

1.4 Synchronization & auto load sharing.

1.5 Synchronous AC brushless alternator suitable to deliver 625kVA net output at NTP.

1.6 Cooling and exhaust system, complete with necessary extension piping's/ supports

required as per CPCB norms.

1.7 Battery and battery charger.

1.8 Day fuel tank of suitable capacity to for backup of 8-10hr running of DG set.

1.9 Acoustic Enclosure for the DG sets suitable for outdoor installation.

1.10 Silencers and Cladding for silencer for DG sets.

1.11 Exhaust Piping and Support structure for DG sets at different location.

1.12 Composite LT panel for DG incomer, outgoing etc. breaker as per single line diagram (SLD)

1.13 Panel Control cables for connection to Panel.

1.14 Complete earthing system.

1.15 Recommended maintenance tools & tackles.

3. Installation, testing & commissioning:

Installation, testing &commissioning of the equipment's mentioned under item (A) along with supply of all accessories required for installation, testing & commissioning of the entire plant including connections, terminations of the power

& control cables, laying of the cables from the outdoor DG sets to Panel located inside the Utility building.

4. ELECTRICAL SYSTEM DETAILS

Design Temp - 48^0 C

HT Supply: 22kV/0.433 kV +/- 10%, 50Hz +/- 3%

LT Supply: 3 Phase - 433/415VAC, +/- 10%, 1 Phase – 240VAC, +/- 10%, 50Hz+/- 3%

5. COMPLETENESS OF TENDER:

All fittings, equipment's, units, assembles and accessories, hardware, foundation, bolts terminal lugs cable and termination glands for electrical connections, junction box and items which are useful and necessary for efficient operation and installation shall be deemed to have been included in the scope of work. The entire installation shall be complete in all respect, whether such details have been mentioned in the specification or not.

6. PERMISSION / APPROVAL:

The scope of work of the Tenderers shall include obtaining CEIG approval / necessary /Pollution control board (local and remote) permissions from state electricity board.

7. STANDARDS

The diesel generator sets, accessories and control panel shall comply with relevant BS/ IS or other internationally accepted standards including the following:

BS 649	:	Diesel Engines for general purpose.
BS 2613	:	Rotating Electrical Machinery.
IS 4722	:	Electrical performance of rotating electrical machinery.
IS 4728	:	Terminal markings for rotating electrical machines.
IS 4729	:	Measurement of vibrations of rotating electrical machines.
IEC60034	:	Rotating Electrical Machines
IEC60034.1	:	Rotating Electrical Machines Part1: Rating and Performance
IEC60947	:	Low Voltage Switchgear and Control Gear

ISO 8528 Part 1 to 10: Reciprocating Internal Combustion engine Driven Alternating current generating set

8. GENERAL REQUIREMENTS

Diesel Generator set shall comprise of following main equipment. Vendor shall also include any other accessories/ equipments required for the satisfactory operation of the DG set.

8.1. SCOPE

Scope of work under this section covers the Design, Detailed Engineering, Manufacture, Quality Control, Shop Testing, Delivery at Project Site, Unloading and placement at Site, Site Assembly, Erection, Testing and Commissioning including Performance & Acceptance Testing, Training of Owner's personnel as required, Putting into Commercial Operation and handing over to the Owner of Diesel Generating Sets complete with all parts like exhaust system including piping up to desired height as per CPCB norms, cabling including control & power between the DG sets & AMF Cum Sync Control panel, Earthing, fuel system & all items, auxiliaries

i) Prime rated diesel engine suitable to give desired alternator output at site, complete with fuel system, lubrication system, cooling system, air intake and exhaust system, battery and battery charger, instruments and protection system, annunciations, coupling arrangements etc.

ii) 415V, 50Hz alternator with exciter, automatic Digital voltage regulator etc.

A) Supply:

Design, manufacture, supply, delivery to properly packed for transportation to site including loading/unloading etc .of the following materials-.

1. DG sets shall comprise of following items/accessories as specified-
2. Diesel engine shall be suitable to deliver required BHP.
3. Base frame, AVM pads &other standard accessories.
4. Microprocessor based integrated DG set controller with inbuilt logic for auto start, Auto
5. Synchronization & auto load sharing.
6. Synchronous AC brushless alternator suitable to deliver 625kVA net output at NTP.
7. Cooling and exhaust system, complete with necessary extension piping's/ supports
   required as per CPCB norms.
8. Battery and battery charger.
9. Day fuel tank of suitable capacity to for backup of 8-10hr running of DG set.
10. Acoustic Enclosure for the DG sets suitable for outdoor installation.
11. Silencers and Cladding for silencer for DG sets.
12. Exhaust Piping and Support structure for DG sets at different location.
13. Composite LT panel for DG incomer, outgoing etc breaker as per single line diagram (SLD)
14. Panel Control cables for connection to Panel.
15. Complete earthing system.
16. Recommended maintenance tools &tackles.

B) Installation, testing & commissioning:

Installation, testing &commissioning of the equipment's mentioned under item(A) along with supply of all accessories required for installation, testing

&commissioning of the entire plant including connections, terminations of the power &control cables, laying of the cables from the outdoor DG sets to Panel located inside the Utility building.

C) COMPLETENESS OF TENDER:

All fittings, equipment's, units, assembles and accessories, hardware, foundation, bolts terminal lugs cable and termination glands for electrical connections, junction box and items which are useful and necessary for efficient operation and installation shall be deemed to have been included in the scope of work. The entire installation shall be complete in all respect, whether such details have been mentioned in the specification or not.

D) PERMISSION / APPROVAL:

The scope of work of the Tenderers shall include obtaining CEIG approval / necessary /Pollution control board (local and remote) permissions from state electricity board. All Official Fee for the same will be borne by IITM.

8.2. PERFORMANCE CRITERIA AND GUARANTEE

The DG sets along with all auxiliaries and accessories shall be capable of performing intended duties under specified conditions. It is the responsibility of the Contractor to supply the equipment as per guaranteed technical particulars and shall also guarantee the reliability and performance.

8.3. DESIGN AND CONSTRUCTION

Unless otherwise agreed upon the general arrangement shall be as follows:

The combined diesel engine and generator with all required accessories shall be mounted on a structural steel base frame and plate. All base plate mounted components shall be completely piped and wired in the shop. Vibration isolation shall be provided for the base plate mounted units and all outgoing pipes and tubes. The diesel engine with the generator shall be engineered and designed to be free from all harmful critical speed within the normal operating range. The DG sets shall be soundproof to the maximum extent possible.

The generator shall be brush-less alternator, directly flanged to the engine, with closed damper cage and a reactive current compensator.

The voltage regulator shall be electronic type having regulation of 0.5% at all loads between no load to full load and power factor 0.8 lagging to unity,

The governor shall be electronic with adjustable speed droop 0-4%.

Suitable lifting lugs shall be provided on each diesel generator assembly.

8.4. DIESEL ENGINE

Engine supplied should be four strokes, Turbo charged,

The Diesel engine shall give rated output as specified in the SLD after applicable derating considering site conditions.

It shall be possible to draw rated output continuously 24 hours each day.

Maximum air temperature for Engine should be 50 deg.C.

DG set rating should be prime power.

The engine shall be suitable for starting from cold at minimum ambient temperature and necessary accessories like pre-heater, etc. shall be supplied. It shall be multi-cylinder, turbo-charged heavy-duty industrial type. The Diesel Engine shall be suitable for operation on HSD. Maximum rated crank shaft operating speed shall be 1500 rpm. engine is to be supplied with battery charging alternator. It should have radiator cooling system, Forced feed lubrication system, Pumped fuel supply system.

8.5. GOVERNOR

The governor shall be electronic type with isochronous to 4% droop externally adjustable both manually and with motor for speed control.

Make, Type : Woodward Electronic or Equivalent

For automatic paralleling, Woodward or equivalent Electronic Governor shall be offered. Whenever equivalent to above is offered technical catalogue shall be furnished. Governor shall be suitable for synchronization purpose in future.

Each engine shall be provided with appropriate governor to maintain the speed within the value stipulated for class A-1 (precise standard) governing in BS: 5514. The governor shall have drooping characteristics to ensure proper load sharing. A over speed trip mechanism shall be provided to automatically shut off the supply of fuel in case the engine speed reaches 110 % of rated speed.

8.6. FLYWHEEL

Shall be solid disc type accurately balanced. Suitable guard shall be provided for flywheel.

8.7. STARTING

The engine shall be arranged for 24V DC motor starting. Necessary batteries and battery charging facilities shall be included. Battery charger shall have constant potential characteristics, which maintains the battery in peal condition at all times without causing excessive gassing. The input voltage for the battery charger shall be 240V, 50 Hz. One set of batteries with necessary cables and jumpers shall be supplied. Batteries shall be located near the engine or housed in the panel as specified.

If pneumatic starting is offered, it shall be complete with compressor, air bottle, electronic solenoid valve, etc.

8.8. EXCITATION SYSTEM

Each alternator shall be provided with excitation system. The capacity of the exciter shall be adequate to meet the full load and overload ratings of the alternator particularly under short circuit conditions. The exciter shall have an automatic demagnetizing arrangement for the field circuit and insertion of field circuit in the event of an internal fault. Such an arrangement shall be capable of reducing the induced voltage to a safe limit. Alternator shall have rotary brushless exciter and Pilot exciter.

8.9. FUEL SYSTEM

The fuel system shall be equipped with fuel filters. The fuel oil day tank shall be sized to house fuel for eight hours Or 1000 liters.

The day tank shall be equipped with fuel return connection, vent, sight glass, level switch for transfer pump control, overflow line, and drain valve.

All necessary fuel line pipes, valves and other misc. piping materials from day tank to engine is in vendor's scope. Alarm shall be given for fuel low level and fuel high level in day tank.

8.10. LUBRICATION

Pressure feed lubrication system by means of engine driven gear type lubricating oil pump shall be included for lubrication of main and piston bearings, camshaft bushing, valves trains, etc.

For cleaning and filtration both by-pass and fuel flow lubricating oil filters shall be included. A hand-priming pump shall also be included for priming of lube oil.

8.11. COOLING

Engine shall be fresh water-cooled. Water shall be circulated by engine driven centrifugal pump around cylinder liners, cylinder heads and injector sleeves.

Engine coolant shall be cooled by engine mounted fan assisted radiator of typical capacity, driven directly either by engine or by motor and as per the specifications. Fresh water quantity required for topping up shall be indicated.

8.12. AIR SYSTEM

The intake air shall be routed through an air cleaner. Air from air cleaner shall be routed to turbocharger. Engine with after cooler shall be preferred.

8.13. VENTILATION

Vendor shall plan well-ventilated layout such that clean, cool and dry air flows over the engine and generator and that the temperature rise of the room with DG in operation is within permissible limits of 7^{o} C to 10^{o} C above ambient temperature.

8.14. EXHAUST

Exhaust system shall consist of Expansion Bellows, insulated exhaust manifold, silencers and other miscellaneous piping materials as required. Supply of total exhaust system from engine exhaust outlet flange is in vendor's scope.

The exhaust system shall be so designed as to maintain back-pressure within permissible limits. The exhaust outlet shall be outside the building and at a height stipulated by Pollution Control Board. Necessary information from Pollution Control Board for Exhaust outlet height shall be obtained by vendor.

Engine exhaust system shall be provided with following devices of suitable capacity and rating.

- Exhaust Elbow Dry with 400 deg C paint.
- Exhaust manifold dry type
- Silencer with 400 deg C paint
- Flexible fitting Exhaust
- Muffler
- Fume Outlet pipe till safe height as per MPCB
- Necessary insulation, cladding, High Temp paint.
- Necessary Structural Arrangement

Adequate sized piping and fittings shall be installed to carry the engine exhaust discharge in to the atmosphere at a height as indicated in the drawings & as per the requirement of Center / State Pollution Control Board or Pollution Control Committee as the case may be.

Galvanized M.S. structural support and vibration arrestors for D.G. set chimney to specify along with drawing for statutory clearance.

Mufflers shall be installed to reduce the engine exhaust noise to a maximum of 5dBA above ambient noise level at nearest area accessible to the public within 3m from Generator Room and at least 2m above floor level. Flexible connection shall be provided between the engine and the fixed piping.

The Exhaust pipe must be extended up to three/ necessary meters above from the nearest building height followed by the formula.

H=h+0.2xsq.root of KVA or as per local Polluation control board norms (CPCB norms)

8.15. ENGINE CONTROL, MONITORING & PROTECTION

Engine shall be equipped with following Control Monitoring and Protection System.

a) Over speed device for automatic shutdown of engine independent of governor at speed of 10% above rated speed. The shut-down shall be annunciated in control panel.

b) Frequency deviation not more than 5% returning to within 1 % of rated frequency within 3 sec.

c) For following condition, an alarm and trip indication shall be given on control panel.
   - Lube oil pressure low.
   - Lube oil temperature high.
   - Water temperature high.

d) The engine shall be equipped with electric shut-down valves.

e) Automatic Operation of Engine

Starting

The diesel generator will be connected to the 415 V switchgear system,

Automatic starting of the diesel generator shall be through a starting signal from the auxiliary control system after ensuring necessary interlocks as explained later in the chapter in the case of:

a. Mains power outage

b. Low mains voltage

c. Loss of one phase in mains

d. The unit shall start and build up voltage automatically with in desired time limit.

Automatic shut-down

Automatic shutdown shall be under following conditions:

a. Low voltage,

b. Low frequency,

c. Over Speed.

d. High water temperasure

e. Low oil Pressure

f. Low fuel level,

g. Reverse Power.

h. Earth Fault

MICROPROCESSOR BASED ENGINE MOUNTED CONTROLLER-

The diesel generator shall have a separate engine instrument panel. The panel shall be mounted on the frame work of the generating set and shall contain:

INTEGRATED DG SET CONTROLLER

The DG Engine Controller shall be microprocessor-based generator set monitoring, metering, and control system. The control provides an operator interface to the genset; digital voltage regulation, digital governing, and generator set protective functions. The integration of all the functions into a single control system provides enhanced reliability and performance compared to conventional control systems

CONTROL:

1. Run/ off / Auto switch.
2. Emergency stop.
3. Manual Run / Stop Control switch.
4. Idle / Run mode control.

METERING:

1. Current / Voltage / Frequency / KW / KWH / Pf.
2. Starting Battery Voltage.
3. Lube Oil Temperature & Pressure.
4. Engine Coolant Temperature.
5. Coolant Pressure.
6. Engine RPM.
7. Operating Hours.
8. Number of Starts

ENGINE PROTECTION / WARNING:

1. Over Speed Shutdown.
2. Low Lube Oil Pressure Warning /Shutdown.
3. High Coolant Temperature Warning / Shutdown.
4. Low Coolant Temperature Warning.
5. Low Coolant Level Warning./ Shut Down.
6. Low And High Battery Voltage Warning.
7. Weak Battery Warning.
8. Over Crank Shutdown.
9. Fail To Crank Shutdown.
10. Magnetic Pickup Failure Shut Down.

ALTERNATOR PROTECTION / WARNING:

1. Over Current
2. High Voltage
3. Low Voltage
4. Under / Over Frequency
5. Reverse Power (KVA & KVAr)
6. Phase Sequence

MANDATORY FEATURES:

1. Digital AVR
2. Amp Sentry Protection
3. Sensor Failure Indication
4. Programmable Idle Speed Control
5. Digital Control Function
6. Sync Check
7. Synchronoscope
8. Auto Load Sharing
9. Compatibility to Remote Monitoring.
10. Smart Starting

8.16. COUPLING

The Engine and the Alternator shall be coupled with a fully flexible power coupling with suitable coupling guard. Arrangement shall ensure constant alignment and ease of maintenance.

8.17. MISCELLANEOUS EQUIPMENT

Comprising of bearing (base) plates and shims for setting up the DG Set on foundation, foundation bolts, nuts, washers, brackets, piping supports and any other necessary materials. The base frame shall be provided with lifting facility and pre-drilled foundation holes. Anti-vibrating pads shall be provided on base plates.

8.18. ALTERNATOR

a) The Alternator design shall be suitable for the site conditions.

b) Nominal voltage should be 415 V +/-5%, 3 pole & frequency 50 Hz+/-3%, Maximum air temp 50 Deg C & P.F should be .8 Lag.

c) The Alternator shall be mounted on a common base frame together with the engine.

d) The insulation shall be Class-H, but temperature rise limited to that of Class-B. The windings and overhangs shall be suitably braced to withstand the short circuit forces.

e) The line and neutral ends of the windings shall be connected to six terminals mounted on insulated base of non-hygroscopic and

fireproof material. Suitable clamping and terminating arrangements for cables shall be provided as specified in the SLD.

f) All parts and accessories shall be suitable to withstand stresses due to over speed/ overload/ short circuit conditions specified.

g) Voltage restoration to +/- 0.5% within 10 sec and to +/- 2.5% within 1 sec.

h) Output Voltage shall not deviate more than 15% and returning to within 2 % nominal frequency within 1 sec.

i) Alternator shall be with bearing temperatures detectors.

j) Alternator winding shall be provided with RTDs of two per phase and wired to separate terminal box.

k) The generator shall be capable of delivering continuously at full load, rated frequency and power factor and at any voltage between 105% and 95% of rated voltage without any part exceeding the maximum allowable temperature rise. It shall also be capable of operating continuously with 20% unbalanced load. The generator shall be capable of withstanding for not less than 15 seconds a current 50% excess of its rated current after having attained the thermal equilibrium corresponding to the rated load, the voltage being maintained as near the rated values as possible consistent with the maximum capacity of the prime mover i.e. engine. The engine shall be capable of delivering an output of 10% in excess of its rated output at its rated speed for a period of one hour in any period of 12 hours consecutive running, without undue heating of the engine or any other mechanical part. Make of alternator shall be same as per engine manufacturer.

l) The alternator shall be complete with following:

- 2 Nos. Terminal Boxes - one for phase and one for neutral - suitable for cable specified in the SLD.

- Space heaters - These shall be wired upto separate terminal box.

- Lifting hooks.

- Earthing terminals - 2 Nos.

- Rating plate.

8.19. EXCITATION SYSTEM

The Alternator shall have rotary brushless exciter and pilot exciter.

8.20. VOLTAGE REGULATOR

a) Automatic solid state, volts per hertz type of voltage regulator shall be provided.

b) The voltage regulator shall be complete with cross current compensation, voltage setting device and all accessories required for successful operation.

c) Each alternator shall have necessary inherent regulation and for close regulation there shall be an automatic voltage regulation

having regulation of 0.5 % at all loads between no load to full load and power factor 0.8 lagging to unity.

8.21. EFFICIENCY

a) Generator Efficiency at nominal load and at power factor of 0.8 lagging shall not less than 93%

b) Guaranteed values for efficiency shall be given by SUPPLIER for 50%, 75% and 100% for rated output.

8.22. ACOUSTICENCLOSURE FOR DIESEL GENERATOR

Acoustic Enclosure for DG Set shall be as given below:

Outer sheet	:	16 gauge CRCA sheet steel.
Insulation	:	Mineral wool as per IS8183-1993
Thickness	:	75mmthick
Density	:	64Kg/m3
Finishing	:	Powder coating of color shade ONAN Green.
Noise Level	:	75dbA at 1m under free field conditions.
Location	:	Outdoor
Painting of Exhaust Piping	:	High temperature aluminum paints shall be used for painting of exhaust pipe up to the man's accessible height only
Base frame for canopy	:	Powder coated as per approved color.

9. ASSOCIATED SWITCHGEAR & CONTROL PANEL FOR DG SET

The Constructional features of Switchgear Panel and Control Panel shall be as follows:

9.1. The control panel and accessories shall comply with the requirements of latest editions of relevant Indian or International Standards.

9.2. The control panel shall be free standing, floor mounting, sheet steel clad, and cubicle type with flush front.

9.3. The panel shall be fabricated from sheet steel of minimum thickness of 1.6/2.0 mm. Sufficient stiffeners shall be provided wherever required.

9.4. The panel shall be fabricated to ensure totally enclosed busbar chambers, complete shrouding of live parts when the panel door is open after switching off the circuit breaker and ample space for cabling. If specified it shall be possible to extend the busbars on both sides for adding breakers in future.

9.5. The busbars shall be aluminium and shall be braced to withstand the fault level of the DG Set. The supports for the busbars shall be non-hygroscopic.

9.6. The make of circuit breaker, contactors, relays, indicating instruments, etc. shall be as specified.

9.7. The cable entry for incoming and outgoing to the panel shall from bottom. Necessary adoptor Panel shall be provided for connecting outgoing Cables.

9.8. The fabricated parts shall undergo a treatment of degreasing, pickling and two coats of primer before given the final stoved epoxy. The colour shade shall be shade 631 as per IS-5 or RAL-7032.

10. CIRCUIT BREAKERS

10.1. The Circuit Breaker shall be triple pole, air break, and drawout type with solid manually detachable type neutral.

10.2. The closing mechanism of the circuit breaker shall be manual/ motor operated (as specified in SLD) spring charged independent type. The close/ trip control switch to be interlocked to trip before close. The closing and tripping circuits shall be self-opening on completion of their respective functions irrespective of the position of the control switch. Manual closing devices shall also be provided.

10.3. The Circuit Breaker shall be electrically and mechanically trip-free.

10.4. For all electrical circuit breakers, anti-pumping device shall be incorporated.

10.5. The breaker shall be provided with minimum 6NO + 6NC auxiliary contacts. Auxiliary contacts 20% (min. 3NO + 3NC) shall be provided for Owner's exclusive use. All spare contacts shall be wired upto terminal blocks. Each auxiliary contact shall be capable of modification from normally open to normally closed and vice versa at site. Auxiliary contactor or relay shall be used to multiply contacts.

10.6. The auxiliary contact for the shunt trip shall be of advanced nature such that the auxiliary contact close before main contacts.

10.7. The main and secondary isolating contacts of the circuit breaker shall be self-aligning type.

10.8. The main isolating contact shall have continuous rating equal to the rating of the breaker.

10.9. The secondary isolating contact shall be of wiping contact type.

10.10. The fixed portion of the circuit breaker shall have rail arrangement over which the chassis can move smoothly.

10.11. It shall be possible to bring the circuit breaker to isolated position with the help of external lever without opening the compartment door.

10.12. The breaker shall have 3 distinct positions, such as "SERVICE", "TEST" and "ISOLATED".

10.13. Proper mechanical indication shall be provided to locate these three positions without opening the compartment door.

10.14. It shall be possible to further withdraw the breaker from isolated position for inspection of the circuit breaker "withdrawn" position.

10.15. A stop block shall be provided on the slide rails to prevent the forward movement of the circuit breaker when it reaches the isolated position so that any accidental fall can be avoided. Provision shall be provided to padlock the breaker in all the three positions.

10.16. The following interlocks shall be provided on the circuit breaker:

a) It shall not be possible to withdraw the circuit breaker from the service position with the contacts of the breaker closed.

b) It shall not be possible to close the circuit breaker unless any one of the three positions is located, the service position, a definitely located test position, or isolated position.

c) It shall not be possible to push breaker in if either set of safety shutter is not free and not in its normal closed position.

d) The circuit breaker can be padlocked in OFF position.

e) The castell interlocking shall be provided wherever specified.

10.17. The circuit breaker shall be provided with mechanical ON/ OFF, TRIP and SPRING CHARGED indication, mechanical trip push button, operating handle or 'close' push button, in case of electrically operated circuit breaker and padlocking facility wherever specified.

10.18. The circuit breaker shall be provided with automatic safety shutters, so that before the breaker reaches `isolated' position the main isolating contacts are completely shrouded.

10.19. The circuit breaker compartment shall be so designed that hot gases produced shall be lead away from the operator.

10.20. The protective relays and instruments shall be mounted as near to the circuit breaker as possible. Separate compartment for the instruments and relays shall be provided.

10.21. When the circuit breaker compartment door is open, it must not be possible to touch the live parts.

10.22. All removable covers protecting live parts shall be clearly labelled with warning notices reading "LIVE PARTS. ISOLATE ELSEWHERE BEFORE REMOVING COVER".

10.23. It shall be possible to readily remove the arc chutes for routine inspection of the contacts with the circuit breaker in the "withdrawn" position.

10.24. All circuit breakers of same rating shall be identical in all respects and shall be interchangeable.

10.25. All the non-conducting metal parts of the circuit breaker trolley shall be bonded together and shall make perfect electrical connection to earth through substantial sliding contacts, at service and test positions. Such sliding contacts shall be arranged to make before power plug-in and interrupt after power draw out.

11. Drawings and Documents to be submitted by the contractor.

The following drawings and data in addition to those mentioned elsewhere in the specification shall be submitted with each copy of the tender:-

11.1. General outline dimensional drawings showing front and side elevation and plan of a completely assembled DG Set, accessories including accessories, net weight and shipping weights, center of gravity, crane lift required for assembly / dismantling of DG Set, minimum space required all round the DG Set for installation / operation / maintenance.

11.2. Assembly drwgs. And weights of main/component parts.

11.3. Shippingdrgs.Showingdimensionsandweightsofmajorpackagesdetailing arrangement for inert gas retention and monitoring and other protective arrangements during transportation.

11.4. Test reports for type tests on similar DG Set supplied and installed.

11.5. Technical literature and catalogues, etc. pertaining to erection, operation and maintenance.

11.6. Minimum 5 purchase order copy & satisfactory performance certificates from end user. Performance certificates should be more than five year old certifying DG set is satisfactory running for more than 5 years & 8000 running hours.

11.7. Minimum 10year old type test report of offered engine & alternator

Drawings and Documents to be submitted after award of contract:

After award of the contract, a comprehensive list of drawings/documents planned to be submitted for reference/approval along with time schedule shall be furnished by the contractor for approval of the IITM. The contractor shall supply 6 (six) copies of the following drawings, but not limited to, for IITM's approval.

Design calculation

The Contractor shall submit the design calculation as per "General Technical Specification (GTS)"covering at least the following, for approval.

Calculations for selecting the engine capacity based on the black start of the generating unit,Automatic mode starting/ stopping logics.The Contractor shall also provide other calculations as required by the Engineer for his approval of the Contractor's design.

12. SYSTEM OPERATION

The Diesel Generator Set shall be either suitable for manual start or auto start. In manual start the Diesel Generator shall be started manually by an operator. In auto start the Diesel Generator shall start on receiving an impulse from certain relay. Mostly it shall be under voltage relay. In either case the DG Set may be required to work in isolation or in parallel with any other source.

12.1. MANUAL MODE

In this mode of operation, the operator shall manually start the engine from engine local panel after carrying out necessary initial steps. The operator shall close the outgoing circuit breaker after the voltage builds up to rated value.

12.2. AUTOMATIC START (Automatic Mains Failure Scheme)

12.2.1. Auto Mode

This shall be effective in Auto position of AUTO / MANUAL Selector switch located in local control panel. The diesel generator set will normally be at rest. Upon failure of plant normal supply or voltage falls below set value between 80% to 95% or under failure of one of the phase an impulse will be extended. The impulse shall be normally from an under-voltage relay. The relay will be located elsewhere. Upon receipt of this impulse, diesel set shall be started automatically and brought to rated speed and generator voltage brought to rated value. All accessories required for starting and completion of various sequences of operation for the above purpose shall be provided. In case the DG fails to start and run up on first attempt the engine cranking shall be repeated two more times. When engine does not respond to three impulses, it shall be locked out and alarm given. Contacts for repeat alarm shall be provided.

Immediately after the diesel set reaches rated speed and generator reaches rated voltage, a voltage and frequency-monitoring relay located in control panel shall extend an impulse for closing generator breaker.

12.2.2. Manual Test Mode

Facility for manually starting the diesel generator set for routine testing shall be provided. This shall be done by putting the AUTO/ MANUAL selector switch in manual position and by pressing the push button on control panel. The scheme of operation shall be same as that of auto mode except that the closing impulse for Generator breaker shall not be extended automatically.

12.2.3. Starting Time

The total time from the receipt of starting impulse for diesel generator set until the diesel set reaches rated speed and generator reaches rated voltage shall not be more than 10 seconds.

12.2.4. Transfer to Mains

On restoration of mains supply the load shall be transferred to the mains manually/automatically. During this transfer there will not be paralleling of the DG set with grid sources.

13. RELAY AND METERING PANEL

13.1. ISOLATED OPERATION OF DG SET

Following Relays shall be provided, unless otherwise specified, if DG is operating under independent mode.

Auxiliary voltage supply for relay shall be as per manufacturer's standards.

a) Restricted E/F Relay – SEG or equivalent.

Setting - 10% to 40%.

Stabilizing resistance - as per alternator impedance value.

b) Voltage controlled inverse time over-current relay type CDV62B or Equivalent.

Setting - 50% - 200% in seven steps.

Time setting - 0-3.0 secs. At 4 times the current setting on faults.

c) Earth fault relay type - CDG11 or Equivalent

Setting - 10% - 40%

Time - 1.3 seconds.

d) Under-voltage relay type VAGM22 (2 Nos.) with VTT Timer.

U/V Setting - 40% to 80%.

Timer - 05 sec to .5 sec.

e) Master tripping relay type VAJH13 or Equivalent.

This relay shall have 2No + 2 NC wired to terminal for owner's exclusive use.

Following meters shall be provided unless otherwise specified.

One - 0 - 500V Voltmeter with selector switch.

One - Ammeter with selector switch with appropriate range.

One - 45 Hz - 55 Hz Frequency meter (Reed Type).

One - .5 lag to .5 lead Power Factor Meter

One - KW Meter suitable for 3 phase, 4 wire.

One - KWH Meter suitable for 3 phase, 4 wire.

One - KVAR Meter.

One - Hour meter.

13.2. **PARALLEL MODE**

Following relays shall be provided, unless otherwise specified, if DG is operating in parallel mode.

Auxiliary voltage supply for relay shall be as per manufacturer's standards.

a) Differential protection relay type CAG34 or Restricted Earth Fault CAG14.

Setting	-	1% to 40%.
Stabilizing resistance	-	200 ohms variable.

b) Voltage controlled inverse time over current relay type CDV62B.

Setting	-	50% - 200% in seven steps.
Time setting	-	0-3.0 secs. At 4 times the current setting on faults.

c) Earth fault relay type - CDG11 or equivalent

Setting	-	10% - 40%
Time	-	1.3 seconds.

d) Under-voltage relay type VAGM22 (3 Nos.) with VTT Timer.

U/V Setting	-	40% to 80%
Timer	-	05 sec to .5 sec.

e) Master tripping relay type VAJH13.

This relay shall have 2 NO + 2 NC wired to terminal for owner's exclusive use.

f) Definite Time Reverse Power Relay Type - CCUM21.

g) Definite time Reverse Reactive Power Relay - CCUM21.

Following meters shall be provided unless otherwise specified in 'Specific Requirements'.

One	-	0 - 500V Voltmeter with selector switch.
One	-	Ammeter with selector switch with appropriate range.
One	-	45 Hz - 55 Hz Frequency meter (Reed Type).
One	-	0.5 lag to 0.5 lead Power Factor Meter
One	-	KW Meter suitable for 3 phase, 4 wire.
One	-	KWH Meter suitable for 3 phase, 4 wire.
One	-	Hour meter.

One - KVA Meter suitable for 3 phase, 4 wire.

One - KVAR Meter suitable for 3 phase, 4 wire.

14. SYNCHRONIZING CUM AMF (Auto Mains Failure)PANEL

To be provided for DG Set which will run in parallel mode with any other source. In case of more than one DG Set, the synchronizing panel will have a selector to select the incoming DG Set. The logic of selector switch shall be specified during order stage. Synchronization panel is to be supplied with auto neutral closure logic as well as auto neutral change over logic. The logic should be make before break. None of the time neutral to be floating. Supplier has to submit the logic.

Generally the synchronizing panel shall consist of:

a) Double voltmeter.

b) Double frequency meter.

c) Synchroscope.

d) Check synchronizing relay.

e) Dark and bright indicating lamps.

f) Control switch for DG Breaker.

g) Selector switch for selecting group to be paralleled.

h) SYNCH IN / OUT switch.

i) Synchroscope ON / OFF Switch.

j) Raise / Lower Voltage.

k) Raise / Lower Speed.

l) Synchronization to be microprocessor based relay with Auto AMF and auto synchronization system, with load dependant start and stop.

m) All necessary protection like reverse power, reverse KVAr, etc.

15. AUTOMATIC LOAD MANAGEMENT AND SYNCHRONISATION

15.1. The panel shall also certain the following functions:

15.2. Load on each DG set shall be continuously motorized.

15.3. In case the load on any of the DG Sets is less than of the rated value and the summation of the loads is within 90% of the rating of one of the DG Sets, one DG set shall shut down and load shall be transferred to the second.

15.4. DG Set

15.5. In case a DG set is shut down due to non-available of adequate load and should the load increase, the Micro PLC for load management shall automatically start the DG set and shall automatically synchronize the same on the LT bus.

15.6. The automatically load management system shall be designed to provide optimum utilization of the DG set so that operation of the DG sets is obtained with higher load factor on each set. The PLC shall ensure that all the A.C.B.'s may close and open and DG sets are started and stopped

according to the predetermined logic and interlocking scheme to provide a fail-safe system.

15.7. Static relay shall be provided for the system for electrical protection of O/C, E/F, reverse power relay and will take care of protection of the system in case of fault. Protection features of PLC in that case may be redundant and if provided by manufactures should work as secondary line of protection.

15.8. The panel shall automatically arrange for rotational starting DG sets to be based on number of operating hours of each DG sets so as to ensure that all DG sets are operated as equally as possible.

15.9. In case of overload on the DG system the panel shall give an audio visual alarm to enable the operators to switch off load as required and if load is not taken care of in predetermined time, the panel shall put the DG sets in shut down mode with alarm.

16. TEST MODE

- When under "TEST" mode pressure on "TEST" button shall complete the startup sequence simulation and start the engine. The simulation will be that of mains failure.
- Engine shall build up voltage but the set shall not close alternator circuit breaker when the load is on the mains monitoring performance of voltage / frequency etc. should be feasible without supply to load.
- If during "TEST" run the power supply has failed the load shall automatically get transferred to alternator
- Bringing the mode selector to auto position shall shut down the sets

17. ENGINE PANEL

On this panel annunciation for following unhealthy condition shall be provided.

- Lube oil pressure low.
- Lube oil temperature high.
- Water temperature high.

In case of unhealthy condition both hooter and annunciator will get energized. Accept PB will silence the hooter and reset PB will reset the annunciator.

On the same panel, following items shall be provided.

a) Remote Speed Controller.

b) Control Switch for Engine start-stop.

c) Alternator voltage setter.

d) Controller.

e) Automatic load sharing device.

18. MISCELLANEOUS ITEMS

18.1. CURRENT TRANSFORMER

18.1.1. The current transformers shall be Resin cast bar primary/ wound primary type. Current transformers

shall have sufficient capacity to operate with the burden imposed by all connected devices. Separate cores shall be used for metering and protection.

18.1.2. The current transformers shall be capable to withstand dynamic and thermal stresses originated by the fault current.

18.1.3. The CTs shall be suitably insulated and the mounting of the CTs shall facilitate easy maintenance.

18.1.4. The CTs shall be mounted in stationary part of switchgear.

18.1.5. The secondary of the CTs for metering when wired to terminals, shorting links shall be provided. Shorting links shall be of removable type of Wago make.

18.1.6. Unless otherwise required for proper relaying one side of current transformer secondary shall be grounded in the compartment with the meters or relays, which they serve, and each CT group shall be grounded with a separate identified lead, which may be disconnected for testing.

18.1.7. The accuracy class of protection CT shall be 5P10 and secondary rating shall be 5A. The accuracy class of differential protection CT shall be PS and secondary rating shall be 1A. The accuracy class of metering CT shall be 1.0 and secondary rating shall be 5A.

18.1.8. The differential CT for both phase side and neutral side shall be mounted either in the panel or at alternator terminal.

18.2. **POTENTIAL TRANSFORMERS**

18.2.1. The potential transformers wherever provided shall be epoxy cast resin type and have sufficient burden. This shall be of sufficient capacity to operate with the burden imposed by the relevant devices with their accuracy classification.

18.2.2. Wherever provided, the voltage transformers shall generally conform to IS: 3156 and shall be cast resin type. The voltage transformers shall be provided with primary fuses. Miniature Circuit Breakers with auxiliary contacts shall be provided on the secondary side.

The voltage transformers shall have an accuracy class 3.0 from 50% to 110% of normal voltage and class 1.0 from 80% to 120% of normal voltage with burdens varying between 25% to 100% of the rated value at 0.8 PF lagging.

The primary of the voltage transformers shall be rated for 415 volts and the secondary for 110 volts.

18.2.3. The PT shall be mounted in a separate compartment complete with its accessories.

18.2.4. Proper relaying, one side of PT secondary shall be grounded at the transformer and the ground connection shall be identified and removable for testing.

18.3. **NEUTRAL ISOLATION**

18.3.1. In case of DG Set, running in parallel a contactor shall be provided in the neutral for neutral isolation. Neutral contactor shall have interlock so that only one can be closed at a time.

18.3.2. The neutral point shall be formed in the panel.

19. ENGINE SPARES, TOOLS & TACKLES

Vendor shall furnish complete list of spares for two years of satisfactory operation along with unit price and suggested quantity.

Vendor shall quote for complete set of tools and tackles required for maintenance of Engine and Alternator.

Vender shall forward quote for following items at the time of submission

Sr No	Description	Change Period in Hrs	Quantity	Net Price including Taxes
1	Lubricating Oil Change			
2	Lubricating Oil Top Up			
3	Air Filter Replacement			
4	Fuel Filter Replacement			
5	Lubricating Oil Filter Replacement			
6	Labour Charges for replacement of above.			
7	Comprehensive Annual maintenance charges during warranty period.			
8	Operation and maintenance contract charges during warranty period.			

20. DRAWING AND DATA

20.1. Following Documents shall be furnished along with the offer without which offer will not be considered.

a) Plan and Sectional Layout of DG Sets showing various auxiliaries and panels. Size of DG building shall be as attached layout.

b) GA of panels showing arrangement of various devices on panels.

c) P&I Diagrams for the following :

i) Lube Oil System.

ii) Fuel Oil System.

iii) Cooling Water System.

20.2. Following Documents shall be furnished in quadruplicate for IITM's comments/ approval within four weeks after placement of LOI. Vendor shall incorporate Client/ Consultant's comments on these drawings and furnish revised/ final drawings in six sets. All documents shall be in English.

a) Layout of DG Room with all accessories, weight of equipments, maintenance space etc., clearly indicated.

b) Wiring & scheme diagram for HT, LT system and control system of DG Set.

c) P&I Diagrams for the following system.

i) Lube Oil System.

ii) Fuel Oil System.

iii) Cooling Water System.

d) Foundation drawing of DG Set with static and dynamic loading/ centre of gravity of loads and location of all loads.

e) Foundation requirement of all auxiliaries like compressors, heat exchangers, tanks, etc.

f) Bill of material for DG Set, fuel oil system, cooling water system, lube oil system, electrical system (including cables) engine and alternator control system (including cables).

g) GA of panels showing arrangement of various devices on panel and foundation details.

h) Test Certificates.

i) Installation and Operational Manual.

21. VENDOR SCOPE

21.1. Design, Supply, Erection, Testing, Commissioning, Load sharing tests within the DG system.

21.2. Design, Supply, Erection, Commissioning of:

a) Engine and Alternator.

b) Relay, metering, engine panels, Battery, Battery Charger etc.

c) All piping for fuel oil, lube oil, exhaust system.

d) All wiring and cabling from DG Sets to the panels supplied by vendor.

e) Any other work connected with complete system commissioning.

f) Moving the material from Owner's store to site for installation.

g) Approval of statutory authorities.

22. Approved Make of Supplier

Engine—Caterpillar/Cummins or equivalent

Alternator- Stamford / Lorey Somer

ACBs- Schneider/Siemens/ABB

23. QUALITY CONTROL AND ASSURANCE

To ensure quality during each stage of work, the Contractor shall establish a system defining quality assurance plan/procedures during various stages of work.

The Contractor shall maintain quality control during manufacturing of equipment as per the approved quality assurance plan. Inspections and tests shall be carried out by the Contractor as per approved quality assurance plan with due regard to stipulations in of "General Technical Specification".

The Contractor shall follow approved site quality assurance plan and installation procedures. The Contractor shall maintain the quality records during site installation and commissioning which shall be produced to the Engineer for approval at defined stages.

Inspection and tests shall be carried out at site by the Engineer during installation and commissioning as described in relevant clauses.

All subcontractors including vendors associated in completing the supply and work under this section shall have their own quality assurance systems conforming to ISO 9000 series and certified by an internationally acceptable organization.

24. INSPECTION AND TESTING

a) IITM or his representative shall have free access for his manufacturing location of SUPPLIER.

b) All test procedures, test plan and inspection plan shall be submitted for approvals.

c) IITM's representative shall have the rights to rejects any components which do not conform to purchase order.

d) Inspection package may include but not limit to

- Review of Quality Assurance Document
- Stage Inspection During Manufacturing
- Surface preparation and painting
- Dimensional and assembly inspection

e) Hydrostatic Test – All pressure containing parts shall be tested hydrostatically as per relevant standard.

f) Load Test – During this test generator set shall run for at least four hours under the following conditions

- 30 minutes at 25% of rated output
- 30 minutes at 50% of rated output
- Two hours at 100% rated output
- One hour at 110% rated output
- Instantaneous swing in voltage and frequency after load removal and block loading
- Block Load test

Generator load test shall be based on resistive load.

g) Dynamic Load Test- Frequency and voltage regulation of the generator set shall be verified.

h) Functional test – Supplier shall perform functional test on complete generator set including generator and engine with synchronisation panel.

i) Insulation Resistance Test – Insulation resistance test shall be performed on Alternator, Exciter winding, panel components.

j) Noise Test and Vibration Test – Noise and Vibration test shall be carried out and overall level shall meet guaranteed values.

Brief Scope of Supply and installation should be as below

1. DG Set Supply

- Diesel engine suitable to operate on HSD, Radiator Cooled with necessary fan, electronic governor and electric start and electronic control, protection and monitoring module.
- Permanent magnet brushless alternator coupled to Diesel Engine realigned in Shop.
- Common Base frame
- Residential silencer
- 990 lts. Fuel tank, fuel pipes
- Battery and Battery leads along with Battery Charger.
- Synchronisation panel (Automatic) Load Sharing, monitoring and control Necessary protection relays for generator and bus duct .Necessaries CT shall also be included.
- All control Cabling between DG sets and local control panel and synchronisation panel.
- Adaptor Box suitable for connecting Al. Arm. cables
- Local Control Panel

2. DG Set Installation Testing and Commissioning

Scope of DG set Installation shall includes

- Unloading of DG set on site, storage if required shifting of DG set on foundation
- Complete mechanical installation of DG set on AVM on foundation, Checking of alignment and coupling after installation.
- Supply and installation of exhaust piping of required size with residential silencer of suitable height with end cap or as required by pollution control board with vertical structure support and support foundation.
- Installation of exhaust piping with glass wool with aluminium cladding for internal portion and reachable outdoor portion.
- Installation of Fuel tanks and fuel piping from day tank to engine and return pipes.
- Equalizing pipes between the day tanks.
- All control cabling between DG sets and local control panel/ Synchronisation panel.
- Charging of batteries
- First fill of Oil and Diesel required for preliminary testing.
- Installation of adaptor box for alternator /bus ducts.
- Testing and commissioning of complete system.
- Statuary approvals for the installation and operations from pollution control board and electrical inspectors.

Making and providing shop drawing including all civil requirements, openings, foundations, cut outs etc.

Equipment Data Sheet for Diesel Engine Generator To Be filled by Supplier

VTA- Vender to Advise

Sr. No	Particular Of Equipment	Units	IITMs Requirement	Vender Response
	Generator			
1	Manufacturer		VTA	
2	Type and Model No		VTA	
3	Paint Specification and Colour		VTA	
4	Applicable codes and Standard		IEC	
5	Rated Voltage	V AC	415	
6	Rated Frequency	Hzs	50	
7	Duty Type		S1	
8	Maximum Continuous Rating at S1 Duty	KW	VTA	
9	Power Factor (lag/lead)	pf	0.8 lag	
10	Stator Connections		Star	
11	Neutral Earthing Method		Solidly	
12	Phase Rotation		R-Y-B	
13	System Max Fault Current (Isc symmetrical)		VTA	
14	Rotation facing Drive End		VTA	
15	Insulation Class		Class-H	
16	Temperature Rise		Class-H	
17	Speed	rpm	VTA	
18	X/R ratio			
19	Overload capability 30 Sec		150%	
	1 hour		110%	
20	Unbalanced load capability		VTA	
21	Voltage / frequency variations		Zone B	
22	Generator Efficiency Full Load		VTA	
	50% load		VTA	
	75 % load		VTA	
23	Type of Excitation		Self	
24	Telephonic Harmonic factor		VTA	
25	Suitable for parallel operation	Yes/ No	Yes	
26	Winding Temp detector type		6 off RTD	
27	Max Noise level at no load	DB	VTA	
28	Pole Pitch		2/3	
29	Space heater details		VTA	
30	Direct Axis Reactance			
	Synchronous		VTA	
	Transient		VTA	

	Sub - Transient		VTA	
31	Positive Sequence Resistance		VTA	
32	Negative Sequence Reactance		VTA	
33	Zero Sequence Resistance		VTA	
34	Zero Sequence Reactance		VTA	
35	Short Circuit Ratio (X/R)		VTA	

36	Quadrature Axis Reactance			
	Synchronous		VTA	
	Transient		VTA	
	Sub - Transient		VTA	
37	Direct Axis Open Circuit Time Constant			
	Transient		VTA	
	Sub Transient		VTA	
38	Direct Axis Short Circuit Time Constant			
	Transient		VTA	
	Sub Transient		VTA	
39	Quadrature Axis Open Circuit Time Constant			
	Transient		VTA	
	Sub Transient		VTA	
40	Quadrature Axis Short Circuit Time Constant			
	Transient		VTA	
	Sub Transient		VTA	
	Physical Characteristics			
1	Package Dimensions	mm	VTA	
2	Package Weight	Kg	VTA	
3	Wet		VTA	
4	Dry		VTA	
5	Mounting		VTA	
6	Enclosure Ingress Protection rating		VTA	
7	Generator Cooling Method		VTA	
8	Air Discharge (Top or Bottom)		VTA	
9	Air Filters		VTA	
10	Bearing Type – NDE		VTA	
11	Lubrication		VTA	
12	Terminal Box Type , size and arrangement		VTA	
13	Max Cable Size and No of runs per			

	phase			
	Main	mm^2	VTA	
	Heater	mm^2	VTA	
	Aux	mm^2	VTA	
14	Rotor Moment of Inertia	Kg m^2	VTA	
15	Motor Inertia Constant		VTA	
	Excitation System			
1	Manufacturer		VTA	
2	Permanent Magnet Pilot Generator Type		VTA	
3	Brushless rotating rectifier type		VTA	
4	Voltage Rating (% of exciter ceiling voltage)	%	VTA	
5	Current Capacity (% of nominal)	%	VTA	
6	Diode bridge element failure detector		VTA	
7	Rated Current	A	VTA	
8	Rated Voltage	V	VTA	
9	Input Current	A	VTA	
10	Input Voltage	V	VTA	
11	Hermetically Sealed		Yes	
	Automatically Voltage Regulated System			
1	Manufacturer		VTA	
2	Type		VTA	
3	Solid State Regulator	Yes/ No		
4	Excitation Limitation			
	Max excitation limit	V	VTA	
	Min volt/hertz limit	V/Hz	VTA	
5	Out put voltage set point adjustment		+/- 10%	
6	Dip and Dwell Function	Yes/ No	Yes	
7	Under frequency Protection	Yes/ No	Yes	
8	Voltage regulation under transient condition	%	VTA	
9	Over Fluxing control	Yes/ No	Yes	
10	Functional without external power supply	Yes/ No	Yes	
	Exciter Model Parameter			
11	Excitation Time Constant			
12	Excitation Gain Constant			
13	Maximum exciter voltage	V	VTA	
14	Minimum exciter voltage	A	VTA	
15	Minimum regulator output		VTA	
	Automatic Voltage Regulator			
16	Forward Gain Constant Of AVR		VTA	
17	AVR amplifier time constant		VTA	
18	Feedback gain of AVR		VTA	

19	AVR Feedback Time Constant		VTA	
	Engine Governer			
1	Droop and Isochronous speed control	Yes/ No	Yes	
2	Frequency deviation for load condition			
3	100% load rejection	%	VTA	
4	50% load acceptance with base load 0%	%	VTA	
5	50% load acceptance with base load 50%	%	VTA	
6	Full load rejection with no over speed trip	Yes/ No	Yes	
7	Frequency range for steady state conditions	% (+/-)	1	
8	Engine Block Loading Capability at			
	0% of Base Load		VTA	
	50% of Base Load		VTA	

	Synchronizer			
1	Manufacturer			
2	Type			
3	Type of Synchronization and auto start	Auto/ Manual	Auto	
4	Load Shearing			
	Kw	Yes/ No		
	KVAr	Yes/ No	Yes	
5	PF control	Yes/ No	Yes	
6	Check Synch Relay Out put	Yes/ No	Yes	
	Engine			
1	Manufacturer		VTA	
2	Model No		VTA	
3	Fuel / Specifications		VTA	
4	Maintenance Interval	Period	VTA	
5	Mounting		VTA	
6	Rated Power		VTA	
7	Rated Speed		VTA	
8	Cylinder		VTA	
9	Turbocharged		VTA	
10	Governer manu./ model		VTA	
11	Duty		Prime	
12	Start System		Electrical	
13	Guaranteed fuel rate (Kw/KWH)			
14	@ full load	Kw/Kwh	VTA	
15	@ 75 %full load	Kw/Kwh	VTA	
16	@ 50% full load	Kw/Kwh	VTA	
17	@ 25% full load	Kw/Kwh	VTA	

18	Compression Ratio		VTA	
19	No Of Cylinders		VTA	
20	Bore		VTA	
21	Stroke		VTA	
22	Displacement		VTA	
23	Fuel Tank capacity	Lit	VTA	
24	Pump Type		VTA	
25	Filter Arrangement		VTA	
26	Filter Type		VTA	
27	Lub Oil Temperature Switch	Yes/ No	Yes	
28	Lub oil Pressure Switch	Yes/ No	Yes	
29	Over Speed Switch	Yes/ No	Yes	
30	Lub Oil Filter Type		VTA	
	Protections			
1	Lub Oil Pressure	Yes/ No	Yes	
2	Lub Oil Temp	Yes/ No	Yes	
3	Over Speed	Yes/ No	Yes	
4	High Water Temp	Yes/ No	Yes	
5	High canopy Temp	Yes/ No	Yes	
6	Over Load	Yes/ No	Yes	
7	No Of Cranks	Yes/ No	Yes	
8	Over Excitation	Yes/ No	Yes	
9	Over Current	Yes/ No	Yes	
10	Over Voltage	Yes/ No	Yes	
11	Under Voltage	Yes/ No	Yes	
12	Diode Failure	Yes/ No	Yes	
13	Over Fluxing	Yes/ No	Yes	
14	Pole Slipping	Yes/ No	Yes	
15	Differential	Yes/ No	Yes	
16	Earth Fault	Yes/ No	Yes	
17	Under Frequency	Yes/ No	Yes	
18	Reverse Power			
	Kw	Yes/ No	Yes	
	KVAr	Yes/ No	Yes	
19	Rotor Leakage Current	Yes/ No	No	
20	Synchronization Window	Yes/ No	Yes	

22 KV SF6 INSULATED COMPACT RING MAIN UNIT TECHNICAL SPECIFICATION

TECHNICAL SPECIFICATIONS

SCOPE

1.3 This Specification covers the requirements of Design, Fabrication, Assembly, Inspection, Testing, Painting , Packing ,forwarding and Delivery of 22 KV indoor, ring main unit. Vendor shall furnish clause-by-clause acceptance / comments. Any deviations shall be brought out clearly in the quotation.

1.4 The project under consideration is Construction of **Proposed Data Centre** for M/s **INDIAN INSTITUTE OF TROPICAL METEOROLOGY**, Pune.

Dr. Homi Bhabha Road, Pashan, Pune-411008, INDIA

Contact person: -

Email -

Contact No:-

38 SYSTEM DETAILS

Design Temp. - 45^0 C.

HT Supply: 22kV +/- 10%, 50Hz +/- 3%

LT Supply: 3 Phase - 433/415VAC, +/- 10%, 1 Phase – 240VAC, +/- 10%, 50Hz+/- 3%

39 STANDARDS

The Equipment shall conform to the requirements of the following but not limited to latest revision of relevant Indian Standards or equivalent British or any other International Standard Specifications.

- IEC 298 MV metal-enclosed switchgear,
- IEC 265 MV switches,
- IEC 129 AC disconnections and earthing switches,
- IEC 694 common clauses for MV switchgear standards,
- IEC 56 MV AC circuit breakers,
- IEC 801 monitoring and control
- EC 529 degrees of protection procured by enclosures (IP code).

40 General conditions.

These specifications apply to factory-built, RMU type, metal-enclosed indoor switchgears. The equipment to be supplied shall come in the form of a compact switchboard and shall meet the following requirements :

Easy to install

Safe and easy to operate

Compact

Low maintenance

The supplier shall be capable of proving that he has a broad experience in the area of MV switchgears and shall provide proof that he has already supplied equipment of the equivalent type and brand which has been in operation for at least three years.

41 Service conditions

The RMU shall be suitable for operations at a height of less than 1000 meters above sea level.

The RMU shall be capable of operating normally within the following temperature range :

Maximum air temperature : + 45 ° C

Minimum air temperature : - 10 ° C

Manufacturer shall declare whether RMU is able to operate in air temperature higher than + 45 °C and if current derating is necessary.

The RMU shall be capable of being operated in electrically exposed locations.

The RMU shall be capable of being exposed to high relative humidity and ambient air pollution.

42 System Parameters

Network	Three phases - Three wires
Rated Voltage	24 kV
Service Voltage	22 kV
System Frequency	50/60 Hz
Lightning Impulse withstand Voltage Phase to phase, phase to earth Across the isolating distance	 95 - 125 kV 110 - 145 kV
Power Frequency withstand voltage	50 kV rms - 1 mn
Rated Normal Current Line Protection Feeder Line Switch Transformer feeder	 630 A 630 A 200 A
Rated Short time current withstand (1 sec)	20 kA

Rated Short circuit making capacity of line switches and earthing switches	50 kA peak at Rated Voltage
Rated Bus Bar Current	630 A
Number of operations at rated short circuit current on line switches, earthing switches and CB	5 closing operations
Rated load interrupting current Line switch	 630 A rms
Rated cable charging interrupting current Line switch	 110 A
Rated magnetizing interrupting current Line switch	 16 A
Number of mechanical operations Line switches and earthing switches Circuit breaker	 1000 O/C 2000 O/C
Number of electrical operations at full loop current	100 O/C
Number of operations at rated short circuit current on circuit breaker	 3 breaking operations

All of the switchgear shall be capable of withstanding this current without any damage being caused, in accordance with the recommendations IEC 694 § 4.5, 4.6, 4.7 and IEC 298 § 4.5.

43 General stipulations regarding the design and development of switchgear

43.1 Introduction

The RMU shall meet the criteria for compact, metal-enclosed indoor switchgear in accordance with IEC 298.

It shall include, within the same metal enclosure, the number of MV functional units required for connection, power supply and protection of transformers, i.e.

- ✓ "network" switch disconnectors. (630A).
- ✓ Line protection feeder.(630A).
- ✓ "transformer protection" feeders (630A)
- ✓ Transformer protection feeder(630A).
- ✓ Metering Modules.
- ✓ earthing switches.

43.2 Switchboards

The switchgear and busbar shall all be contained in a stainless steel enclosure filled with SF6 at 0.2 bar (200 hPa) relative pressure to ensure the insulation and breaking functions. Sealed for life, the enclosure shall meet the "sealed pressure system" criterion in accordance with the IEC 298 standard (appendix GG § 2.3 and 3.3): a system for which no handling of gas is required throughout the 30 years of service life. So, refilling valve is not required .In addition, manufacturer shall confirm that maximum leakage rate is lower than 0,1 % / year.

It shall provide full insulation, making the switchgear insensitive to the environment (temporary flooding, high humidity...), IPX7 degrees of protection in accordance with recommendation IEC 529 § 14.2.7.

Thus assembled, the active parts of the switchgear shall be maintenance-free and the switchboard shall be low-maintenance.

The switchboards shall have an IP2XC protection index.

The tank shall be made of at least 2 mm AISI 304 unpainted stainless steel and be able to withstand an accidental internal overpressure of at least 3 bars (3000 hPA)

The colour shall be RAL 9002 for the enclosure and RAL9005 for the mimic panel.

The switchboards shall be suitable for mounting on a trench, utilities space or base.

Each switchboard shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

The switchgear and switchboards shall be designed so that the position of the different devices is visible to the operator on the front of the switchboard and operations are visible as well.

In accordance with the standards in effect, the switchboards shall be designed so as to prevent access to all live parts during operation without the use of tools.

43.3 Dielectric medium

SF6 gas is the preferred dielectric medium for MV RMUs. Oil filled switchgear will not be considered. SF6 gas used for the filling of the RMU shall be in accordance with IEC 376.

It is preferable to fit an absorption material in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption.

43.4 Earthing of metallic parts

There shall be continuity between the metallic parts of the switchboard and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people.

The substation frames shall be connected to the main earth busbar without dismantling any busbars.

43.5 Earthing of the main circuit

The cables shall be earthed by an earthing switch with short-circuit making capacity, in compliance with IEC 129 standard. The earthing switch can only be operated when the switch is open.

The earthing switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action.

The moving contacts of the earthing switch shall be visible in the closed position through transparent covers.

Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earthing switch when the switch is closed.

43.6 "network" disconnectors

They shall be maintenance-free, with breaking in low pressure SF6 gas. The position of the power contacts and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 129 § 6.105 standard.

The switches shall be of the "increased operating frequency" in accordance with IEC 265-1 § 3.104 standard. They shall have 3 positions, open-disconnected, closed and earthed, and will be constructed in such a way that natural interlocking prevents unauthorized operations.

The switches shall be fully mounted and inspected in the factory.

Manual opening and closing will be driven by a fast-acting mechanism, independent of operator action.

Each switch can be fitted with an electrical operating mechanism in a specially reserved location, without any modification of the operating mechanism and without de-energizing the switchboard.

The switch and earthing switch operating mechanism shall have a mechanical endurance of at least 1000 operations.

43.7 "Transformer protection" feeders

By circuit-breakers

The circuit breakers shall be of the maintenance-free, low pressure SF6 gas type. The position of the power and earthing contacts shall be clearly visible on the front of the switchboard. The position indicator shall provide positive contact indication in accordance with IEC 265-1 standard. In addition, manufacturer shall prove reliability of indication in accordance with IEC 129 § 6.105 standard.

The circuit breakers shall have 3 positions: open-disconnected, closed and earthed and shall be constructed in such a way that natural interlocks prevent all unauthorized operations.

They shall be fully mounted and inspected in the factory.

An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement.

It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic reclosing.

The circuit breaker shall be associated with an integrated protection unit that will operate without any auxiliary power supply and shall include:

■Three toroid transformers incorporated in the transformer tee-off bushings,

■An electronic relay,

■A low energy release,

■A "fast-on" test receptacle for protection testing (with or without CB tripping)

The protection system will ensure circuit breaker tripping as of a minimum operating current (Is) which is the rated current of the transformer being protected and may be set to following ratings from 8 to 200A. Following settings shall be available :

Range 1 - 8 to 80 A : 8, 10, 12, 15, 18, 22, 28, 36, 46, 56, 68, 80

Range 2 - 20 to 200 A : 20, 25, 30, 37, 45, 55, 70, 90, 115, 140, 170, 200

Phase to phase protection shall be able to work from 1,2 time the minimum operating curent Is.

Electrical characteristics of the circuit-breaker function shall be at least greater than following values

- rated current: 630A
- short-circuit breaking capacity: 20 kA / 22 kV

43.8 RMU bushings and Cable terminations

43.8.1 Bushing

It is preferable to have all bushings accessible from the front of the RMU. Bushing along the sides or the rear of the RMU are not acceptable.

The bushing should be conveniently located for working with cables specified and allow for the termination of these cables in accordance with the instructions supplied for the MV 400 series, 400 A plug-in or 630 A M16 bolted connectors on line switch and for the MV 200 series 200 A plug-in connectors on transformer protection feeder.

The profiles of the cable connection bushings shall be in compliance with EN-50181 standard.

43.8.2 Cable clamps

A non ferro-magnetic cable clamp arrangement must be provided for all network cables terminated on the RMU

43.9 Padlocking facilities

The circuit breakers and earthing switches can be locked in the open or closed position by 1 to 3 padlocks 6 to 8mm in diameter.

43.10 Voltage indicator lamps and phase comparators

Each function shall be equipped with a voltage indicator box on the front of the device to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps.
Three inlets can be used to check the synchronization of phases.
This device shall be in compliance with IEC 1958 standard.

43.11 Safety of people

Any accidental overpressure inside the sealed chamber will be limited by the opening of a pressure limiting device in the lower part of the enclosure. Gas will be released to the rear of the switchboard away from the operator. Manufacturer shall provide type test report to prove compliance with IEC 298 appendix AA 'Internal fault'.

43.12 Operating lever

An anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earthing switch.

All manual operations will be carried out on the front of the switchboard.

The effort exerted on the lever by the operator should not be more than 250 N for the switch and 250 N for the circuit breaker.

43.13 Front plate

The front plate shall have an IP2XC degree of protection. The front shall include a clear mimic diagram which indicates the different functions.
The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator.
The lever operating direction shall be clearly indicated in the mimic diagram.

The manufacturer's plate shall include the switchboard's main electrical characteristics.

43.14 Cable insulation testing

It must be possible to test the core or the sheath insulation of the network cables while the RMU remains energized at rated voltage. It shall be carried out the phase by phase testing through a built-in facility without necessity to have an access to cable compartment. The maximum test voltage shall be less than 42 kV DC for 10 minutes.

43.15 Dimensions

The overall dimensions shall not be greater than the followings :

	height	depth	width
4 functions	1140 mm	710 mm	1620 mm
3 functions	1140 mm	710 mm	1186 mm
2 functions	1140 mm	710 mm	829 mm

43.16 Finishing

The device shall be fully designed for use in a hot, humid atmosphere and shall be low-maintenance. Manufacturer shall provide type test report to prove salt fog withstand for at least 200 hours on operating mechanism according to IEC 68-2-2 standard.

All metallic parts shall have rust protection.

Two lifting rings shall be installed on the top of the switchboards for handling.

44 Type and routine tests

According to the composition of the switchboard, various type test certificates can be supplied:

- Impulse withstand test,
- Temparature-rise test,
- Short-time withstand current test,
- Mechanical operation test,
- Checking of degree of protection,
- Switch, circuit breaker, earthing switch making capacity.
- Switch, circuit breaker breaking capacity.
- Internal arc withstand
- Checking of partial discharge on complete unit

In addition, for switches, test reports on rated breaking and making capacity shall be supplied.

For earthing switches, test reports on making capacity, short-time withstand current and peak short-circuit current shall be supplied.

The routine tests carried out by the manufacturer shall be backed by test reports signed by the factory's quality control department. They shall include the following:

- Conformity with drawings and diagrams,
- Measurement of closing and opening speeds,
- Measurement of operating torque,
- Checking of filling pressure,
- Checking of gas-tightness,
- Checking of partial discharges on individual components,
- Dielectric testing and main circuit resistance measurement.

45 Quality

When requested by the customer, the supplier shall provide proof that he applies a quality procedure in compliance with the standard, namely:

- ✓ Use of a quality manual approved and signed by a top management representative,
- ✓ Periodic updating of the manual so that it reflects the quality control procedures in effect,
- ✓ ISO 9001 certification.

46 LABEL DETAILS

46.1 Labels of 3-ply laminate shall have black lettering on yellow background provided for following:

46.1.1 Main nameplate for the PCC as per description given in SLD in centre on top side on front of the PCC.

46.1.2 Name plates for all incomers and outgoing feeders indicating description, rating, equipment no., feeder no., etc.

46.1.3 Nameplates for all door mounted components.

46.1.4 Name plates for panel numbers on front and rear.

46.1.5 Warning labels for interlocks.

46.2 Danger labels shall be provided for interlocks.

46.2.1 Danger labels for the PCC as per statutory regulations.

46.2.2 Danger labels for busbar chamber.

46.2.3 Danger labels for cable alley housing live terminals.

46.3 All components shall be provided with components identification stickers.

46.4 Every component shall be provided with label on inside of the door indicating following information:

- Switch / Breaker Rating
- Fuse Rating
- BMR Rating
- Contactor Rating
- CT Rating

- Rating of other major components

46.5 All nameplates shall be fastened by means of screws to the panel.

47 COMMISSIONING AND START-UP SUPERVISION

Commissioning and start-up supervision shall be provided by the manufacturer at site, and charges for the same shall be quoted separately.

48 SWITCHGEAR AND EQUIPMENT CERTIFICATION

Manufacturer shall state in its bid whether proposed circuit breakers and switchgears have been tested by an independent recognised testing organisation. Copy of such test certificates shall be attached to the bid.

49 PACKING

49.1 The switchboard shall be shipped to site packed in wooden crates. They shall be wrapped in polyethylene sheets before being placed in crates to prevent damage to the finish. Crates shall have skid bottoms for handling.

49.2 The packing cases shall be marked as per the details given in the purchase order.

49.3 Each case shall have the reference to the vendor general arrangement drawing and shall normally indicate the sections of the switchgear.

49.4 The packing cases shall contain one set of all the drawings for easy inspection at site.

50 STATUTORY REGULATIONS

The switchgear shall be manufactured as per the requirements of Indian Electricity Rules. The switchgear shall be acceptable to the local statutory authorities such as Electrical Inspectorate and Fire Insurance Council. The switchgear shall have approval of Tariff Advisory Committee and relevant certificates shall be furnished in six sets for records.

51 SPARES

Manufacturer shall quote for recommended spares for 2 years and for spare fuses.

52 TESTING

52.1 415V switchgear shall be tested as per relevant Indian Standards and will include the following:

m) Visual and dimensional inspection as per general arrangement drawing.

n) Checking for provision of feeders as per general arrangement drawing.

o) Checking for provision of components as per bill of material.

p) Operation test.

q) IR measurement before and after HV test.

r) HV test.

52.2 The testing will be witnessed by Client's Engineer. Six copies of Test Certificates shall be furnished to Owner for approval before despatch.

53 DRAWINGS

53.1 In general, the manufacturer shall supply six sets of prints of drawings / documents as below.

53.2 All the above drawings shall incorporate the following information:

e) Client's Name

f) IITM's order reference

g) Vendor's order reference

h) Reference to our specification / single line diagram and relevant drawings.

53.3 Electrical scheme drawing for each equipment shall be submitted separately. These need not be submitted at the time of first submission or approval stage. Once the drawing is approved, separate scheme drawing for each equipment shall be furnished.

53.4 As part of documentation two complete set of manual consisting of the following minimum as listed under.

"Contents" shall be furnished for approval. After approval, the record prints shall be furnished.

All the information shall be clearly indexed, flapped and filed in a folder of the Quality, which is expected for final Documentation.

Vendor to note that his final invoice will be cleared only after submission and acceptance of final record documentation. 5% of the order value is considered for above.

54 SPECIFIC REQUIREMENTS

Refer Single Line Diagram. Quote shall be made for RMU Panel .

55 MAKES OF COMPONENTS

55.1 Unless approved in writing equipment / components of switchgear shall be of following make only:

SF6 Circuit Breakers	:	ABB/Schneider / Siemens/Areva
Breaker Control Switches	:	ABB/Schneider / Siemens/Areva
Other Control Switches	:	ABB/Siemens / Schneider
Protective Relays & Auxiliary Relays	:	ABB/Schneider / Siemens
Push Button / I Lights	:	ABB/Schneider / Siemens
Terminals	:	Elmex / Wago / Technoplast

56 BILL OF MATERIAL

20.1 22 KV, 630A, 24KA Indoor type SF6 C.B. consisting of 1 Incoming SF6 circuit breaker & 3 outgoing SF6 C.B. with following details

Ratings:

Rated Voltage : 22KV

Rated STR : 20KA/1 Sec.

Rated Busbar Current: 630A

- ✓ **Bill of Material for 1 I/C panel:**
  Manually operated 630A SF6 Circuit Breaker & earthing switch with full making capacity.
  Mechanical ON/OFF/EARTH indication.
  Anti reflex operating handle.
  2 NO + 2 NC auxiliary contacts.
  Cable testing facility without opening cable compartment & without disconnecting the cable termination.
  Live cable indicating LEDs energized thru capacitive voltage dividers.
  Cable box for termination of cable upto 1no.3C X 300sqmm.

PILC/XLPE cable.
  Right angle boots.

- ✓ **Bill of Material for Each O/G panel**:
  Manually operated 630A SF6 Circuit Breaker & earthing switch with full making capacity.
  Mechanical ON/OFF/EARTH indication.
  Anti reflex operating handle.
  2 NO + 2 NC auxiliary contacts.
  Shunt Trip coil (230V AC) for external trip signal.

Self powered O/C+E/F relay type VIP35.
Cable testing facility without opening cable compartment & without disconnecting the cable termination.
Emergency Trip Push Button.
Live cable indicating LEDs energized thru capacitive voltage dividers
Cable box for termination of cable upto 1no.3C X 300sqmm.
PILC/XLPE cable.
Right angle boots (Push-ON type).

20.2 22kV, 630A, 24kA outdoor type SF6 Load Break switch 1 no. with following details.

1. 630A outdoor type Load break switch & earthing switch with full making capacity.
2. Mechanical ON/OFF/EARTH indication
3. Anti Reflex operating handle.
4. 2 NO + 2 NC auxiliary contacts.
5. Cable testing facility without opening cable compartment & without disconnecting the cable termination.
6. Cable Box for termination of cable upto 1No. 3C X 300 Sqmm. PILC/XLPE cable.
7. Live Cable indicating LEDs energized thru capacitive voltage dividers.

21 **HT PANEL: 1**

24KV, 630A, 20KA Indoor type SF6 C.B. consisting of 1 Incoming SF6 circuit breaker 3 outgoing SF6 C.B. with following details.

Rated Voltage	24 KV
Type	Indoor (Extendable).
Rated Breaking Capacity	26 kA for 1 Sec.
Rated Making Capacity	50 kA at rated voltage.
Rated Bus bar Current	630 A
Cable Box to accommodate	1RX240 Sq. mm. 3 Core HT XLPE cable at incoming and outgoing feeders.
Shunt Trip Coil	24 V DC.(Power Pack)
Load Manager	With communication port and compatible to Energy Management Software shall be built on SCADA based platform with Tags.

	For each Circuit Breaker.
Incomer	1 Nos.
Quantity and type	1 No of 630A SF6 breaker
Protections Required.	Over Current, Short Circuit
Protective Relays	A. Over-current & Earth Fault Relay (50,51,51N,50N) B. Auxiliary Relay C. Master Trip Relay (86). D. Trip Circuit Supervision Relay. E. Antipumping Relay.
Annunciator	8 Window
Annunciator Indications	As Specified in the HT Single Line Diagram.
Mechanical indications	ON/OFF/EARTH indication.
Aux Contacts	4NO + 4NC
Outgoing Feeder	3 No.
Outgoing 1 to 3	3 No of 630A line protection SF6 Breakers.
Protective Relays (Compatible to 5A CT secondary current)	A. Over-current & Earth Fault Relay (51+50N) B. Auxiliary Relay C. Master Trip Relay (86). D. Trip Supervision Relay. E. Antipumping Relay.
Annunciator	8 window
Annunciator Indications	As Specified in the HT Single Line Diagram.
Mechanical indications	ON/OFF/EARTH indication.
Aux Contacts	4NO + 4NC at each feeder.
CT ratio	As Specified in the HT SLD

Bus Potential Transformers-1 Qty.	Class-1 25VA, 22kV/Sq.rt3/110V/Sq.Rt3
Supply for indications and meters	110 V AC supplied through Bus PT.
Metering Module	1 nos.

NOTE- Power supply required for shunt coil will be supplied by RMU manufacturer along with Battery and Charger .

DEVIATIONS FROM TECHNICAL SPECIFICATIONS OF CONTRACT

All deviations from Technical Specifications shall be filled in hereby the Tenderer

SECTION	CLAUSE NO.	DEVIATION

The Tenderer hereby certificates that the above mentioned are only deviations from Technical Specifications of contract of enquiry.

DATE:

Signature & Seal of Tenderer

7. PRICE SCHEDULE

Sr. No.	Particulars	Unit	QTY	Price (Rs.)	
				Unit	Total
1	Ex-works Price Compact Sf6 RMU panels-1	Nos.	1		
2	Special Tools				
3	Packing & Forwarding				
4	Excise duty				
5	VAT/CST @…….				
6	Freight				
7	Transit insurance charges				
8	Any Other taxes/duty				
9	Total Price for Design, Manufacture, Inspection, Testing, Packing & Forwarding, transport & Delivery at site.				

Sr. No.	Particulars	Unit	QTY	Price (Rs.)	
				Unit	Total
1	Scheduled Maintenance Spare Part				
2	Mandatory Spare Parts for Breakdown Maintenance				

SECTION-E

SAFETY REGULATIONS

The contractor shall at his own expense, arrange for the safety provisions as per the codes of Indian Standard Institution, Indian Electricity Act / Rule and such other Rules, Regulations and Laws as may be applicable in respect of all labour, directly or indirectly employed in the work for performance of the Contractor's part of this agreement. While the Indian Electricity Rules 1956, as amended up to date, are to be followed in entirety, any installation or portion of the installation that does not comply with these Rules, should be rectified immediately.

The contractor shall be responsible for and indemnify the buyer against all injury to persons – both his own workmen and others and for all damage to structural and / or decorative part of the buyer's property during erection and commissioning of the equipment. The contractor shall repair / reinstate all such damage at his own cost.

It shall be ensured that the control switches and distribution boards are duly marked, the distribution diagrams of substations are prominently displayed, and the substation premises, main switch rooms and D.B. enclosures are kept clean. Particular care should be taken to prevent the substation being used as store for inflammable materials, broken furniture, waste materials etc.

No inflammable materials shall be stored in places other than the rooms specially constructed for this purpose in accordance with the provisions of the Indian Explosives Act. If such storage is unavoidable, it should be allowed only for short period and in addition, special precautions such as cutting off supply such places at normal times, storing materials away from wiring and switch boards, giving electric supply for a temporary period with due permission of engineer- in charge shall be taken.

Protective and safety equipment such as rubber gloves, earthing rods, line men's belt, portable respiration apparatus, necessary number of caution boards such as " Man on Line", "Don't switch on" etc should be provided in easily identifiable locations. Where electric welding or such other nature of work is undertaken, goggles shall be provided.

Rubber or insulating mats should be available in front of the main switchboards or any other control equipments of medium voltage or above.

Standard first Aid boxes containing materials as prescribed by the St John Ambulance or Indian red cross should be provided in easily identifiable locations and should be easily available.

Periodical examination of the first aid facilities and protective and safety equipment provided should be undertaken and proper records shall be maintained for their adequacy and effectiveness.

Charts (one in English and one in regional language – Marathi) displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently displayed at appropriate places.

A chart containing the names, addresses and telephone numbers of nearest authorized medical practitioners, hospitals, fire brigade and also officers in charge shall be displayed prominently along with the first Aid box.

Steps to train supervisory staff and authorized persons of the engineering staff in the first Aid practices, including various methods of artificial respiration with the help of local authorities such as fire brigade, St. John's Ambulance Brigade, Indian Red Cross or other recognized institutions equipped to impart such training shall be taken, as prompt rendering of artificial respiration can save life at the time of electric shock.

Electrical wiring and control switches should be periodically inspected and any defective wiring switches which will expose live parts should be replaced immediately to make installation safe.

No work on live L.T. bus bars or pedestal switch boards should handled by a person below the rank of a wire man and such a work should preferably be done in the presence of the Engineer in charge of the work.

When working on or near live installation, suitable insulated tools should be used, and special care should be taken to see that these tools accidentally do not drop on live terminals causing shock or dead short.

The electrical switchgear and distribution boards should be clearly marked to indicate the area being controlled by them.

Before starting any work the existing installation, it should be ensured that the electric supply to that portion in which the work is undertaken is preferably cut off. Precautions like displaying "Men at Work" caution boards on the controlling switches, removing fuse carrier from these switches and these fuse carriers being kept with the person working on the installation, etc, should be taken against accidental energization. "Permit to Work" should be obtained from the Engineer-in-charge. No work on H.T. main should be undertaken unless it is made dead and discharged to earth with an earthing lead of appropriate size. The discharge operation shall be repeated several times and the installation connected to earth positively before any work is taken up.

Before energizing any installation after the work is completed, it should be ensured that all the tools have been removed and accounted and no person is present inside any enclosure of the switchboard. Any earthing connection made for carrying out the work should be removed. "Permit to work" should be received back duly signed by the person to whom it was issued in token of having completed the work and the installation being ready for energisation and "Men at Work" caution Boards removed.

In case of electrical accidents and shock, the electrical installation on which the accident occurred should be switched off immediately and the affected person should be immediately removed from live installation by pulling him with the help of coat, shirt, and wooden material or with any other dry cloth. He should be removed from the place of accident to a nearby safe place and artificial respiration continuously given as contained in BIS code and standard prescribed by St John Ambulance Brigade or Fire Brigade.

While artificial respiration on the affected person is started immediately, help of Fire Brigade and Medical Practitioner should be called for an artificial respiration should be continued uninterrupted until such help arrived.

These instructions should be explained in Hindi / local language to those staff who does not understand English.

The contractor shall ensure that all portable power tools used by the workman are rated 230 volts, double insulated and have to taken through 100 mA Earth Leakage Circuit Breaker (ELCB). Also all temporary lighting shall be supplied through 30 mA ELCB. Inserting wire into the sockets without the plug tops is not allowed. The length of the extension cord for portable tools should not be more than 5 feet. Temporary cables and flexible wires of short length should be bunched up and supported at inaccessible height. Temporary lamps should be mounted at inaccessible height. If lamps are incandescent, they should be protected by wire-mesh.

All power supply / Distribution Boards shall have canopy for protection against weather if located outdoors.

While carrying out work in Vessels / AC ducts or any other confined place, hand lamps with metallic guard suitable for 24 Volts AC supply shall be used All non-current carrying metallic parts of electrical system and equipment shall be earthed with two separate earthing wires of adequate capacity.

GENERAL RESPONSIBILITY

The contractor shall obtain a "Work Permit" from the Site Engineer / Client before starting any work at site. The work permits are issued to prevent any one working in unauthorized areas and they are valid for specific period.

The contractor shall produce test certificates from Government approved certifying authorities for all the lifting gear & hoists (slings, chains, hooks, chain pulley blocks, winches, cranes etc) before starting the work. The contractor's supervisor for subsequent spot checks shall retain the certificates.

The gas cylinders should be used in safe manner. They should not be dropped from heights. Acetylene cylinder should be kept upright position. Oxygen cylinders should not be kept near inflammable materials like oil etc.

The contractor is to remove all waste materials from and around the work site and leave the work spot spick and span.

HOT WORK

Before carrying out any hot work (gas cutting, welding etc) the contractor shall contact the site-in -charge to ascertain about the safety of the area for welding work.
For welding work DC Generator sets are to be used instead of AC transformer sets.

The contractor shall produce certificates for his welding sets checked by the site in charge before starting the work. The certificates shall have to be renewed every two months. A copy of the current certificate shall be displayed on the welding sets.

Only cables in good condition and insulated holders are to be used. The length of the supply cable shall not exceed 25 feet and the welding set body shall be properly earthed. Under no circumstance building structure pipeline should be used as a return path of the current.

A charged fire extinguisher of CO2 type is to be carried with each welding set.

The welder is to wear good quality insulated welding gloves, shoes & goggles while at work.

Tarpaulins are not be used in the vicinity of welding / gas cutting jobs.

EXCAVATION

In the event of an excavation being made, it is the responsibility of the contractor to see that any opening, sump or pit caused by them is securely fenced as required by the Factory Act.

WORKING AT HEIGHT

For carrying out work at heights exceeding 6 feet or over and near the opening in floors, roofs, etc the following precaution to be taken.

The written permission of the Departmental Manager is to be taken before carrying out any work. Adequate safety precautions like use of safety belts, crawling ladders etc are to be taken.

All personnel engaged on overhead work shall be men experienced in such work.

Whenever possible timber staging or platform shall be erected with planks of minimum thickness 2 inches and minimum width 12 inches when the nature of work demands staging of a greater width than plank provided then additional planks shall be added and lashed securely.

Staging shall be provided with simple safety rails or ropes throughout its length, at waist height and on each open side.

Staging supports shall be of standard steel scaffolding safely secured and supported on firm level footings or slung from overhead beams. The supports shall be situated at a maximum distance of 8 feet apart and staging shall be secured to each support.

In case the site or nature of work is unsuitable for erection of proper staging all workers shall wear safety belts around their waists and secure their lifelines to strong scaffolding or structural members.

Wherever it is not possible to put up staging and / or use safety belts, safety nets or sheets shall be slung beneath the place of work.

When working in open process vessels or tanks, safety belts or safety nets shall always be used whether or not staging and scaffolding is provided.

Safe access to all points of work should be provided in the form of suitable ladders, stairways etc.

Contractor's employee of at least status of a foreman shall examine all arrangements before starting such work is commenced and shall satisfy himself that all reasonable safety precautions have been taken.

FIRE INSTRUCTIONS

Before carrying out any hot work (gas cutting, welding etc) the contractor shall contact the site-in -charge to ascertain about the safety of the area for welding work.

Smoking is strictly prohibited in factory premises. Severe action will be taken if any of the contractor's workmen is found smoking at the work site area.

In case fire is discovered, dispatch additional force & site Engineer. Wherever possible switch off any electrical and gas apparatus near the fire.

Check the nature of fire, pick up appropriate fire extinguisher and try to put out fire. For Electrical fire use carbon dioxide fire extinguisher.

PERSONAL PROTECTIVE EQUIPMENT

The personal protective equipment should be worn wherever necessary.

REVIEW MEETINGS

Periodic safety review meeting shall be conducted to review safety and for better coordination with other agencies.

Periodically safety review will be held with Site Engineer and issues will be discussed and action points shall be monitored and recorded in a separate safety Register / File.

SAFETY AUDITS

Periodic safety audit shall be carried out by Institute. The interval between the safety audits shall be discussed with Site Engineer / safety Officer.

WORK AFTER NORMAL WORKING HOURS

Extra care need to be taken for jobs being carried out after normal working hours with due revalidated work permit.

ACCIDENTS

In case of injury or serious illness, the department should be informed immediately. All injuries are to be reported by filling in the "injury report" form, which will be available with the respective department / site engineer.

These safety conditions should not be regarded as exhaustive. These have been issued for the guidance of the contractor and will not in any way absolve the contractor from any obligations or liabilities that might incur or transfer such obligations on liabilities to the company.

PART6: BIDFORM, PRICESCHEDULES AND OTHERFORMATS(BF)

INDEX

FORMATNUMBERS

FORMAT–6.1.1
BIDFORM (TECHNICALBID)
(to be included in Technical Bid Envelope)

Date:.....

To:
Indian Institute of Tropical Meteorology,
Dr. HomiBhbha Road,
Pashan
Pune - 411008

Dear Sir,

Ref.: Construction of HPC Data Centre

Having examined the Bidding Documents, the receipt of which is hereby duly acknowledged, we, the undersigned, offer to supply and deliver the Solution for Data Centre Build inconformity with the said Bidding documents.

We undertake, if our Bid is accepted, to deliver, install and commission the Solution in accordance with the delivery schedule specified in the Schedule of Requirements.

If our Bid is accepted, we will obtain the guarantee of a Bank in a sum equivalent to 10 percent of the Contract Price for the due performance of the Contract, in the form prescribed by the Institute.

We agree to abide by the Bid and the rates quoted therein for the orders awarded by the Institute up to the period prescribed in the Bid, which shall remain binding upon us.

Until a formal contract is prepared and executed, this Bid, together with your written acceptance thereof and your notification of award, shall constitute a binding Contract between us.

We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We understand that you are not bound to accept the lowest or any Bid you may

receive. Dated this ..... day of 2013

_____

(Signature) *(Name)* *(In the capacity of)*

Duly authorised to sign Bid for and on behalf of _____

FORMAT – 6.1.2

FORM 2

PROPOSAL FORM (PRICE PROPOSAL) (to be included in Price Proposal Envelope)

To:
Indian Institute of Tropcial Meteorology,
Dr. Homi Bhbha Road,
Pashan
Pune - 411008.

Dear Sir,

Ref.: Construction of HPC Data Centre

Having examined the Bidding Documents, the receipt of which is hereby duly acknowledged, we, the undersigned, offer to supply & deliver the solution for **HPC Data Centre ,** in conformity with the said Bidding documents for the sum of ..... *(Total Proposal amount in words and figures)* or such other sums as may be ascertained in accordance with the Schedule of Prices attached herewith and made part of this Proposal.

We undertake, if our Proposal is accepted, to deliver, install and commission the system, in accordance with the delivery schedule specified in the Schedule of Requirements.

We agree to abide by the Proposal and the rates quoted therein for the orders awarded by the Institute.

Until a formal contract is prepared and executed, this Proposal, together with your written acceptance thereof and your notification of award, shall constitute a binding Contract between us.

We undertake that, in competing for (and, if the award is made to us, in executing) the above contract, we will strictly observe the laws against fraud and corruption in force in India namely "Prevention of Corruption Act 1988".

We understand that you are not bound to accept the lowest or any Proposal you may

receive. Dated this ..... day of 2013

_____ _____

(signature) *(in the capacity of)*

Duly authorized to sign Proposal for and on behalf of _____

FORMAT 6.2

NON-DISCLOSURE AGREEMENT

WHEREAS, We, _____, having Registered Office at _____, hereinafter referred to as the "COMPANY", are agreeable to offering the **solution for HPC Data Centre** and Services to Indian Institute of Tropical Meteorology, , having its registered office at Dr. Homi Bhbha Road, Psahn, Pune -411008, hereinafter referred to as the "INSTITUTE" and,

WHEREAS, the COMPANY understands that the information regarding the Institute's HPC **Data Centre** shared by the INSTITUTE in their Request for Proposal is confidential and/or proprietary to the INSTITUTE, and

WHEREAS, the COMPANY understands that in the course of submission of the offer for the said HPC **Data Centre** and Services and/or in the aftermath thereof, it may be necessary that the COMPANY may perform certain jobs/duties on the Institute's properties and/or have access to certain plans, documents, approvals or information of the INSTITUTE;

NOW THEREFORE, in consideration of the foregoing, the COMPANY agrees to all of the following conditions, in order to induce the INSTITUTE to grant the COMPANY specific access to the INSTITUTE's property/information

The COMPANY will not publish or disclose to others, nor, use in any services that the COMPANY performs for others, any confidential or proprietary information belonging to the INSTITUTE, unless the COMPANY has first obtained the INSTITUTE's written Authorisation to do so;

The COMPANY agrees that notes, specifications, designs, memoranda and other data shared by the INSTITUTE or, prepared or produced by the COMPANY for the purpose of submitting the offer to the INSTITUTE for the said **HPC Data Centre** and Services, will not be disclosed to during or subsequent to submission of the offer to the INSTITUTE, to anyone outside the INSTITUTE

The COMPANY shall not, without the INSTITUTE's written consent, disclose the contents of this Request for Proposal (Bid) or any provision thereof, or any specification, plan, pattern, sample or information (to be) furnished by or on behalf of the INSTITUTE in connection therewith, to any person(s) other than those employed/engaged by the COMPANY for the purpose of submitting the offer to the INSTITUTE and/or for the performance of the Contract in the aftermath. Disclosure to any employed/engaged person(s) shall be made in confidence and shall extend only so far as necessary for the purposes of such performance.

Place Authorised Signatory
Date: Name: Designation: Office Seal:

FORMAT–6.3

Price Schedule Summary **Part I**

(Include in Price Bid Only–Not to be included in Technical Bid)

1	2		3	4
Sr. No.	**PARTICULARS**	**AMOUNT (USD, if any)**	**AMOUNT (RS)**	**REMARKS IF ANY**
1	CIVIL, INTERIOR & FURNITURE WORKS			
2	ELECTRICAL WORKS			
3	D.G SET			
4	STRUCTURED AND INTELLIGENT CABLING			
5	LV SYSTEM			
6	UPS SYSTEM			
7	PRECISION AC SYSTEM			
8	COMFORT AC SYSTEM			
9	OTHER SYSTEMS IF ANY			
10	OTHER SYSTEMS IF ANY			
11	OTHER SYSTEMS IF ANY			
12	**TOTAL BASIC COST OF ALL WORKS (1 TO 11)**			
13	LESS: -DISCOUNT OFFERED IF ANY			
14	**NET BASIC COST OF ALL WORKS POST DISCOUNT**			
15	ALL INDIDENTAL CHARGES, STATUTORY DUTIES & TAXES ETC.			
16	**TOTAL COST OF SYSTEM / ALL WORKS (14 + 15)**			
17	**ADD AMC AMOUNT FOR 3 YEARS**			
18	TAXES ON AMC COST			
19	**TOTAL COST OF AMC (17 + 18)**			
20	**GRAND TOTAL OF THE PROJECT (16 + 19)[FOR L-1 CRITERIA]**			

.(Applicable duties & tax structure may please be shown seperately in the BOQ of each individual item / work)

Signature of Bidder----------
Name ----------
Business address ----------
Seal ----------

Place:
Date :

FORMAT6.4
BID SECURITY FORM

Whereas 1 (hereinafter called "the Bidder") has submitted its bid dated (*date of submission of bid*) for the supply of _____ (*name and/or description of the goods*)(hereinafter called "the Bid").

KNOW ALL PEOPLE by these presents that WE _____(*name of bank*) of _____ (*name of the country*), having our registered office at _____ (*address of bank*)(hereinafter called "the Bank"), are bound unto_____ (*name of Purchaser*) (hereinafter called "the Purchaser") in the sum of _____ for which payment well and truly to be made to the said Purchaser, the Bank binds itself, its successors, and assigns by these presents. Sealed with the Common Seal of the said Bank this ___ day of 20___THE CONDITIONS of this obligation are:

1. If the Bidder withdraws it's bid during the period of bid validity specified by the Bidder on the Bid Form; or
2. If the Bidder, having been notified of the acceptance of it's bid by the Purchaser during the period of bid validity:
   a) fails or refuses to execute the Contract Form if required; or
   b) fails or refuses to furnish the performance security, in accordance with the Instruction to Bidders.

We undertake to pay the Purchaser up to the above amount upon receipt of its first written demand, Without· the Purchaser having to substantiate its demand, provided that in its demand the Purchaser will note that the amount claimed by it is due to it owing to the occurrence of one or both of the two conditions, specifying the occurred condition or conditions.

This guarantee shall remain in force up to forty five days after the period of the bid validity, and any demand in respect thereof should reach the Bank not later than the above date.

(Signature of the Bank)

Name of Bidder.

FORMAT6.5

CONTRACT FORM

THIS AGREEMENT made the .....day of....., 2013. Between .....*(Name of Purchaser)*(hereinafter called "the Purchaser")of the one part and ..... *(Name of Supplier)* of. ..... *(City and Country of Supplier)* (herein after called "the Supplier")of the other part:

WHEREAS the Purchaser invited Bids for certain Products and services viz., ... *(Brief Description of Products and Services)* and has accepted a Bid by the Supplier for the supply of those Products and services in the sum of ..... *(Contract Price in Words and Figures)* (Herein after called "the Contract Price").

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS:

1. In this Agreement words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract referred to.

2. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz.:

   a) the Bid Form and the Price Schedule submitted by the Bidder;

   b) the Bill of Material;

   c) the Technical & Functional Specifications;

   d) the Terms and Conditions of Contract;

   e) the Purchaser's Notification of Award;

   f) Schedule of Dates, Amounts etc. (SDA)

3. In consideration of the payments to be made by the Purchaser to the Supplier as hereinafter mentioned, the Supplier hereby covenants with the Purchaser to provide the Products and services and to remedy defects therein, in conformity in all respects with the provisions of the Contract.

4. The Purchaser hereby covenants to pay the Supplier in consideration of the provision of the Products and services 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 times and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with their respective laws the day and year first above written.

Signed, Sealed and Delivered by the

said..... (For the Purchaser)

in the presence of:.....

Signed, Sealed and Delivered by the

said ..... (For the Supplier)

in the presence of:.....

FORMAT 6.6

PERFORMANCE SECURITY FORM

To: _____(Name of Purchaser)

WHEREAS ..... (Name of Supplier) (hereinafter called "the Supplier") has undertaken, in pursuance of Contract No..... dated,..... 2008 to supply..... ..... (Description of Products and Services) (hereinafter called "the Contract").

AND WHEREAS it has been stipulated by you in the said Contract that the Supplier shall furnish you with a Bank Guarantee by a recognised Bank for the sum specified therein, as security for compliance with the Supplier's performance obligations in accordance with the Contract.

AND WHEREAS we have agreed to give the Supplier a Guarantee:

THEREFORE, WE hereby affirm that we are Guarantors and responsible to you, on behalf of the Supplier, up to a total of .... (Amount of the Guarantee in Words and Figures) and we undertake to pay you, upon your first written demand declaring the Supplier to be in default under the Contract and without cavil or argument, any sum or sums within the limit of ..... (Amount of Guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until the .....day of.....

Signature and Seal of Guarantors (Supplier's Bank)
.....

Date.....

.....
.....

Address:.....
.....
.....

FORMAT6.8

MANUFACTURERS'/PRODUCERS'AUTHORIZATIONFORM

No._____Date: To:

DearSir:

Ref: Construction of HPC DataCentre

We _____who are established and reputable manufacturers / producers of _____having factories / development facilities at _____(*address of factory / facility)* do hereby authorise M/s _____*(Name and address of Agent)* to submit a Bid, and sign the contract with you against the above Bid Invitation.

We hereby extend our full guarantee and warranty for the Solution, Products and services offered by the above firm against this Bid Invitation.

We also undertake to provide any or all of the following materials, notifications, and information pertaining to the Products manufactured or distributed by the Supplier :

(a) Such Products as the Institute may opt to purchase from the Supplier, provided, that this option shall not relieve the Supplier of any warranty obligations under the Contract; and

(b) in the event of termination of production of such Products:

i. advance notification to the Institute of the pending termination, in sufficient time to permit the Institute to procure needed requirements; and

ii. following such termination, furnishing at no cost to the Institute, the blueprints, design documents, operations manuals, standards, source codes and specifications of the Products, if requested.

We duly authorise the said firm to act on our behalf in fulfilling all installations, Technical support and maintenance obligations required by the contract.

Yours faithfully,

(Name)

(Name of Producers)

Note: This letter of authority should be on the letterhead of the manufacturer and should be signed by a person competent and having the power of attorney to bind the manufacturer. The Bidder in its Bid should include it.

FORMAT 6.9

PROFORMA OF CERTIFICATE FOR ISSUE BY THE PURCHASER AFTER SUCCESSFUL COMMISSIONING OF THE HPC DATA CENTRE

No. Date:

M/s.

Sub: Certificate of commissioning of Data centre

1. This is to certify that the products / equipment as detailed below has/have been received in good condition along with all the standard and special accessories (subject to remarks in Para No. 2) in accordance with the Contract/Specifications. The same has been installed and commissioned.

   a) Contract No._____dated _____ ___

   b) Description of the Solution _____

   c) Quantity _____

   d) Date of commissioning and proving test _____

2. Details of products not yet supplied and recoveries to be made on that account:

   S.No. Description Amount to be recovered

3. The proving test has been done to our entire satisfaction and Staff have been trained to operate the Product.

4. The Supplier has fulfilled his contractual obligations satisfactorily*

   or

   The Supplier has failed to fulfill his contractual obligations with regard to the following:

   (a)

   (b)

(c)

(d)

5. The amount of recovery on account of non-supply of Products is given under Para No.
2.

6. The amount of recovery on account of failure of the Supplier to meet his contractual obligations is as indicated in endorsement of the letter.

Signature _____

Name _____

Designation with stamp _____

* Explanatory notes for filling up the certificates:

(a) The supplier has adhered to the time schedule specified in the contract in dispatching the Products / Manuals pursuant to Technical Specifications.

(b) The supplier has supervised the commissioning of the solution in time i.e., within the period specified in the contract from the date of intimation by the Purchaser in respect of the installation of the Product.

(c) Training of personnel has been done by the Supplier as specified in the contract.

(d) In the event of Manuals having not been supplied or installation and commissioning of the Solution having been delayed on account of the Supplier, the extent of delay should always be mentioned.

****

FORMAT 6.10

MATRIX OF BID EVALUATION CRITERIA

BEC Clause	BID EVALUATION CRITERIA	COMPLIANCE
A.	Vital criteria for acceptance of bids: Is bidder has taken any exceptions/deviations in their bid? If yes, whether bidder has indicated specifically in their	 Yes/No Yes/No
B	**Rejection Criteria:**	
1	Whether the bid is complete & covering entire scope of job/supply as per the technical specifications?	Yes/No
1.1	Bidder should have the required facilities for installation, testing and commissioning data center facilities and agree that for inspection by Institute or any other agency nominated by Institute (at the bidder's cost if required)	Agreed/Not Agreed
1.2	Whether bidder has quoted separately for a comprehensive AMC for the data center and also for operational support	Yes/No
1.2.1	The prices quoted for Comprehensive AMC and Operational support for all the five year will be considered for price evaluation of bids.	Agreed/Not Agreed
1.2.2	Institute reserves the right to negotiate with the L1 bidder for the quotes received as well as the Comprehensive AMC and Operational support for all the three years and award the contract for AMC and Operational support accordingly.	Agreed/Not Agreed
1.3	Whether bidder will take up supply, installation and commissioning of system by themselves? If no, (i) Whether they have indicated the name of their partner i.e. system integrator in their techno-commercial bid? (ii) Whether bidder has submitted undertaking for full responsibility for the turnkey completion of the job and	Yes/No Yes/No Yes/No
1.3.1	Whether bidder has mentioned in their bid that they will handle the comprehensive AMC and operational support in post-one and half-year?	Yes/No Yes/No

1.4	Bidder should specifically confirm that the quoted products i.e. technology/supply is not in the process of being phased out. They should specifically confirm that the hardware/software/ technologies are the latest, meeting all the technical specifications and also shall be supported at least for a period of 5 years from date of supply	Agreed/Not Agreed
1.5	Technological Up gradation: Bidder may offer if they so desire, hardware/equipment which has better/improved technology, performance, technical specifications, at no extra cost to Institute. However, before such offers shall be benchmarked and approved by the Institute that they meet the intended for use of necessary application software with the better/improved technology.	Agreed/Not Agreed /Not applicable
1.6	Any deviation in the Quantities	Agreed/Not Agreed
1.8	Whether, the bidder and/or the aligned partners i.e. System Integrators have their registered office in Mumbai	Yes/No
2.0	**Eligibility and experience of the bidder:**	
2.1	Whether, bidder want to subcontract some of the jobs/services to any third party? If Yes, (i) Whether, bidder has mentioned the name of subcontractors in their technical bid? (ii) Whether, subcontractors i.e. system integrator satisfy all the conditions of technical bid (iii) The bidder should confirm unconditional acceptance of full responsibility of executing the 'Scope of work' of this tender including the work to be executed by subcontractors. This confirmation should be submitted along with the techno-commercial bid. (iv) Whether, bidder has submitted necessary documents establishing tie up with the sub contractors in their techno-commercial bid? (v) Whether, bidder has submitted an	Yes/No Yes/No Yes/No Agreed/Not agreed Yes/No Yes/No

	undertaking in the techno-commercial bid that they shall be jointly & severally liable to and for all the actions of the sub contractors?	
3.	Training of Engineers: Specialist Trainings like Server Administration, Network management, router programming for maintenance of the Data Center are required. Bidder should agree to provide specialist training to the Institute without any extra cost.	Agreed/Not Agreed
B.2	Commercial rejection criteria:	
1	Whether bid has been submitted in two bid system as per tender document?	Yes/No
2.0	Whether, bidder has accepted all the terms & conditions of the tender document in toto?	Yes/No
3.	(a) Whether bidder has submitted bid security (E.M.D) as per tender? (b) Whether bid validity is 90 days? (c) Whether quoted prices are firm during the entire period of contract? (d) Whether quoted prices are as per the price format of the tender document? (e) Whether, bidder has accepted mobilization/delivery as per tender document? (f) Whether, bidder has accepted the contract period?	Yes/No Yes/No Yes/No Yes/No Yes/No Yes/No
4.0	Bidder shall bear, within the quoted rates, all the applicable taxes arising out of this contract.	Agreed/Not agreed
C.	**Price Evaluation Criteria**	
1.0	Evaluation of bids: The bids shall be compared based on the total package evaluated contract price which shall be worked out by summing up the evaluated contract price as per price format considering total contract values. Payments will be made as per the guidelines stipulated	Agreed/Not agreed Agreed/Not agreed

	The Contractor has filled up all the relevant technical evaluation sheets in the attached technical specifications with this document and they meet all the stipulated technical criteria's as desired by the Institute.	Agreed/Not agreed
D	**General**	
1	Any other points arise during the tender/contract will be decided by Institute	Agreed/Not agreed
2	Institute reserves the right to reject any or all bidders at any time without assigning any reasons	Agreed/Not agreed

FORMAT6.11

Service Support Details Form

City/ Location	Postal Address, Telephone, Fax, E-Mail and Contact Details of Support Personnel	OfficeWorking Hours (Please mention whether the Support Agency is Owned or Franchisee arrangement)	Number of Software / Hardware Engineers capable of supporting the system being offered	Ownedor Franchisee.

****

FORMAT6.12

FORMAT FOR BANK GUARANTEE AGAINST ANNUAL MAINTENANCE (ON NON-JUDICIAL STAMP PAPER OF APPROPRIATE VALUE)

Bank Guarantee No.:.....

Date:.....To.....

.....(Name of the Purchaser)

Whereas ..... (Name of the Supplier) hereinafter called "the Supplier" has undertaken,in pursuance of contract No..... dated..... to supply..... (Description of Products and Services) hereinafter called"the Contract".

AND WHEREAS it has been stipulated by you in the said contract that the Supplier shall furnish you with a Bank Guarantee by a recognized Bank for the sum specified therein as security for compliance with the Supplier's performance obligations under the contract for Annual Maintenance and Repairs of the entire system including cost of spares after warranty period for next three years.

AND WHEREAS we have agreed to give the Supplier a Guarantee.

THEREFORE WE hereby affirm that we are Guarantors and responsible to you on behalf of the Supplier, up to a total of Rs. ..... (Amount of guarantee in words and figures) being 10% of the Contract Price and we undertake to pay you, upon your first written demand declaring the Supplier to be in default under the contract and without cavil or argument, any sum or sums within the limit of Rs. ..... (Amount of guarantee) as aforesaid, without your needing to prove or to show grounds or reasons for your demand or the sum specified therein.

This guarantee is valid until ..... day of ....

Signature and Seal of Guarantors

.....

.....

Date: ....

NOTE:

1. SUPPLIERS SHOULD ENSURE THAT SEAL AND CODE NO. OF THE SIGNATORY IS PUT BY THE BANKERS, BEFORE SUBMISSION OF THE BANK GUARANTEES.

2. STAMP PAPER IS REQUIRED FOR THE BANK GUARANTEES ISSUED BY THE BANK LOCATED IN INDIA

FORMAT6.13

Pre Contract Integrity Pact

General

This pre-bid-contract Agreement (hereinafter called the Integrity Pact) is made on _____day of the month of _____ 2010, between, on one hand, the Director IITM, Pune acting through Shri _____, Designation of the officer, Ministry/ Department, Government of Indian (hereinafter called the 'BUYER", which expression shall mean and include, unless the context otherwise required, his successors in office and assigns) of the First Part and M/s _____represented by Shri_____, Chief Executive Officer (hereinafter called the 'BIDDER/Seller" which expression shall mean and include, unless the context otherwise requires, his successors and permitted assigns) of the Second Part.

WHEREAS the BUYER proposes to procure (Name of the Stores/Equipment/Item) and the BIDDER /Seller is willing to offer/has offered the stores and

WHEREAS the BIDER is private company / public company / Government undertaking / partnership / registered export agency, constituted in accordance with the relevant law in the matter and the BUYER is a Ministry / Department of the Government of India / PSU performing its functions on behalf of the President of India

NOW, THEREFORE,

To avoid all forms of corruption by following a system that is fair, transparent and free from any influence/prejudiced dealings prior to, during and subsequent to the currency of the contract to be entered into with a view to :-

Enabling the BUYER to obtain the desired said stores/equipment at a competitive price in conformity with the defined specifications by avoiding the high cost and the distortionary impact of corruption on public procurement, and

Enabling BIDDERs to abstain from bribing or indulging in any corrupt practice in order to secure the contract by providing assurance to them that their competitors will also abstain from bribing and other corrupt practices and BUYER will commit to prevent corruption, in any form, by its officials by following transparent procedures.

The parties hereto agree into this Integrity Pact and agree as follows :-

Commitments of the BUYER

1.1 The BUYERE undertakes that no official of the BUYER, connected directly or indirectly with the contract, will demand, take a promise for or accept, directly or through intermediaries, any bribe, consideration, gift, reward, favour or any material or immaterial benefit or any other advantage from the BIDDER, either for themselves or for any person, organization or third

party related to the contract in exchange for an advantage in the bidding process, bid evaluation, contracting or implementation process related to the contract.

1.2 The BUYER will, during the pre-contract stage, treat all BIDDERS alike, and will provide to all BIDDERs the same information and will not provide and such information to any particular BIDDER which could afford an advantage to that particular BIDDER in comparison to other BIDDERs.

1.3 All the officials of the Buyer will report the appropriate Government office any attempted or completed breaches of the above commitments as well as any substantial suspicion of such a breach.

2. In case any such preceding misconduct on the part of such official(s) is reported by the BIDDER to the BUYER with full and verifiable facts and the same is prima facie found to be correct by the BUYER, necessary disciplinary proceedings, or any other action as deemed fit, including criminal proceeding, or any other action as deemed fit, including criminal proceedings may be initiated by the BUYER and such a person shall be debarred from further dealings related to the contract process. In such a case while an enquiry I being conducted the BUYER the proceedings under the contract would not be stalled.

Commitments of BIDDERs

3. The BIDDER commits itself to take all measures necessary to prevent corrupt practices, unfair means and illegal activities during any stage of its bid or during any pre-contract stage in order to secure the contract or in furtherance to secure it and in particular commit itself to the following :-

3.1 The BIDDER will not offer directly or through intermediaries, any bribe, gift, consideration, reward, favor, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER, connected directly or indirectly with the bidding process, or to any person, organization or third party related to the contract in exchange for any advantage in the bidding, evaluation, contracting and implementation of the contract.

3.2 The BIDDER further undertakes that it has not given, offered or promised to give, directly or indirectly any bribe, gift, consideration Reward, favor, any material or immaterial benefit or other advantage, commission, fees, brokerage or inducement to any official of the BUYER or otherwise in procuring the Contract or forbearing to do so having done any act in relation to the obtaining or execution of the contract or any other contract with the Government for showing or forbearing to show favor or disfavor to any person in relation to the contract or any other contract with the Government.

3.3* BIDDERs shall disclose the name and address of agents and representatives and Indian BIDDERs shall disclose their foreign principals or associates.

3.4* BIDDERs shall disclose the payments to be made by them to agents/brokers or any other intermediary, in connection with this bid/contract.

3.5* The BIDDER further confirms and declares to the BUYER that the BIDDER is the original manufacturer/integrator/authorized government sponsored export entity of the defense stores and has not engaged any individual or firm or company whether Indian or foreign to intercede, facilitate or in any way to recommend to the BUYER or any of its functionaries, whether officially or unofficially to the award of the contract to the BIDDER, nor has any amount been paid, promised or intended to be paid to any such individual, firm or company in respect of any such intercession, facilitation or recommendation.

3.6* The BIDDER, either while presenting the bid or during pre-contract negotiations or before signing the contract, shall disclose any payments he has made, is committed to or intends to make to officials of the

BUYER or their family members, agents, brokers or any other intermediaries in connection with the contract and the details if services agree upon for such payments.

3.7 The BIDDER will not collude with other parties interested in the contract to impair the transparency, fairness and progress of the bidding process, bid evaluation, contracting and implementation of the contract.

3.8 The BIDDER will not accept any advantage in exchange for any corrupt practice, unfair means and illegal activities.

3.9 The BIDDERS shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information provided by the BUYER as part of the business relationship, regarding plans, technical proposals and business details, including information contains in any electronic data carrier. The BIDDER also undertakes to exercise due and adequate care lest any such information is divulged.

3.10 The BIDDER commits to refrain from giving any complaint directly or through any other manner without supporting it with full and verifiable facts.

3.11 The BIDDER shall not instigate or cause to instigate any third person to commit any of the action mentioned above.

3.12 If BIDDER or any employee of the BIDDER or person acting on behalf of the BIDDER, either directly or indirectly, is a relative of any of the officers of the BUYER, or alternatively, if any relative of an officer of the BUYER has financially interested/stake in the BIDDER's firm, the same shall be disclosed by the BIDDER at the time of filling of tender.

The term 'relative' for this purpose would be as define in Section 6 of the Companies Act 1956.

3.13 The BIDDER shall not lend to or borrow any money from or entire into any monetary dealings or transactions, directly or indirectly, with any employee of the BUYER.

4. Previous Transgression

4.1 The BIDDER declares that no previous transgression occurred in the last three years immediately before signing of this Integrity Pact, with any other company in any country in respect of any corrupt practices envisaged hereunder or with any Public Sector Enterprise in India or any Government Department in India that could justify BIDDER's exclusion from the tender process.

4.2 The BIDDER agrees that if it makes incorrect statement on this subject BIDDER can be disqualified from the tender process or the contract, if already awarded, can be terminated for such reason.

5. Earnest Money (Security Deposit)

5.1 While submitting commercial bid, the Bidder shall deposit an amount _____ (to be specified in RFP) as Earnest Money/ Security Deposit, with the BUYER through any of the following instruments:

i) Bank Draft or a Pay Order in favor of _____

ii) A confirmed guaranteed by an Indian Nationalized Bank. Promising payment of the guaranteed sum to the BUYER on demand within three working days without any demur whatsoever and without seeking any reason whatsoever. The demand for payment by the BUYER shall be treated as conclusion proof of payment.

iii) Any other mode or through any other instruments (to be specified in the RFP).

5.2 The Earnest Money/ Security Deposit shall be valid upto a period of six months or the complete conclusion of the contractual obligation to the complete satisfaction of the both the BIDDER and the BUYER, including warranty period, whichever is later.

5.3 In case of the successful BIDDER a clause would also be incorporated in the Article pertaining to performance Bond in the Purchase Contract that the provisions of Sanctions for Violation shall be applicable for forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

5.4 No interest shall be payable by the BUYER to the BIDDER on Earnest Money/Security Deposit for the period of its currency.

6. Sanction for Violations

6.1 Any breach of the aforesaid provisions by the BIDDER or any on employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER) shall entitled the BUYER to take all or any one of the following actions, wherever required:

i) To immediately call off the pre contract negotiations without assigning any reason or giving any compensation to the BIDDER. However, the proceedings with the other BIDDER(s) would continue.

ii) The Earnest Money (in pre-contract stage) and/or Security Deposit/ Performance Bond (after the contract is signed) shall stand forfeited either fully or partially, as decided by the BUYER and the BUYER shall not be required to assign any reason thereof.

iii) To immediately cancel the contract. If already signed, without giving any compensation to the BIDDER.

iv) To recover all sums already paid by the BUYER, and in case of an Indian BIDDER with interest thereof at 2% higher that the prevailing Prime Lending Rate of State Bank of India, while in case of a BIDDER from a country other than India with interest thereon at 2% higher than the LIBOR. If any outstanding payment is due to the bidder from the BUYER in connection with any other contract for any other stores, such outstanding payment could also be utilized to recover the aforesaid sum and interest.

v) To encash the advance bank guarantee and performance bond/warranty bond, if furnished by the BIDDER, in order to recover the payments, already made by the BUYER, along with interest.

vi) To cancel all or any other Contracts with the BIDDER. The BIDDER shall be liable to pay compensation for any loss or damage to the BUYER resulting from such cancellation/rescission and the BUYER shall be entitled to deduct the amount so payable from the money(s) due to the BIDDER.

vii) To debar the BIDDER from participating in future bidding processes of the Government of India for a minimum period of five years, which may be further extended at the discretion of the BUYER.

Viii) To recover all sums paid in violation of this Pact by BIDDER(s) to any middleman or agent or broker with a view to securing the contract.

ix) in case where irrevocable Letters of Credit have been received in respect of any contract signed by the BUYER with the BIDDER, the same shall not be opened.

(x) Forfeiture of Performance Bond in case of a decision by the BUYER to forfeit the same without assigning any reason for imposing sanction for violation of this Pact.

6.2 The BUYER will be entitled to take all or any of the actions mentioned at para 6.1 (i) to (x) of this Pact also on the Commission by the BIDDER or any one employed by it or acting on its behalf (whether with or without the knowledge of the BIDDER), of an offence as defined in Chapter IX of the Indian Penal Code, 1860 or Prevention of Corruption Act, 1988 or any other statute enacted for prevention of corruption.

6.3 The decision of the BUYER to the effect that a breach of the provisions of this Pact has been committed by the BIDDER shall be final and conclusive on the BIDDER. However, the BIDDER can approach the Independent Monitor(s) appointed for the purposes of this Pact.

7. Full Clause

7.1 The BIDDER undertakes that it has not supplied/is not supplying similar product/systems or subsystems at a price lower than that offered in the present bid in respect of any other Ministry/Department of the Government of India or PSU and if it is found at any stage that similar product/systems or sub systems was supplied by the BIDDER to any other Ministry/Department of the Government or India or a PSU at a lower price, then that very price, with due allowance for elapsed time, will be applicable to the present case and the difference in cost would be refunded by the BIDDER to the BUYER, if the contract has already been concluded.

8. Independent Monitors

8.1 The BUYER has appointed Independent monitors (hereinafter referred to as Monitors) for this Pact in consultation with the Central Vigilance Commission (Names and Addresses of the Monitors to be given).

8.2 The task of the Monitors shall be to review independently and objectively, whether and to what extent the parties comply with the obligations under this Pact.

8.3 The Monitors shall not be subject to instructions by the representatives of the parties and perform their functions neutrally and independently.

8.4 Both the parties accept that the Monitors have the right to access all the documents relating to the project/procurement, including minutes of the meetings.

8.5 As soon as the Monitor notices, or has reason to believe, a violation of this Pact, he will so inform the Authority designated by the BUYER.

8.6 The BIDDER(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the BUYER including that provided by the BIDDER. The BIDDER will also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to his project documentation. The same is applicable to Subcontractors. The Monitor shall be under contractual obligation to treat the information and documents of the BIDDER/Subcontractor(s) with confidentiality.

8.7 The BUYER will provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the parties. The parties will offer to the Monitor the option to participate in such meetings.

8.8 The Monitor will submit a written report to the designated Authority of the BUYER/Secretary in the Department/ within 8 to 10 weeks from the date of reference or intimation to him by the BUYER / BIDDER and, should the occasion arise, submit proposals for correcting problematic situations.

9. Facilitation of Investigation

In case of any allegation of violation of any provisions of this Pact or payment of commission, the BUYER or its agencies shall be entitled to examine all the documents including the Books of Accounts of the BIDDER and the BIDDER shall provide necessary information and documents in English and shall extend all possible help for the purpose of such examination.

10. Law and Place of Jurisdiction

This Pact is subject to Indian Law. The place of performance and jurisdiction is the seat of the BUYER.

11. Other Legal Actions

The actions stipulated in this Integrity Pact are without prejudice to any other legal action that may follow in accordance with the provisions of the extant law in force relating to any civil or criminal proceedings.

12. Validity

12.1 The validity of this Integrity Pact shall be from date of its signing and extend upto 5 years or the complete execution of the contract to the satisfaction of both the BUYER and the BIDDER/Seller, including warranty period, whichever is later. In case BIDDER is unsuccessful, this Integrity Pact shall expire after six months from the date of the signing of the contract.

12.2 Should one or several provisions of this Pact turn out to be invalid, the remainder of this Pact shall remain valid. In this case, the parties will strive to come to an agreement to their original intentions.

13. The parties hereby sign this Integrity Pact at _____on _____

BUYER	BIDDER
Name of the Officer	
Designation	
Deptt./Ministry/PSU	
Witness	Witness
1. _____	1. _____
2. _____	2. _____

*Provisions of these clauses would need to be amended/deleted in line with the policy of the BUYER in regard to involvement of Indian agents of foreign suppliers.

FORMAT6.14

ORGANISATIONAL PROFILE

(Include in Technical Proposal Only – Not to be included in Price Proposal)

CONSTITUTION 1. Proprietary 2. Partnership 3. Private Ltd. 4. Public Ltd.	:		
Established since Commercial Production of the solution on Offer started since	: :		
Address of Registered Office	:		
Category	:	i. Software Producer / Developer (Principal) ii. Hardware Manufacturer (Principal) iii. System Integrator / Solution Provider (Third-party) iv. Any Other (*please specify*)	
		Name	**Phone Nos. (With STD Codes)**
Names of Proprietor/Partners/ Directors	:	1.	
		2.	
		3.	
		4.	
		5.	
Number of Engineers familiar with the solution being offered	:		
Number of Total Employees	:		

Date: **Signature of Bidder: _____**

Place **Name: _____**

Business address: _____

DATA CENTRE – B

Scope of Work

1.0 Overview

As a part of this RFP, NCMRWF will build its own Captive Data Centre at Noida, UP to host its high density servers.

The overall broad Scope of Work (SoW) for the DC Bidder or DC Turnkey Partner (DCTP) includes the following:-

(i) Design and Site Preparation of the proposed Data Centre in terms of the civil, electrical, Safety & Security System and mechanical work required to build the Data Centre including false ceiling, raised flooring, moisture sealing and fortification of the windows and all other necessary components.

(ii) Supply, installation and setting up of the Data Centre basic Infrastructure (HT Panel, Transformer, and Air-Conditioning System, Fire Prevention, Detection and Suppression System, Diesel Generator Units, Lightings, , Power Panels (HT/LT System), Power Cabling, BMS management system etc.

(iii) Five years on-site maintenance of all the equipments and their components supplied in setting up the basic infrastructure in the proposed Data Centre.

(iv) The scope of work does not include the supply of UPS and its low side work. The UPS requirement mentioned in this document is only for completeness.

(v) Onsite support for Data Centre Infrastructure Operations on 24*7*365 basis by qualified engineers/ personnel for a period of five years to ensure at least 99.982% uptime on a monthly basis.

Phases

The project is divided in three phases as per following:-

(i) Phase-1 (Design and approval)

(ii) Phase-2 (Implementation and Acceptance)

a) Design, Engineering, Construction Drawings
b) Material Ordering & Pre-Dispatch Inspection
c) Material Delivery
d) Installation and Commissioning
e) Handover and Documentation

(ii) Phase-3 (O&M)

2.0 Data Centre Work/Sub-Work Packages

The bidder shall design, implement, operate & maintain the complete data Centre physical infrastructure (Non-IT) and its support facility for following Work Packages/ Sub-Packages as per RFP requirements and shall include all the statuary approvals as applicable.

S No	Work/Sub-Work Package Component Description
1	Electrical System Work Package
1a	**Electrical Distribution**
i	HT Distribution Panels and System (HT Breakers, panels, Battery chargers, cables etc)
ii	HT Distribution - HT Cable and other low side works
iii	HT Transformers
iv	HT Transformers Low Side Works
v	LT Distribution Panels- Electrical Panels such as DG Panels, LT Main Panels, DG changeover Panels, Capacitor Panels, HVAC Electrical Panels, CRAC Units Electrical Panels, Electrical Panels and distribution boards for Lighting , Electrical Panels for other utility services for Data Center requirement etc
vi	BUS-Bar Trucking complete with flexible, flanges, connectors, mounting support, canopy, accessories etc (i) Main HT Transformer to Main LT Panels (ii) DG Sets to Main DG panels, change over Panels, APFC, Transformer tap changing panels
vii	Electrical LT power Distribution- LT power cables and control Cables
viii	Electrical LT power Distribution low side works-Cable tray, tray support, race ways, fixing accessories etc
ix	Earthing Pits, Earthing Strips and Earthing grid
x	Lighting fixtures
xi	Others- TVSS, Static Switch, First Aid Box, Shock treatment chart, No Smoking Board, Electric caution Board, Rubber Mat for Each Electrical Panel of suitable specification etc
	DG Systems
i	DG System
ii	DG System Low side Works- day oil tanks, Canopy, Exhaust Structure, Fencing, cabling ,Piping, Sand Buckets, Fire Extinguisher, etc
iii	DG Bulk storage tank of 50KL with all low side pumps and piping and automated controls and sensing. Necessary explosive and CCOE Nagpur approval to be considered.
2	HVAC WORK PACKAGE
1	Air cooled chillers

	Air Cooled Chillers low side works piping, controls, primary & secondary pumps, valves as per design etc Water Softening Plant for chilled Water
	Data Center Precision Air-conditioning
	Precision-Air conditioners units for Medium density cooling and room cooling and humidity control (Dx or CW based) along with low side work
2c	**Chemical Air Fliter**
i	To maintain a positive pressure and contamination filtration feature
2d	**Very High Density Cooling (Rear Door Heat Exchanger)**
i.	Rear Door Heat Exchanger (RDHx) with Dedicated Chillers. *RDHx will come fitted with the servers*
ii.	Necessary Low side work like CW pipelines, butterfly valves, insulations, manifold, flex piping, CDUs etc as applicable as per the designed scheme
3.	**Civil and Interior**
	Civil Works- Walls Partition, Wall Finishes, Doors, Ceilings, Civil foundation for the chiller, pumps and pannels etc
	Furniture for BMS room, stores etc
4	Fire and security
4a	**Safety System**
	Hand Held Extinguishers
	VESDA/Aspirating Smoke Detection System
4b	**Security Systems**
	Access Control System
	IP CCTV system
	Water leak detection system
	Rodent Repellant
4c	**Integrated building Management System with 5 Client user system**
4d	**Help Desk Support System with minimum 5 users access license**

3.0 Data Centre Space Estimation

Zone A: Total DC White Space Indoor

- IT Server room
- PAC units
- PDUs
- **Area:** Approx~1400 sq ft
- **Location**: Ground Floor

Zone B

Support Area Indoor
Electrical, UPS, Battery, BMS room
Location: Ground Floor

Zone C

Utility Substation Area

- Transformers, HT panel, Synch Panel, Change over panel
- RMU will be placed in HT metering cubicle.

The new equipment need to place along with the existing panels.

4.0 DESIGN GUIDELINES

Area Statement

S.NO.	ROOM DESCRIPTION	L (IN MT)	W (IN MT)	(AREA IN SQ.METER)	(AREA IN SQ.FT)
1	SERVER RM. (P1) New Server Hall	10.76	10.76	115.78	1245.77
2	SERVER RM. (P2)	5.8	2	11.60	124.82
	TOTAL CARPET AREA			11.60	1370.58

4.1 Load sheet

Server load

Power Calculation for proposed HPC Infrastructure at NCMRWF			
Component	**Qty**	**Label Rated Power[in W]**	**Total Label rated Power [in W]**
IBM System x iDataPlex dx360 M4 - Compute	**1052**	**384.5**	**404494**
IBM System x3650 M4 - Login / Master	**4**	**546**	**2184**
IBM System x3550 M4 – Cluster Management	**6**	**335.2**	**2011.2**
IBM System x3550 M4 – Fabric Management	**3**	**335.2**	**1005.6**
IBM System x3650 M4 – Utility	**8**	**506.8**	**4054.4**
IBM System x3650 M4 – Backup	**4**	**506.8**	**2027.2**
IBM GSS Building Block	**5**	**9000**	**45000**
IBM TS3500 Tape Library Main Enclosure	**1**	**785**	**785**
IBM TS3500 Tape Library Expansion Enclosure	**6**	**710**	**4260**
Mellanox 36 Port FDR14 Managed Switch	**63**	**126**	**7938**
Mellanox 648 Port FDR14 Switch	**2**	**5500**	**11000**
IBM SAN Cisco MDS 9148	**6**	**100**	**600**

IBM BNT 1Gb Ethernet Rack Swicth	**29**	**150**	**4350**
KVM Switch + TFT Panel	**1**	**140**	**140**
Total Power Consumption [in kW]			**489849.4**

Total Load in kW: 490

DG and Transformer Requirement

DG Capacity for Data centre		
S No	**Load Description**	**Load in KVA**
1	UPS Load	1166
2	PAC Load	292
3	Miscellaneous	10
	Total	1468.10
	DG Efficiency and derate factors	1835.13
	DG Capacity Factored as per Site Requirement	**2000 kVA x 2 No.s**
	Transformer capacity Facored as per Site requirement	**2000 kVA x 2 No.s**

Cooling calculation

DESCRIPTION	(AREA IN SQ.FT)	UPS Loads in KW	Loads in TR from UPS loads	Load in TR due to Area	Total TR	Type of Cooling
Server Load		489.85	139.20		139.20	Water Type
Humidification Load		48.98	13.92		13.92	Air Side
Space cooling	1370.58			6.85	6.85	Air Side

Chiller capacity shall be 140 Tr actual
PAC shall be 20 Tr actual for Humidification and space cooling.

Redundancy Levels

HVAC System

S. No.	Package	Redundancy
1.	Chillers	N+1
2.	Pumps	N+1
3.	Piping	DualPiping
4.	Power Distribution	N+N
5.	PACs	N+1

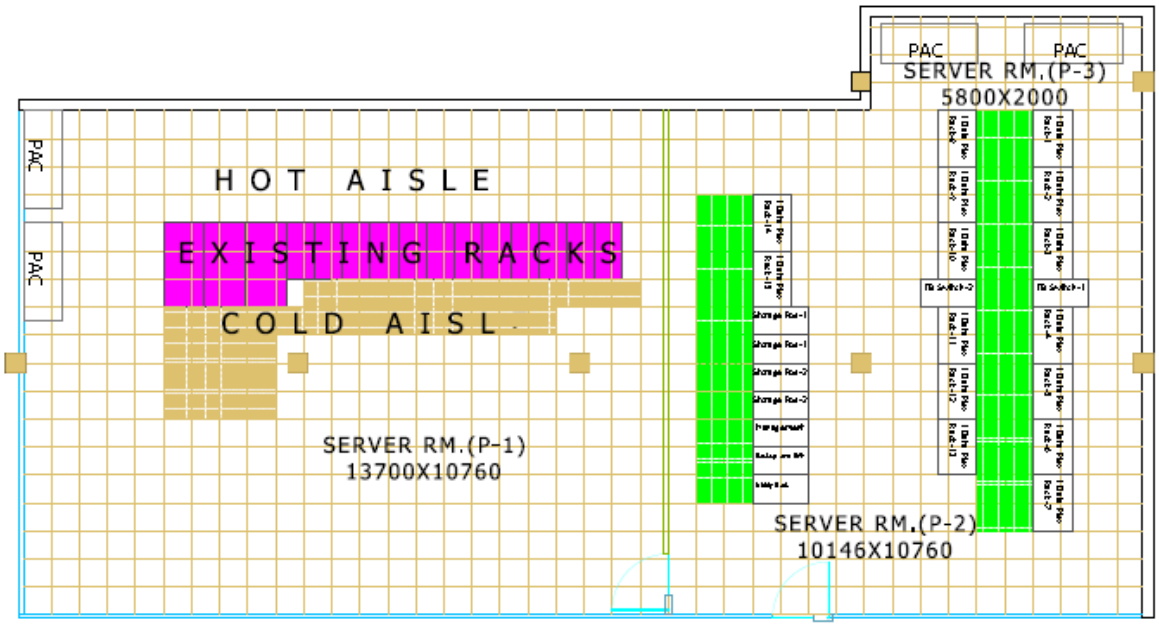
Electrical System

S. No.	Package	Redundancy
1.	DG Set	N+1
2.	Transformer	N+1
3.	LT panel	N+1
4.	UPS	N+N
5.	Rack Supply	N+N

4.3 Minimum Design Scope of Requirement

Civil & Interior

Indicative layout



- **Ground Floor**
  - Available height between slab to slab: 3900 mm
  - Raised Floor 600 mm
  - False Ceiling 600 mm
  - Room Void 2700 mm

- **Doors**
  - Door size Clear Width and height for rack movement (Not Less than): 1300mm(w)x2400mm (H)
- **Fire rated Partitions**
  - Fire rated partitions/doors in complete DC : 2 hours
  - Fire rated glass in DC : 2 hours
  - Fire rated doors in complete DC: 2 hours
- **Utility Room**
  - Epoxy paints on floors
  - Fire rated paints on walls

Structure and Foundation Works: DG Set, Buffer Tank, Chiller Units, Transformer, HT Panel, LT Panel.

Civil Works: closing of existing windows, painting and punning to match the existing shade.

Interior works; Opening of false ceiling for approx. 500 sq. ft for full height partition and closing it again in as is condition

Opening of false Floor for approx. 500 sq. ft for cable trays installation and full height partition work and closing it again in as is condition.

Fire rated Door for existing server hall.

4.3 Security

- System battery backup : battery (8 hours min)
- Data gathering Panels: battery (24 hours min)
- Access control : Minimum 8 hours battery backup
- WLD, CCTV: Min 8 hours

4.3.1 Access control

- Generators : Card Access (in & out)
- UPS & MEP rooms: Card Access (in and out)
- Emergency exit doors: delay egress per code
- BMS room : Card access (In and out)
- Server room: Biometric access + PIN+ Card (In & out)
- Perimeter building doors Card access (in & out)

4.3.2 CCTV Monitoring

- Generators : Outdoor CCTV
- All Access controlled Doors and emergency exits: CCTV
- Server room Floor(entry/exits and cold aisles): CCTV
- Utility room (entry/exit and in different sections viz battery , UPS and LT panel):: CCTV
- CCTV Type: IP based
- CCTV recording on all cameras: Digital
- Recording rate: 20 frames/sec(min)
- Video storage: 1 month

4.3.3 Rodent Repellent System

Ultrasonic Frequency sound wave based system in the Server Room area.

4.3.4 Water Leak detection System

Water Leak Detection system is proposed for the Server room to detect and water flooding below the floor of the DC.
This is wire based solution with alarm, the wire needs to laid in DC surrounding the PAC units, which is the probable source of water leakage.

4.4 Building management System

BMS shall monitor mechanical, electrical and other facility equipment. Capable of local and remote monitoring and operation. Controlling building system as well as historical trending. BMS to have feature to record Real time PUE and historical trending. It should also integrate with the HSD storage tank being set up by NCMRWF separately.

System to be designed to have minimum IO points as given below:

Powder coated Cable trays to be used for all the cables for CCTV, F&S system.

4.5 HVAC

Server Room and Medium density server cooling: Precision AC designed at 43.3 deg C ambient. It should be ensured that CRAC should also work at inlet air temp upto 32 deg C. Minimum Net sensible Tonnage required is 20 TR. PAC to be supplied with necessary Humidity/dehumidify units.

High density server cooling: Rear door heat exchanger. The RDHx will become fitted with the high density servers.

Chillers: Air cooled with minimum capacity (actual) to be 140 **TR** designed at 43.3 Deg C ambient temperature with quick start feature. Chiilers to come to full load

HVAC System: RDHx water temperature is to be maintained 2 deg C above room dew point. The complete system should take care of complete integrated cooling upto the RDHX. The bidders should design system so that required flow rates and inlet water temperatures are achieved for required cooling.

The HVAC system should be designed with dual piping and for concurrent maintainability.

The electrical system for HVAC upto the chillers, pumps and CRAC units should be 2N.

The chillers should be operated through dedicated Chiller plant manager with connectivity to BMS for read only data.

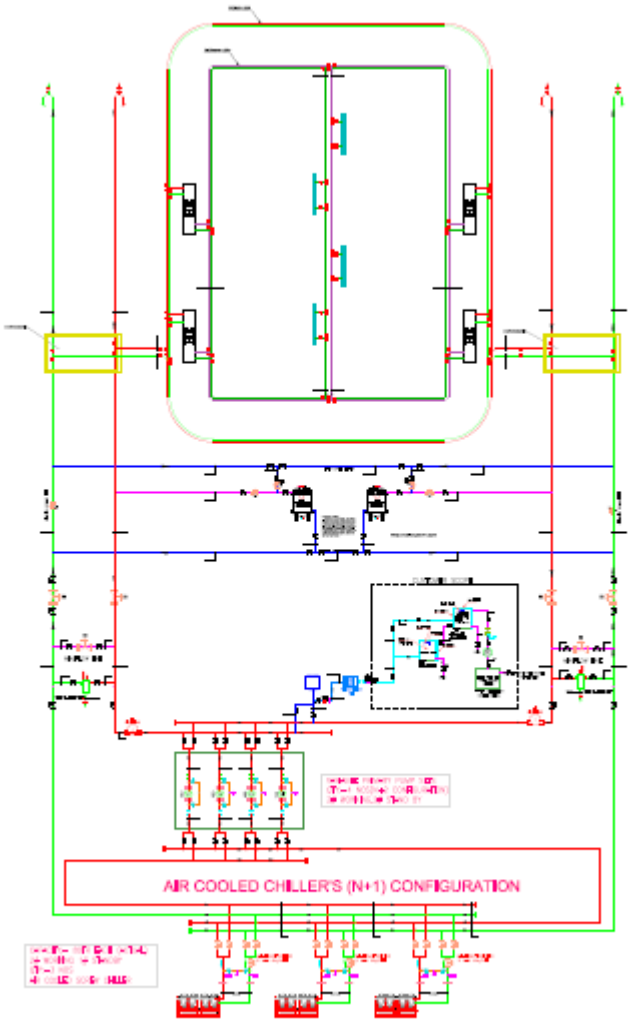
The CW pumps should be with VFD and PUMP Motors to be NEMA Class 1 Premium efficiency. All VFD panels or any other HVAC electrical panels etc should be suitable for outdoor placements. The bidders are required to design the outdoor panels keeping this condition.

The bidders to consider the steel platform for the chillers.

Thermal storage tank of 10 minutes to be factored. The system should have closed loop expansion tank.

Pumps should be in N+2 redundancy.
Floor grills for tap library should have fans for proper flow of air.

The tentative high level HVAC single line diagram is given in Annexure 2 is given below for bidders to give an idea:



SERVER ROOMSCHEMATIC PLAN

It is to be noted that chillers and storage tanks will be placed at ground floor and the pipes will have to be taken upto the DC floor (ground Floor). The bidders to factor buried CW piping.

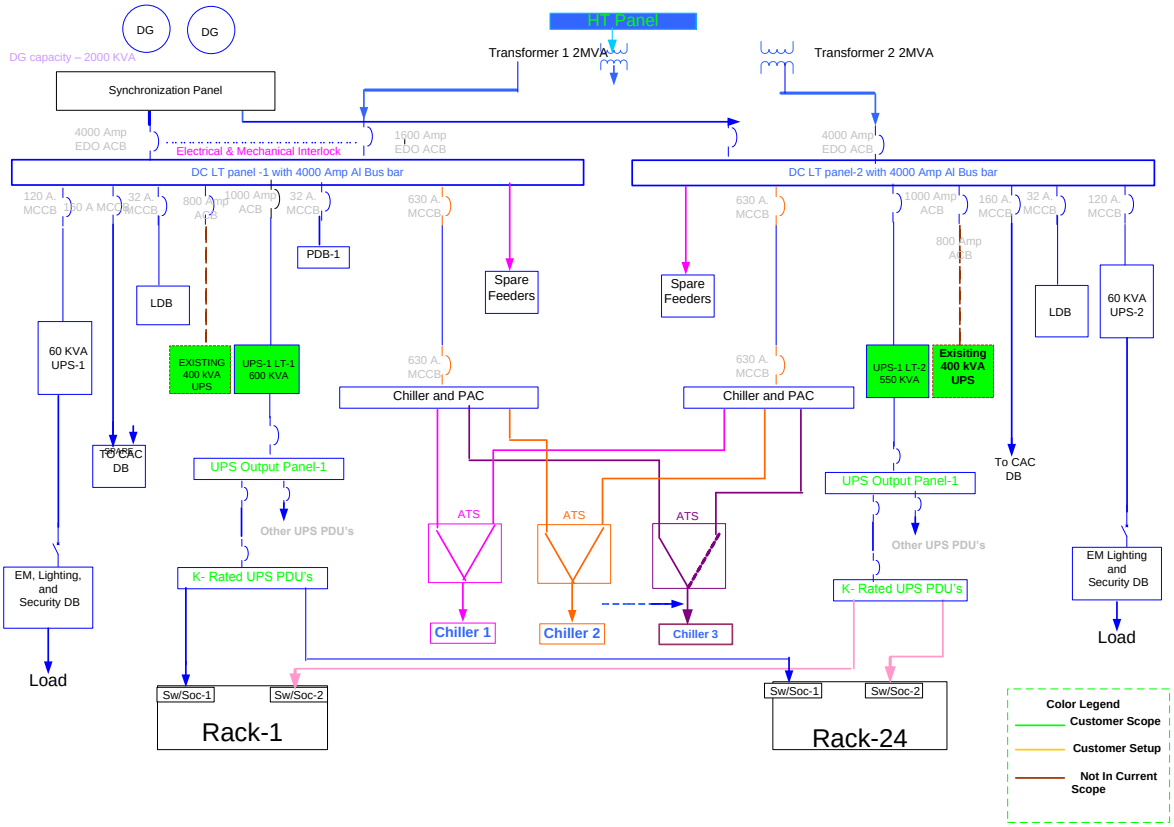
Air Filter

1. Filter Chemical Scrubber
2. Positive Air Pressurization

4.9 ELECTRICAL SYSTEM

Following are broad guidelines:

The high level indicative Electrical Scheme is attached for only reference for bidders in **Annexure 3.**



System to allow concurrent maintenance.

TVSS to be put in all panels except lighting panels.

Dual feed for server racks through IEC connectors.

Electrical Distribution:

- HT panel to Transformer: HT Cables
- Transformer to LT change over Panel: AL Bus Duct (Outdoor/Indoor)
- DG set to Main DG panels: Al Bust duct (outdoor/indoor type)
- LT change over panel to Main LT panel: Al XLPE cable
- LT Main panel to HVAC panels: AL XLPE cables
- HVAC Panel to power distribution up to CRAC : Al Copper PVC armoured cables
- Power Distribution-others, miscellaneous: Al or copper which is logical and consistent with overall design and distribution.
- Each I-data flex server rack will have 4 nos of 3 phase, 5 (3P+N+G) wire 32 A supply (IC 309).
- Tape library: 2 nos per rack of 1 phase 32 A (P+N+G)
- Each row should have 4 quantities of 32 A of IC 309 connectors as spare and for Tape library row should have 2 quantity of 32 A 1 phase connector(IC 309) as spare.

Lighting

- Lighting in server room 500 Lux at 3 feet from raised floor level and 400 Lux at utility Room.
- Emergency Lights to be 20% on UPS

DG sets

DG min rating 2*2000 KVA in N+1 with necessary AMF/ Synchronization and control panels is required. The synchronization and load management will be based by PLC or microprocessor based controllers.
80% loading in each DG sets

The bidder shall provision for Diesel Generators sets to support the Data center physical infrastructure equipments load in providing emergency power supply to the computer equipment during a prolonged power outage. The DG set shall support other essential facilities and equipment such as the air-conditioning system, security and access control system and lighting. The DG set shall come on-line automatically within 30 seconds of AC mains failure. DG system shall have N+1 configuration. Harmonics generated by Load shall be accounted while designing the DG system.

(i) Required numbers of right capacity DG Sets & acoustically treated room with ventilation arrangement

(ii) Exhaust piping with heavy duty residential silencer, insulation of exhaust piping, Height of exhaust piping as per pollution control norms.

(iii) Diesel engine complete with all accessories and Alternator directly coupled to the engine through flexible/ rigid coupling, complete with all accessories for starting, regulation and control, including base frame, foundation bolts, interconnecting piping and accessories, power and control cable glands and lugs. Engine shall have command and control through power command centre or equivalent.
(iv) Diesel Local/Remote control panel, DG control panel, DG auxiliary panel including power cables, control cables to be provided.

(v) DG Set should have an Synchronising/ AMF Panel & AMF panel controller between main power and DG set

(vi) Equipment necessary for fuel storing and distribution, day oil tank with level switches, piping, pumps, valves, level indicators etc.

(vii) Flexible connections & residential type silencer of exhaust system, including thermal lagging and height of exhaust structure should be minimum 30 meters or subjected to applicable pollution control norms for all DG system.

(viii) Batteries with Mild Steel/ Stainless steel battery stand and battery charging equipment, including their connections with tools & accessories for battery maintenance.

(ix) Anti Vibration Mountings, etc.

(x) Supplying and erecting bulk storage diesel tank with pumps etc. and covering entire yard with fencing & gate.

(xi) Preparing all related drawings for approval from NCMRWF and statutory bodies.

(xii) Obtaining approval of the installation of Diesel Generators by the Electrical Inspectorate and Pollution Control bodies and all other statutory bodies. Obtaining explosive license and NOC certificate for installation of diesel bulk storage tank from explosive department and NOC from state.

(xiii) Carrying out performance & guarantee test, making arrangements for loads etc. as required.

(xiv) First fill of fuel oil, lubricating oil, etc., including cleaning and flushing out the system.

(xv) Fuel & oil fill for testing, trial run. All cost of fuel, Oil and operation shall be borne by the the bidder.

(xvi) Prepare and submit to NCMRWF for approval- Detailed shop drawings depicting the general arrangement of DG sets, its accessories, fuel tank, fuel oil piping, pumps, control panel, exhaust piping, Chimney/ Scrubber unit, Acoustic container etc. The bidder shall also furnish the detailed foundation drawings for DG sets.

(xvii) Compliance to the deliverables/ requirements, the solution shall also be in accordance and compliance to other building / building services norms as applicable at the proposed project location.

(xviii) DG installation shall be provisioned with protection system and safety devices.

(xix) Aux & Control Cabling requirements and interface with the Electrical scheme.

(xx) DG's shall have Local Emergency Stop integrated with the DG Panel Controls for a co-coordinated operation / monitoring and management.

(xxi) DG shall have appropriate Building Management System integration provisions / ports as well as hardwired alarm/ critical monitoring provisions with details of integration.

(xxii) The scope covers excavation, underground & overhead Piping for fuel storage system lines with appropriate protection & distance from other services as per the site conditions, including trench refilling and also foundation for DG sets and required trenches to lay cables.

(xxiii) Erection of pipe Exhaust structure as per pollution control norms and should have **aviation lights** in the exhaust pipes if the height is 30 meters.

(xxiv) Fuel storage pumping system shall be designed to have a trouble-free automated system without manual intervention for auto-filling of Day Tanks.

(xxvi) The system should not allow for oil pilferage and spills. If such incidences are found, it would show poor quality of manufacturing, work and/ or maintenance and will reflect on its performance.

(xxvii) The overall configuration shall be N+1 in nature, with no single point of failure', which can be put to use in case of failure of any one of the component especially the Fuel Pumps.

(xxviii) Monitoring provision shall be included with Potential free contacts / option to connect Flow Meters inside fuel lines / Underground Level Sensor Provision on tanks etc which shall provide for smooth operation / planning of fuel for the DC operation.

(xxix) Necessary Grounding for DG System shall be provided as per IEEE (Green Book) or relevant BIS norms.

(xxx) Work package shall include Fire Safety & Protection equipments including signage as may be necessary as per the statutory guidelines.

(xxxi) Pumping scheme may include with Overflow protection with Local over flow tank with Oil return provision with connectivity with the Under Ground tank.

(xxxii) Overall system design and scheme shall be fail-proof.

(xxxiii) All necessary statutory approvals including, but not limited to, CEIG approval, CCOE approval, Fire authority approval, etc. as applicable to DG System and Bulk oil storage tank shall be taken by the bidder.

DG Bulk Storage Tank

2* 25KL of underground storage tank with all low side work and redundant pumps

Fuel Storage tanks-Fuel Level monitoring, transfer line flow metering, each pump run status, Fuel high & low level monitoring, supply flow rate monitoring & other critical monitoring components. Fuel storage tank should be designed to have trouble free automated system without manual intervention fo auto-filling of day tank and also have BMS connectivity of monitoring only.

Piping to be done to cater to the existing (2*1500 KVA) as well as new DG sets also.
All required statutory approvals of fire and explosive departments will be in the scope of the bidder.

Utility Transformer

2000KVA Oil filled transformers with OLTC, Dyn-11.
Tap range: +10% to -15% in steps of 1.25%
Temp Rise: 55 Deg above ambient
Neutral CT for REF is required
Transformer oil: 10% extra over required capacity

Earthing/Grounding:

- Maintenance free chemical earthing pits for entire data centre.
- Lighting protection system
- Data centre grounding in server room as per IEEE
- Server rooms should have 25x3mm copper grid under the raised floor for rack body earth connected by copper flexible cables
- The bidder shall provide the grounding pits and ensure proper grounding for the complete Data centre system and facility. IEEE grounding practices shall be followed for the entire facility while ensuring near zero ground differentials.
- All metallic objects on the premises that are likely to be energized by electric currents should be effectively grounded as a safety measure.
- Low maintenance chemical earthing pit and equipotential grid system should be provided for all equipments for the Data Center and its support utilities.
- The connection to the earth or the electrode system should have sufficient low resistance (the tests shall be carried out as per IS: 3043. No earth electrode shall have resistance of more than 1 ohm to ensure prompt operation of respective protective devices in event of a ground fault, to provide the required safety from an electric shock to personnel & protect the equipment from voltage gradients which can damage the equipment.
- Ground resistance shall be automatically measured on an online basis at a pre-configured interval. Low Ground resistance alarm shall be provided if the ground resistance increases than the threshold value and preventive/ corrective action should be initiated based on the observation.
- All metallic bodies shall be equi-potentially bonded.

- The cross sectional area of earthing conductor shall not be less than half that of the largest current carrying conductor
- All panels and equipments should be earthed to avoid accidents to the personnel.
- Signal reference grid should be laid below false floor.
- The pedestals of the false floor should also be earthed.
- Methods to control Electro static discharge should be adopted by employing hand straps, mats, etc.
-

Emergency Power off (EPO): EPO to be factored in the designed for server room.

Central power Monitoring through BMS: Utility, main transformer, UPS, DG, feeder circuits breakers, ATS, PDU, surge protection, critical load branch circuits.
The bidder shall plan the Energy Meters (Multifunction meter with communication protocol RS485 parallel port which can be integrated with main Energy/ Building Management System) at the following but not limited to:-

(i) Each feeder Circuit Breakers for Utility Distribution Main Panel (HT Panel & LT Panels-I/P & O/P Feeder)

(ii) HVAC Panels (I/P & O/P Feeder), each Chillers, Main LT Panel (I/P & O/P Feeder), DG Panel (I/P & O/P Feeder), Each UPS System (I/P and O/P Feeder at LT Panel side), Main Transformer (I/P & O/P Feeder), Automatic Transfer Switch, PDU's (I/P & O/P Feeder), Other utility service feeders (Main Input Feeder) & any breakers above 250 Amp.

(iii) Dual Energy meters should be provided at all incomers of main LT panels to measure the grid power and DG sets power.

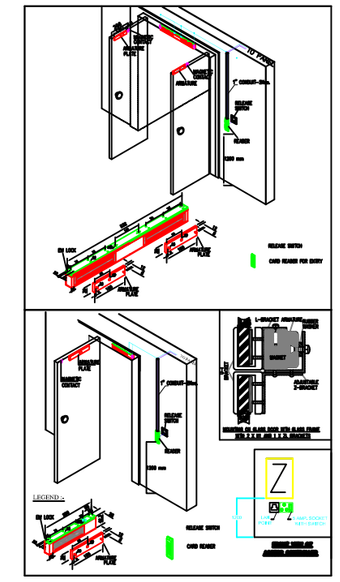
(iv) Metered PDUs should be provided for each racks and which should be integrated with Data Center Infrastructure management software system and BMS.

Testing/Load Bank: DG sets, UPS sets to be tested for the rated load and back-up.

Drawing for DATA CENTRE-A ONLY

DWG.No.
IITM_DC_ACS_MECH_00 R0

RELEASED FOR TENDER



INSTALLATION DETAILS

ACCESS CONTROL SYSTEM

	ACCESS CONTROL PANEL AT SERVER ROOM
	ENTRY READER
	ELECTRO MAGNETIC LOCK FOR SINGLE LEAF DOOR
	ELECTRO MAGNETIC LOCK FOR DOUBLE LEAF DOOR
	MAGNETIC CONTACT
	6C x 1.0 SQ.mm FRLS SCREENED ARMORED CABLE FOR READER
	4C x 1.0 SQ.mm FRLS SCREENED ARMORED CABLE FOR LOCK / MAGNATIC CONTACT
	UPS POWER POINT (230 V. 5 AMP.)
	LAN POINT

REVISIONS :

NO.	DATE	REMARKS
R0	08.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT: INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.

ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
ACCESS CONTROL SYSTEM LAYOUT
GROUND FLOOR

DWG.No.
IITM_DC_ACS_MECH_00

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	08.05.13		

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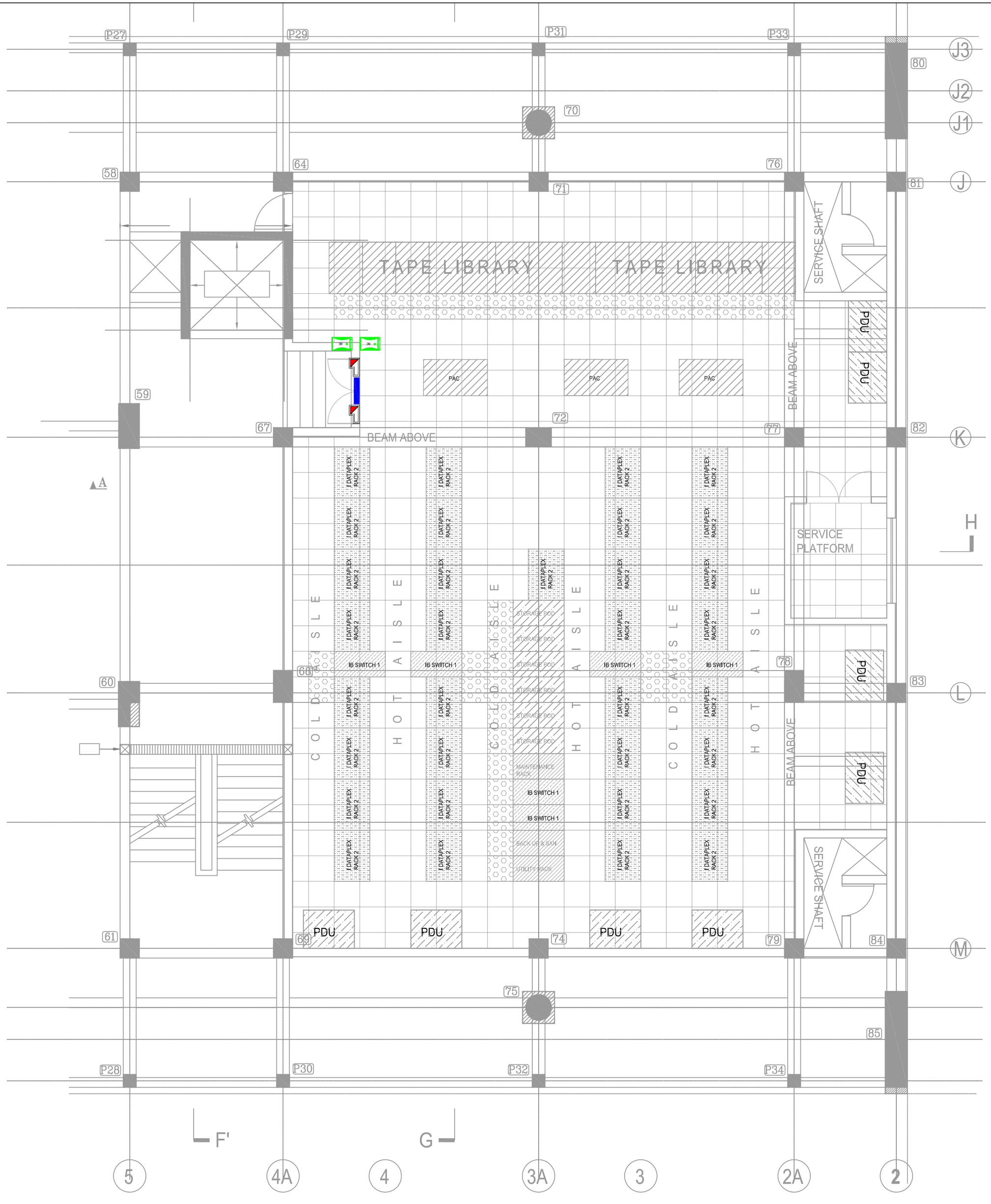

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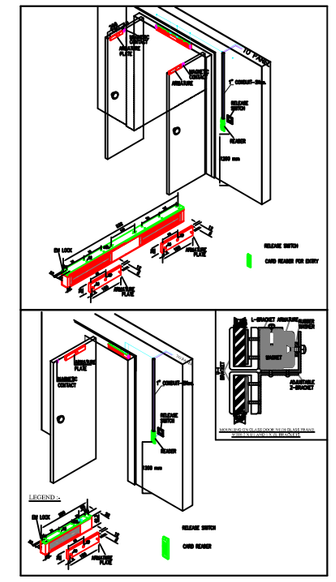

INSTALLATION DETAILS

ACCESS CONTROL SYSTEM

	ACCESS CONTROL PANEL AT SERVER ROOM
	ENTRY READER
	ELECTRO MAGNETIC LOCK FOR SINGLE LEAF DOOR
	ELECTRO MAGNETIC LOCK FOR DOUBLE LEAF DOOR
	MAGNETIC CONTACT
	6C x 1.0 SQ.mm FRLS SCREENED ARMORED CABLE FOR READER
	4C x 1.0 SQ.mm FRLS SCREENED ARMORED CABLE FOR LOCK / MAGNATIC CONTACT
	UPS POWER POINT (230 V. 5 AMP.)
	LAN POINT

REVISIONS :

NO.	DATE	REMARKS
R0	08.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT: INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.

ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
ACCESS CONTROL SYSTEM LAYOUT
FIRST FLOOR

DWG.No.
IITM_DC_ACS_MECH_01

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	08.05.13		

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www.archivistaindia.com

DWG.No.
IITM_DC_CCTV_MECH_00 R0

RELEASED FOR TENDER

CLOSED CIRCUIT TELEVISION SYSTEM

	MOVEABLE COLOR SCAN DOME CAMERA
	CAT 6 Shielded cable

REVISIONS :

NO.	DATE	REMARKS
R0	15.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
GROUND FLOOR
CCTV LAYOUT

DWG.No.
IITM_DC_CCTV_MECH_00 R0

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	15.05.13		

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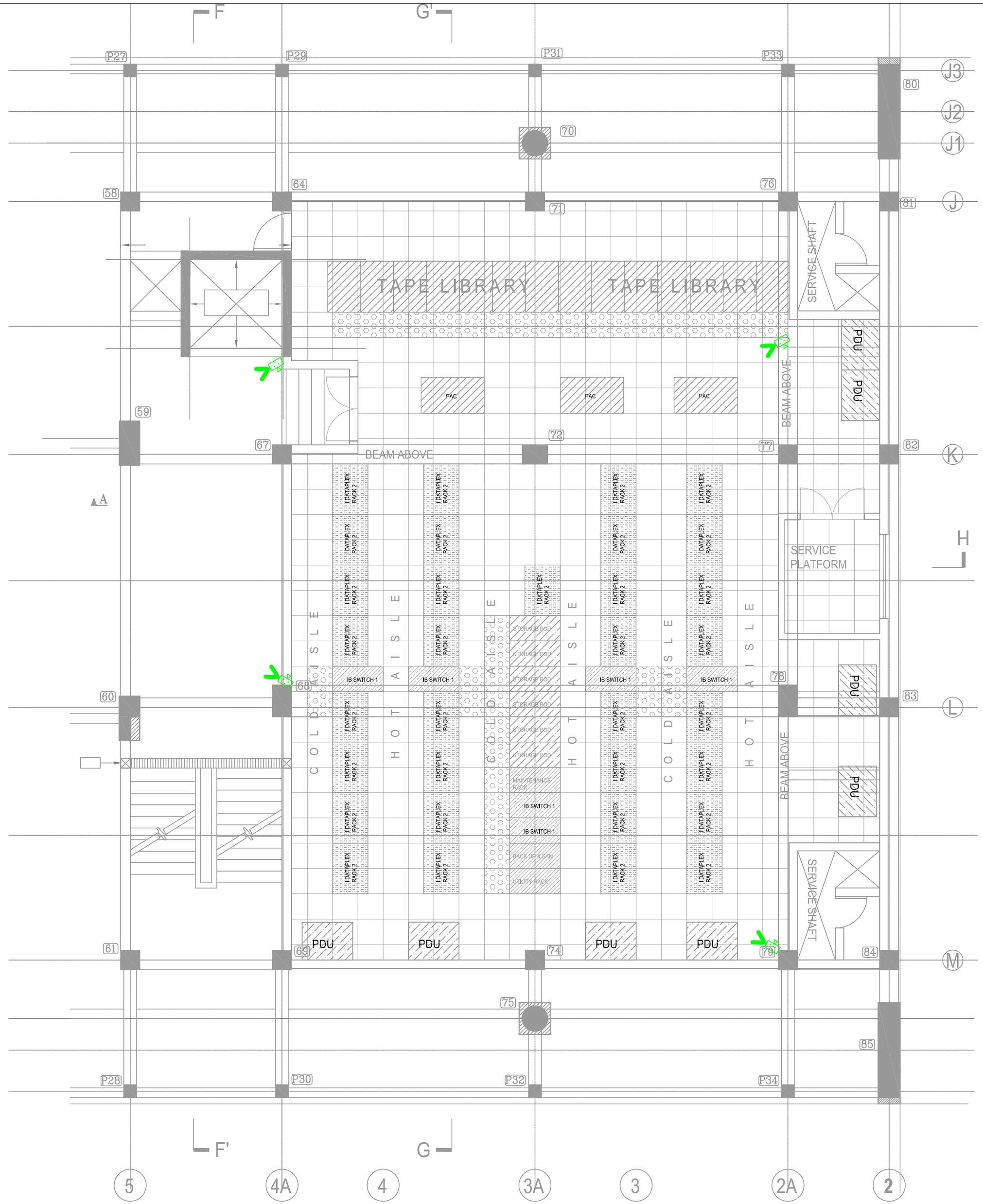

DWG.No.
IITM_DC_CCTV_MECH_01 R0

RELEASED FOR EXECUTION

CLOSED CIRCUIT TELEVISION SYSTEM

	MOVEABLE COLOR SCAN DOME CAMERA
	CAT 6 Shielded cable

REVISIONS :

NO.	DATE	REMARKS
R0	15.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
FIRST FLOOR CCTV LAYOUT

DWG.No.
IITM_DC_CCTV_MECH_01 R0

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	15.0513		

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DWG.No.
IITM_DC_FAS_MECH_00 R0

RELEASED FOR TENDER

NOTES:-

ACTUAL SMOKE DETECTOR SIZE - 100mm DIA

CABLES FROM MAIN CONTROL PANEL TO INDIVIDUAL DEVICE TO BE 2C x 1.5sq mm Cu ARMOURED FRLS MULTISTRANDED

MANUAL CALL POINT TO BE LOCATED AT EVERY DOOR AT 1.2 MTR FROM THE FINISHED FLOOR LEVEL.

ALL MCP's TO BE LOCATED WITHIN 1.5M FROM THE FIRE EXITS.

SUPPLY TO THE FIRE ALARM PANEL TO BE FROM 2 DIFFERENT POWER SOURCES.

ALL THE EQUIPMENTS TO BE UL LISTED.

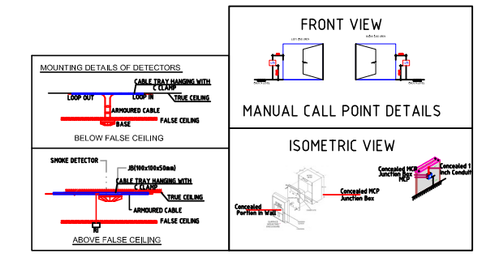
A MINIMUM DISTANCE OF 500mm TO BE KEPT BETWEEN THE FIRE ALARM CABLE & THE POWER CABLE.

JUNCTION BOXES (IF REQUIRED) FOR INSTALLATION OF EQUIPMENTS TO BE CONSIDERED.

LEGEND

SYMBOL	DESCRIPTION	QTY
	MANUAL CALL POINT	04 NOS
	FIRE ALARM SOUNDER WITH STROBE	03 NOS
	FIRE ALARM SIREN	01 NOS
H1-C	FIRE ALARM CENTRAL UNIT	01 NOS
SD	SMOKE DETECTOR (BELOW F/C)	08 NOS
SD	SMOKE DETECTOR (ABOVE F/C)	05 NOS

ALL MCP ON THIS FLOOR



REVISIONS :

NO.	DATE	REMARKS
R0	08.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.

ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
FIRE ALARM SYSTEM GROUND FLOOR

DWG.No.
IITM_DC_FAS_MECH_00 R0

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	08.05.13		

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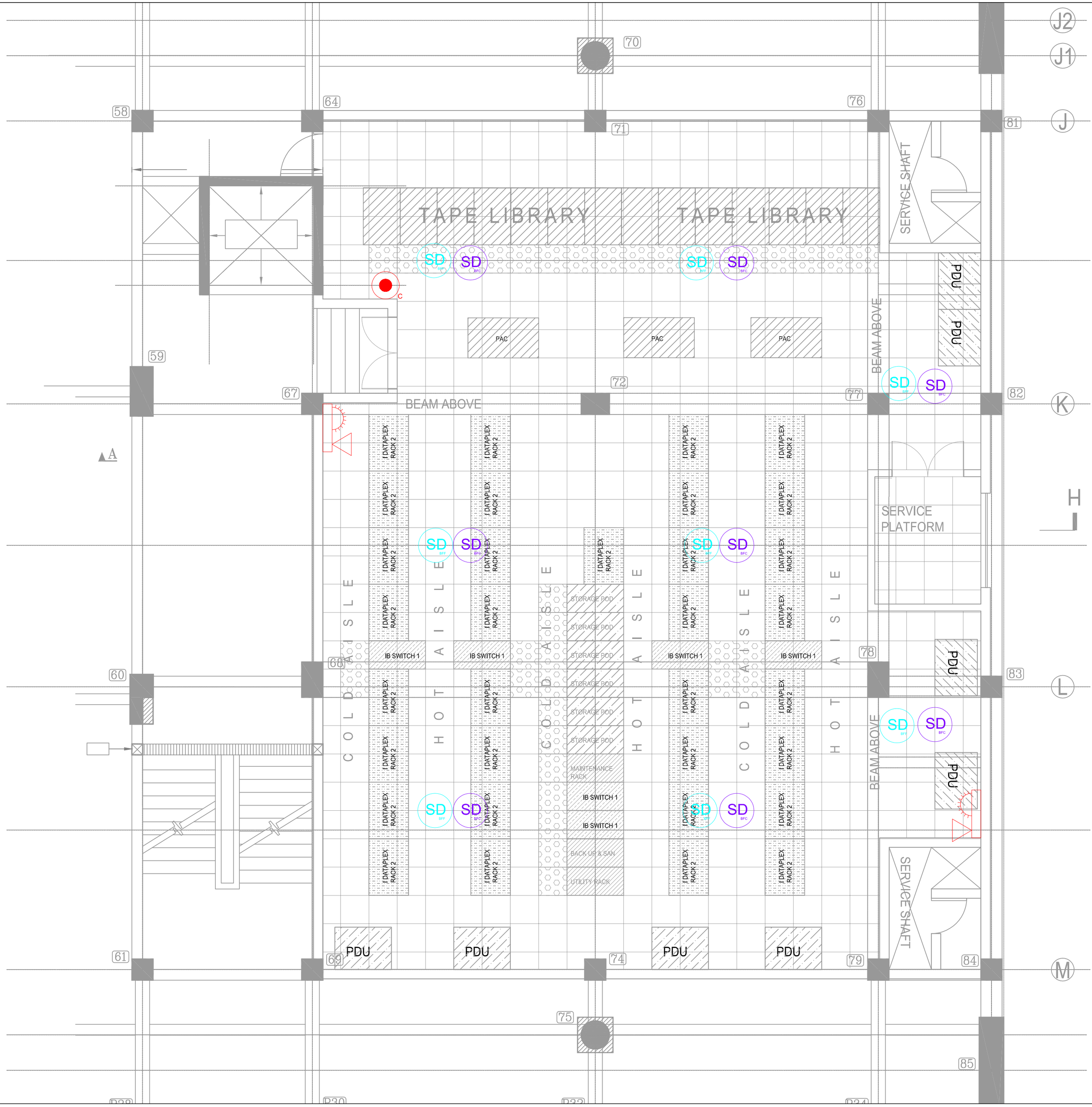


DWG.No.
IITM_DC_FAS_MECH_01 R0

RELEASED FOR TENDER

NOTES:-

ACTUAL SMOKE DETECTOR SIZE - 100mm DIA

CABLES FROM MAIN CONTROL PANEL TO INDIVIDUAL DEVICE TO BE 2C x 1.5sq mm Cu ARMOURED FRLS MULTISTRANDED

MANUAL CALL POINT TO BE LOCATED AT EVERY DOOR AT 1.2 MTR FROM THE FINISHED FLOOR LEVEL.

ALL MCP's TO BE LOCATED WITHIN 1.5M FROM THE FIRE EXITS.

SUPPLY TO THE FIRE ALARM PANEL TO BE FROM 2 DIFFERENT POWER SOURCES.

ALL THE EQUIPMENTS TO BE UL LISTED.

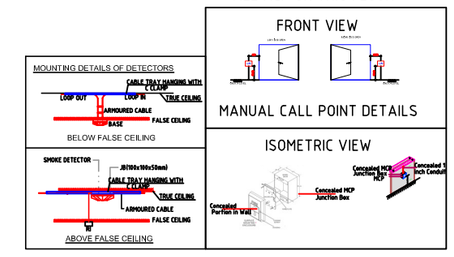
JUNCTION BOXES (IF REQUIRED) FOR INSTALLATION OF EQUIPMENTS TO BE CONSIDERED.

A MINIMUM DISTANCE OF 500mm TO BE KEPT BETWEEN THE FIRE ALARM CABLE & THE POWER CABLE.

LEGEND

SYMBOL	DESCRIPTION	QTY
	MANUAL CALL POINT	01 NOS
	FIRE ALARM SOUNDER WITH STROBE	02 NOS
SD	SMOKE DETECTOR (BELOW F/F)	08 NOS
SD	SMOKE DETECTOR (ABOVE F/C)	08 NOS

ALL MCP ON THIS FLOOR



REVISIONS :

NO.	DATE	REMARKS
R0	08.05.13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
FIRE ALARM SYSTEM FIRST FLOOR

DWG.No.
IITM_DC_FAS_MECH_01 R0

JOB NO :	ITM137	DRAWN BY :	SACHIN
SCALE :	–	CHECKED BY :	SUMANT
DATE :	08.05.13		

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DWG.No.
ITM_137_PD_ELEC_ER_002 R0

LEGENDS

EARTHING STRIP

58 64 71 76 81 J

59 67 72 77 82 K

60 68 75 78 83 L

61 69 74 79 84 M

A A

H H

TAPE LIBRARY

TAPE LIBRARY

SERVICE SHAFT

0.90 0.85 1.51

2.15

PDU

PDU

PAC PAC PAC

BEAM ABOVE

BEAM ABOVE

SERVICE PLATFORM

COLD AISLE

HOT AISLE

I DATAPLEX RACK 2

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

IB SWITCH 1 IB SWITCH 1 IB SWITCH 1 IB SWITCH 1

MAINTENANCE RACK

IB SWITCH 1

IB SWITCH 1

BACK UP & SAN

UTILITY RACK

COLD AISLE

HOT AISLE

BEAM ABOVE

PDU PDU PDU PDU

PDU PDU

SERVICE SHAFT

DWG.No.
ITM_137_PD_ELEC_LT_002 R0

LEGENDS

4X14w. SURFACE MOUNTEDLIGHT FIXTURE

58 64 71 76 81 J

59 67 72 77 82 K

60 68 74 78 83 L

61 69 74 79 84 M

75

TAPE LIBRARY

TAPE LIBRARY

PAC

PAC

PAC

0.90

0.85

1.51

SERVICE SHAFT

PDU

PDU

2.15

BEAM ABOVE

BEAM ABOVE

A

H

I DATAPLEX RACK 2

COLD AISLE

HOT AISLE

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

MAINTENANCE RACK

IB SWITCH 1

IB SWITCH 1

BACK UP & SAN

UTILITY RACK

SERVICE PLATFORM

PDU

PDU

PDU

PDU

PDU

PDU

SERVICE SHAFT

DWG.No.
ITM_137_PD_ELEC_PWR_002 R0

LEGENDS

450X75mm. CABLE TRAY

750X75mm. CABLE TRAY

58 64 71 76 81 J

59 67 72 77 82 K

60 68 73 78 83 L

61 69 74 79 84 M

75

TAPE LIBRARY

TAPE LIBRARY

SERVICE SHAFT

0.90

0.85

1.51

PDU

PDU

2.15

BEAM ABOVE

PAC

PAC

PAC

BEAM ABOVE

2 TIRE 750X75mm.
CABLE TRAY

H

A

SERVICE
PLATFORM

2 TIRE 450X75mm.
CABLE TRAY

COLD AISLE

HOT AISLE

I DATAPLEX RACK 2

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

STORAGE POD

MAINTENANCE RACK

IB SWITCH 1

IB SWITCH 1

BACK UP & SAN

UTILITY RACK

IB SWITCH 1

IB SWITCH 1

IB SWITCH 1

IB SWITCH 1

COLD AISLE

HOT AISLE

COLD AISLE

HOT AISLE

BEAM ABOVE

PDU

PDU

PDU

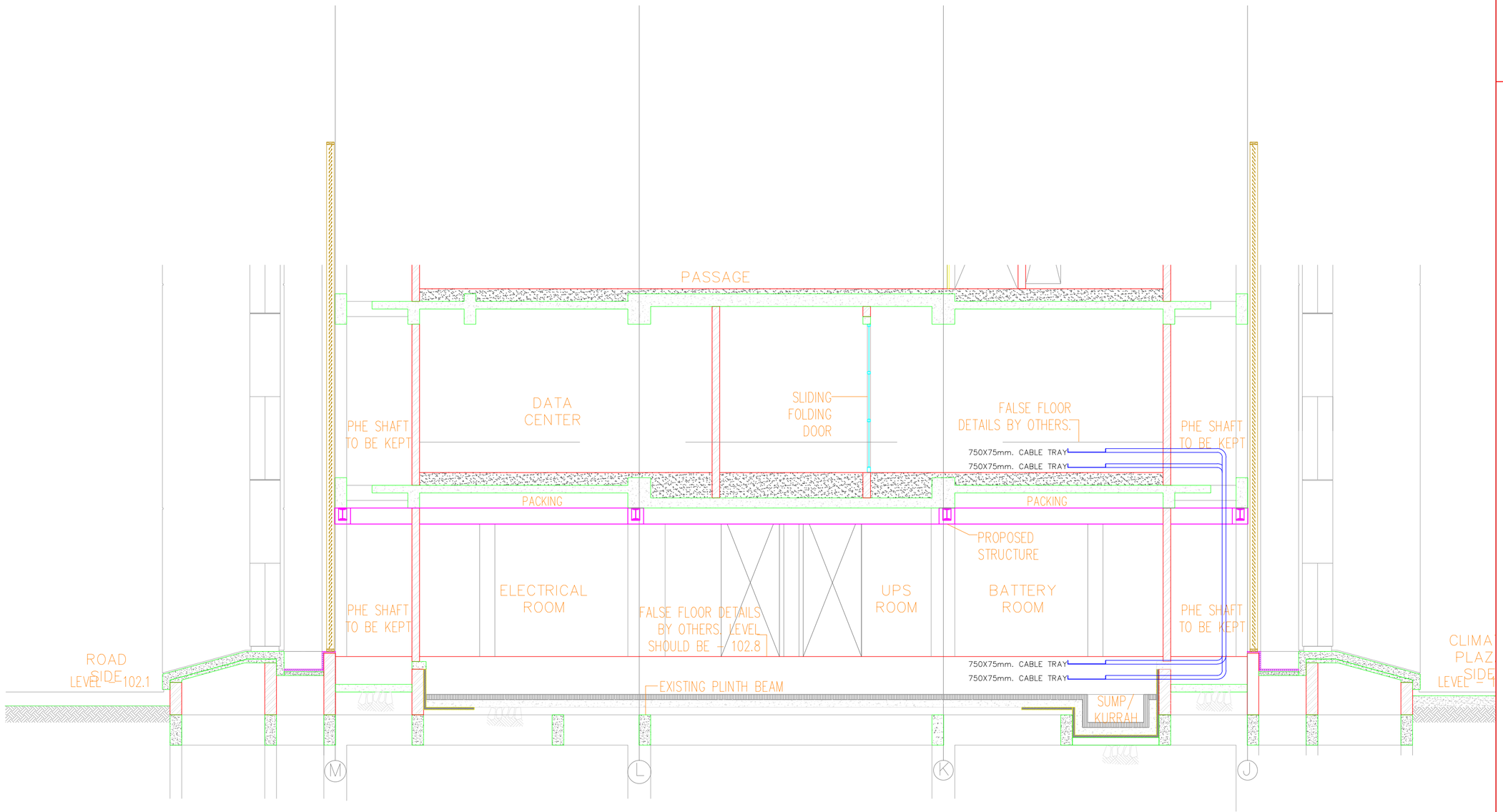
PDU

PDU

SERVICE SHAFT

2 TIRE 750X75mm.
CABLE TRAY

DWG.No.
ITM_137_PD_ELEC_SEC_002 R0

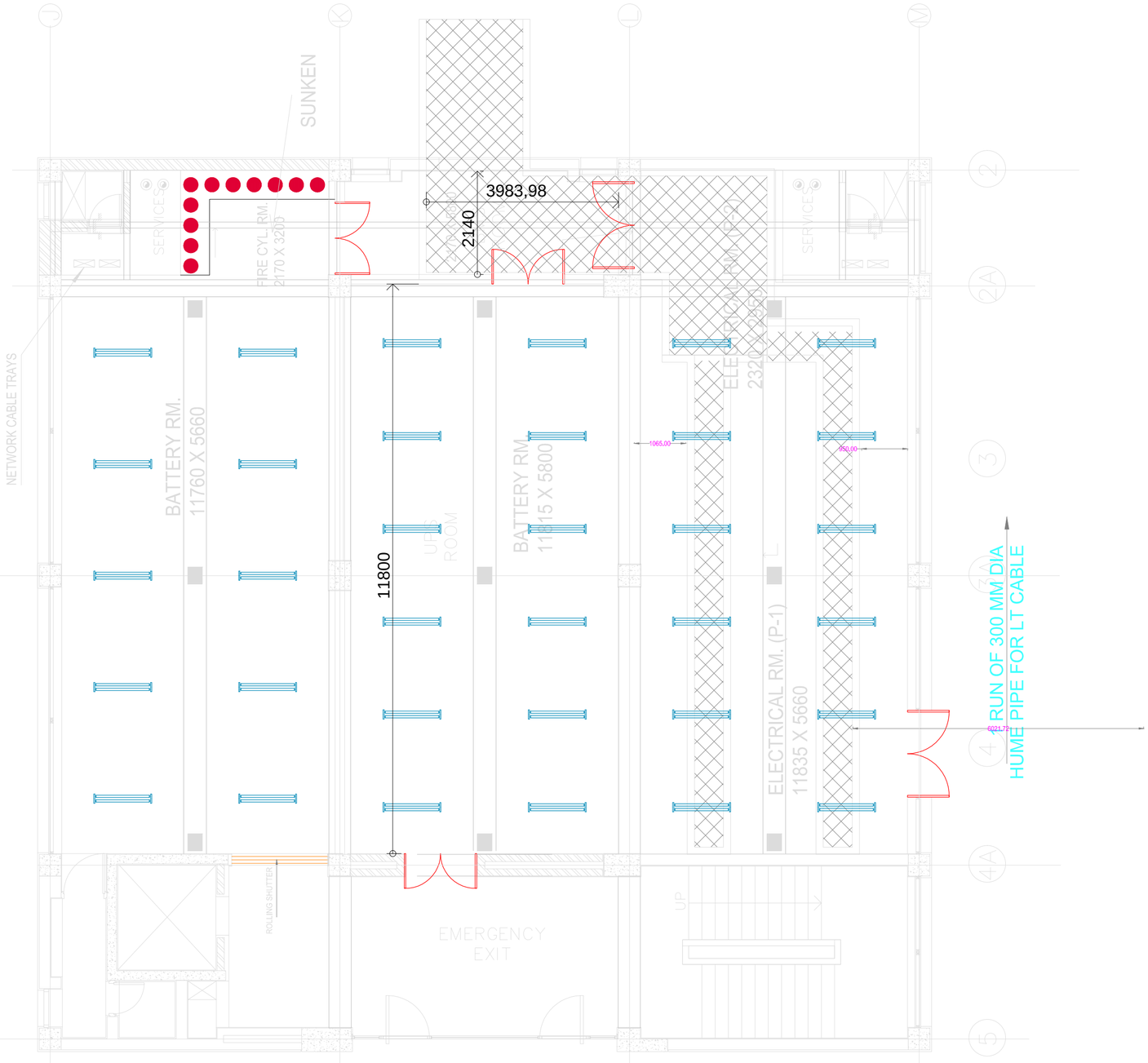


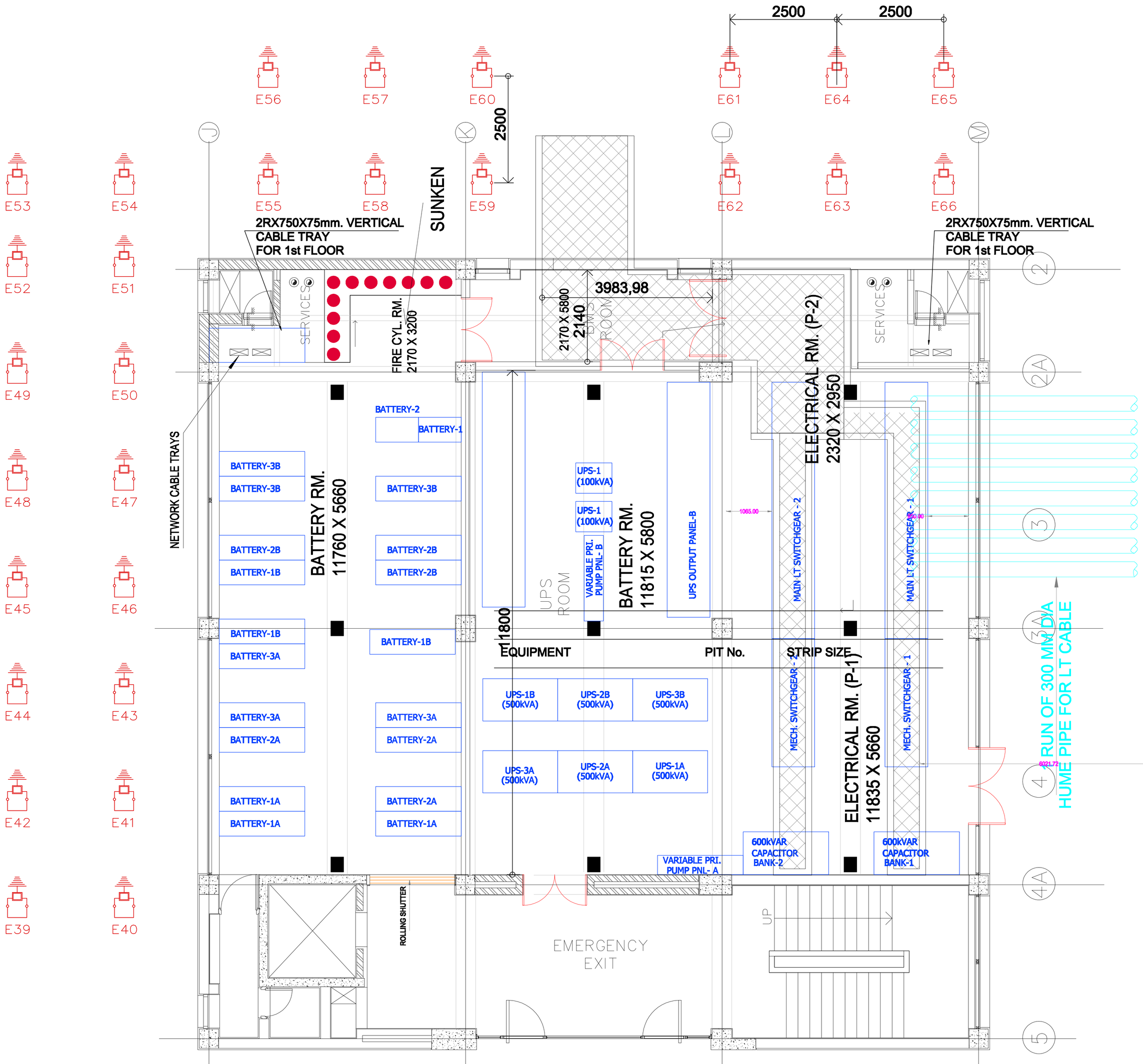
SECTION
JJ'

DWG.No.
ITM_137_PD_ELEC_LTG_001 R0

LEGENDS

2X28w. FIXTURE





EARTHING SCHEDULE		
EQUIPMENT	PIT No.	STRIP SIZE
500 KVA UPS-01 BODY	39 & 40	25 X 3 mm Cu strip
500 KVA UPS-02 BODY	41 & 42	25 X 3 mm Cu strip
500 KVA UPS-03 BODY	43 & 44	25 X 3 mm Cu strip
500 KVA UPS-04 BODY	45 & 46	25 X 3 mm Cu strip
500 KVA UPS-05 BODY	47 & 48	25 X 3 mm Cu strip
500 KVA UPS-06 BODY	49 & 50	25 X 3 mm Cu strip
100 KVA UPS-01 BODY	51 & 52	25 X 3 mm Cu strip
100 KVA UPS-02 BODY	53 & 54	25 X 3 mm Cu strip
Main LT Panel-01	55 & 56	50 x 10 mm GI Strip
Main LT Panel-02	57 & 58	25 x 3 mm Cu Strip
Chiller Panel-01		32 x 6 mm GI Strip
Chiller Panel-02		32 x 6 mm GI Strip
UPS OUTPUT Panel-01		50 x 6 mm GI Strip
UPS OUTPUT Panel-02		50 x 6 mm GI Strip
Power Distribution Unit -01A	59	25 X 3 mm Cu strip
Power Distribution Unit -02A	60	25 X 3 mm Cu strip
Power Distribution Unit -03A	61	25 X 3 mm Cu strip
Power Distribution Unit -04A	62	25 X 3 mm Cu strip
Power Distribution Unit -01B	63	25 X 3 mm Cu strip
Power Distribution Unit -02B	64	25 X 3 mm Cu strip
Power Distribution Unit -03B	65	25 X 3 mm Cu strip
Power Distribution Unit -04B	66	25 X 3 mm Cu strip

DWG.No.
ITM_137_PD_ELEC_PD_001 R0

LEGENDS

450X75mm. CABLE TRAY

750X75mm. CABLE TRAY

EARTHING PIT

REVISIONS :

NO.	DATE	REMARKS
R0	.....	.....

CLIENT:
IITM-PUNE
ADDRESS

TITLE:
POWER CABLE TRAY LAYOUT
GROUND FLOOR

DWG.No.
ITM_137_PD_ELEC_PWR_001 R0

JOB NO :	ITM-137	DRAWN BY : UJWAL	
SCALE :	1: 200	CHECKED BY : AMOL	
DATE :	02.05.13		

DR. HOMI BHABHA ROAD

AREA UNDER ROAD

AREA UNDER ROAD

PROPOSED CTPT & RMU BUILDING

KIOSK AREA

AMINITY SPACE – 1

OPEN SPACE – 1

6 M WIDE ROAD

6 M WIDE ROAD

IITM MAIN BUILDING G+2

IITM MAIN BUILDING G+2

PROPOSED HT CABLE ROUTE

EXISTING ROAD

AMINITY SPACE – 2

GUEST HOUSE G+2

EXISTING ROAD 12M WIDE

AMINITY SPACE – 3

OPEN SPACE – 2

EXISTING ROAD

AMINITY SPACE – 4

LIBRARY G+2

AMINITY SPACE – 5

OPEN SPACE – 3

PROPOSED UTILITY BUILDING (G+2)

PROPOSED 6.0 M WIDE ROAD

EXISTING GARAGE (G)

SERVICE ROAD 6M WIDE

STING MECHANICAL WORKSHOP (G)

AMINITY SPACE – 6

EXISTING CANTEEN BUILDING (G)

EXISTING GARAGE (G)

PROPOSED HPC BUILDING G+1

ISTING ELECTRICAL PANEL ROOM

EXISTING WELL & PUMP HOUSE

OPEN SPACE – 4

NALA

OPOSED DG YARD

PROPOSED ELECTRICAL SUBSTATION BUILDING & TRANSFORMER YARD

PROPOSED ROAD

PROPOSED CCCR BUILDING G+2

DATA CENTER AREA

PROPOSED 9M WIDE ROAD

SUBSTATION AREA

3000X2000X2000mm. DEEP CABLE CHAMBER

PROPOSED LT CABLE ROUTE

8RXø300mm. RCC HUME PIPE

3000X2000X2000mm. DEEP CABLE CHAMBER

EXISTING STRUCTURE G

EXISTING SITE BOUNDARY

PROPOSED 9 M WIDE ROAD

LEGENDS

HT CABLE

CABLE CHAMBER

Ø300mm. RCC HUME PIPE

DWG.No.
ITM_137_PD_ELEC_SP_001 R0

REVISIONS :

NO.	DATE	REMARKS
R0	27.05.13	FOR TENDER

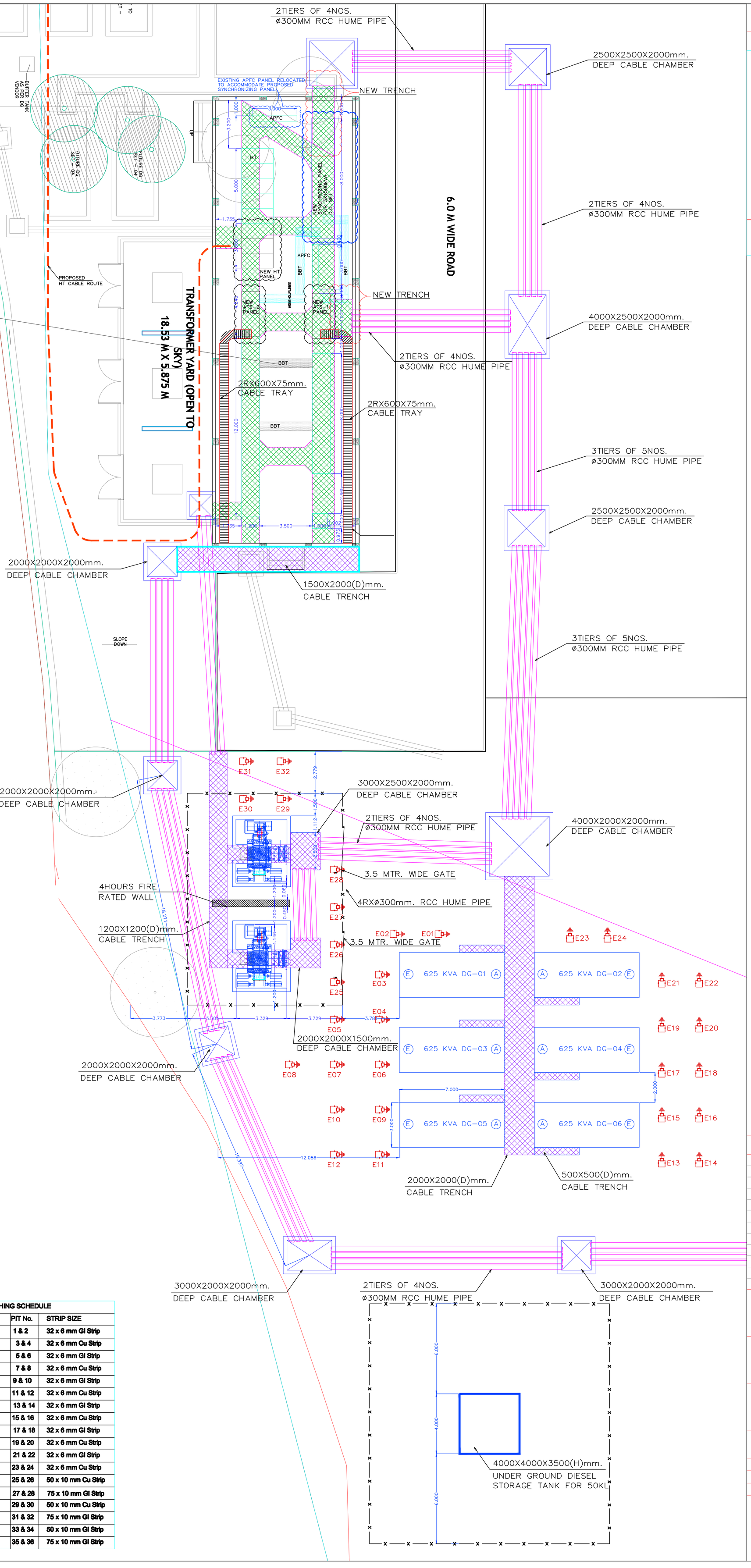
CLIENT:
IITM-PUNE
ADDRESS

TITLE:
EXTERNAL EQUIPMENT LAYOUT

DWG.No.
ITM_137_PD_ELEC_SP_001 R0

JOB NO :	ITM–137	DRAWIN BY : UJWAL	
SCALE :	1: 200	CHECKED BY : AMOL	
DATE :	27.05.13		

TRICAL
ILDING
R YARD



EARTHING SCHEDULE		
EQUIPMENT	PIT No.	STRIP SIZE
625 kVA DG Set-01 body	1 & 2	32 x 6 mm GI Strip
625 kVA DG Set-01 'N'	3 & 4	32 x 6 mm Cu Strip
625 kVA DG Set-02 body	5 & 6	32 x 6 mm GI Strip
625 kVA DG Set-02 'N'	7 & 8	32 x 6 mm Cu Strip
625 kVA DG Set-03 body	9 & 10	32 x 6 mm GI Strip
625 kVA DG Set-03 'N'	11 & 12	32 x 6 mm Cu Strip
625 kVA DG Set-04 body	13 & 14	32 x 6 mm GI Strip
625 kVA DG Set-04 'N'	15 & 16	32 x 6 mm Cu Strip
625 kVA DG Set-05 body	17 & 18	32 x 6 mm GI Strip
625 kVA DG Set-05 'N'	19 & 20	32 x 6 mm Cu Strip
625 kVA DG Set-06 body	21 & 22	32 x 6 mm GI Strip
625 kVA DG Set-06 'N'	23 & 24	32 x 6 mm Cu Strip
2500 KVA Trafo-1 'N'	25 & 26	50 x 10 mm Cu Strip
2500 KVA Trafo-1 Body	27 & 28	75 x 10 mm GI Strip
2500 KVA Trafo-2 'N'	29 & 30	50 x 10 mm Cu Strip
2500 KVA Trafo-2 Body	31 & 32	75 x 10 mm GI Strip
HT Panel	33 & 34	50 x 10 mm GI Strip
ATS Panel 1	35 & 36	75 x 10 mm GI Strip

DWG.No.
ITM_137_PD_ELEC_EQ_001 R3

LEGENDS

- 450X75mm. CABLE TRAY
- 600X75mm. CABLE TRAY
- CABLE CHAMBER
- Ø300mm. RCC HUME PIPE
- EARTHING PIT

REVISIONS :

NO.	DATE	REMARKS
R3	29.05.13	D.G. SET REVISED
R2	27.05.13	D.G. SET LOCATION CHANGED
R1	13.05.13	REVISED AS PER MEETING DATED 10.05.13
R0	02.05.13	FIRST ISSUE

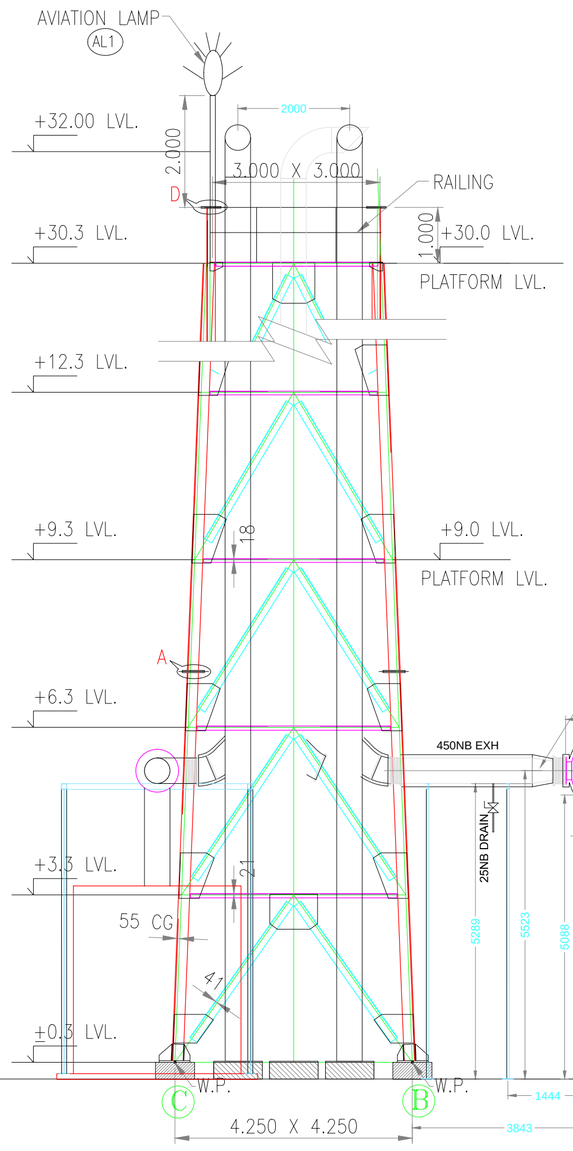
CLIENT:
IITM-PUNE
ADDRESS

TITLE:
EQUIPMENT LAYOUT

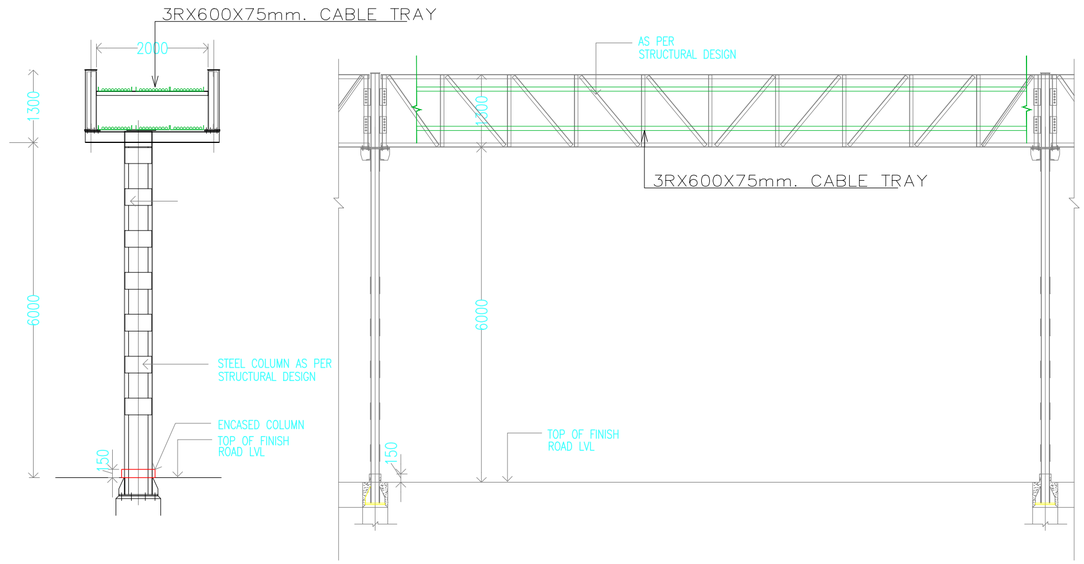
DWG.No.
ITM_137_PD_ELEC_EQ_001 R2

JOB NO :	ITM-137	DRAWN BY : UJWAL	
SCALE :	1: 200	CHECKED BY : AMOL	
DATE :	02.05.13		

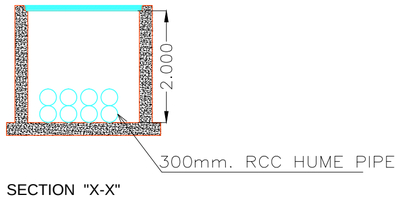
DWG.No.
ITM_137_PD_ELEC_EQ_SEC_001 R0



SECTION FOR DG SET

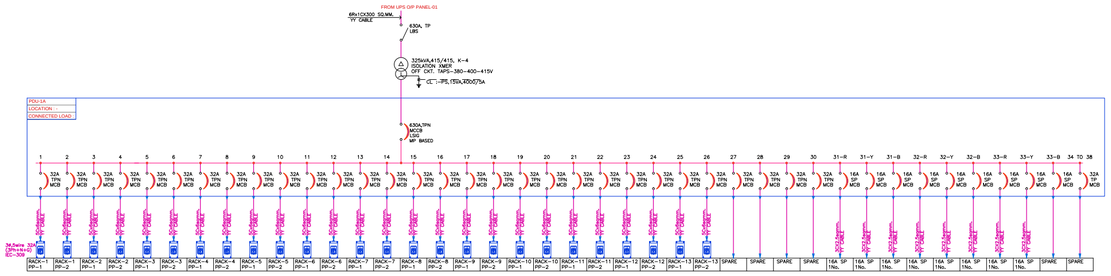


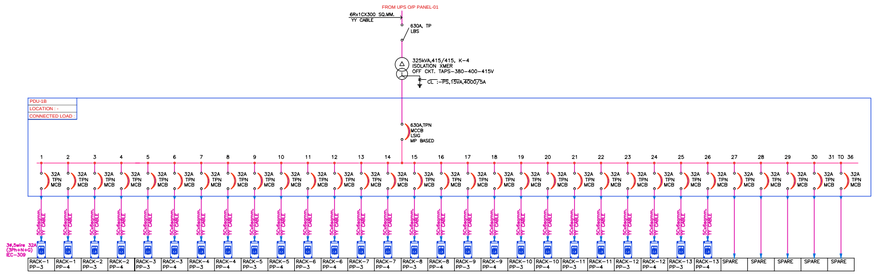
SECTION FOR CABLE TRAY BRIDGE

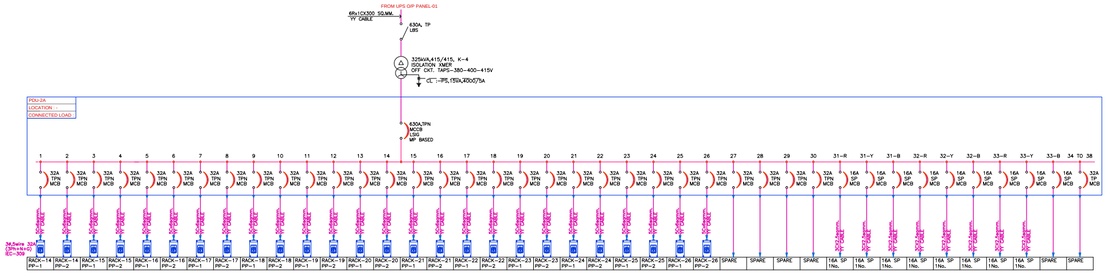


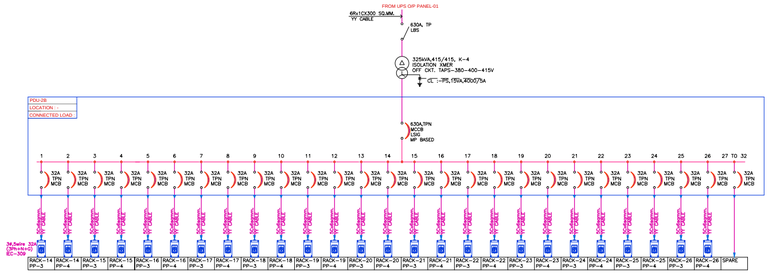
SECTION "X-X"
FOR CABLE CHAMBER No. OF PIPE

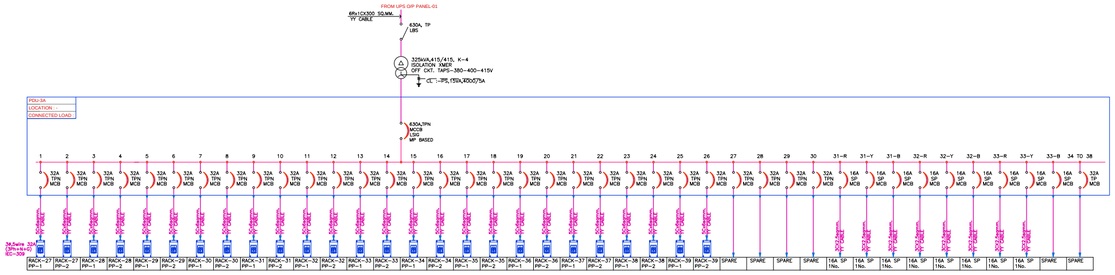
DWG.No.
ITM_137_PD_ELEC_SLD_002 R0

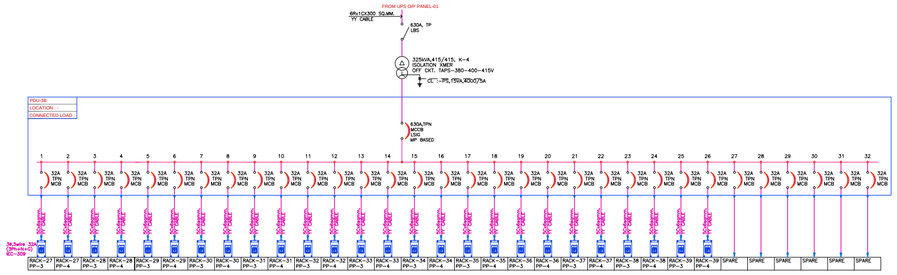


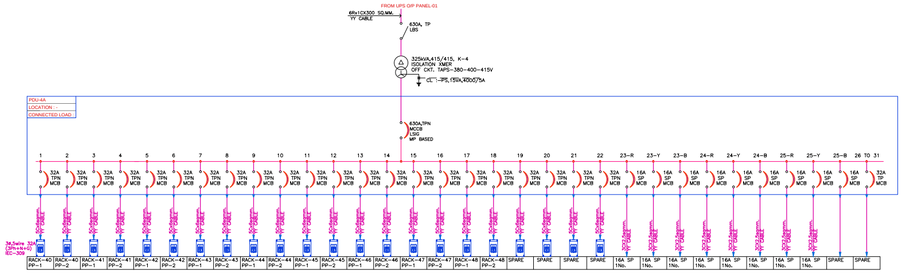


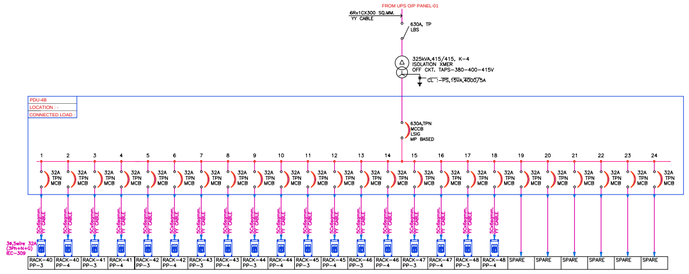


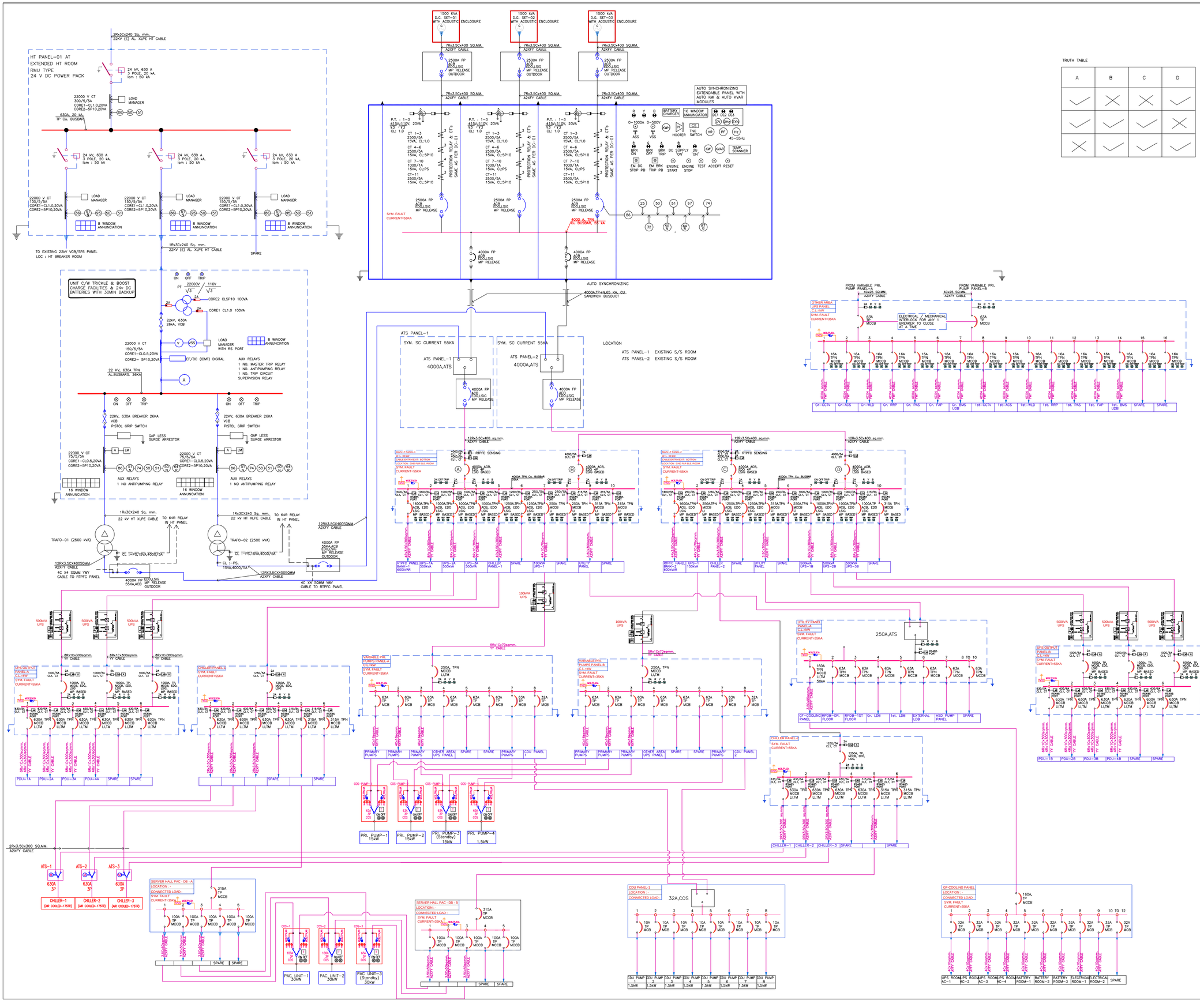












DWG.No.
ITM_137_PD_ELEC_SLD_001 R0

LEGENDS

- ONAN 11KV/433V STEPDOWN TRANSFORMER WITH OLTC
- AIR COOLED K-20 400/400V ISOLATION TRANSFORMER
- UNINTERRUPTED POWER SUPPLY (UPS)
- MOTORISED LOAD BREAK CHANGEOVER SWITCH (ATS)
- ATS

NOTES:

The panels will be built to relevant IEC specification

Unless otherwise stated and or where applicable :

Construction :

1. The panels will be dust and vermin proof with gaskets of the doors Installed on the panel and not on door. The compartmentalized construction is required with extendable bus bars. The entire assembly must go through 7 tank process and will be oven baked .
2. Outdoor installation will be with IP55 enclosure
3. Bus bars will be tinned copper with current density of not more than 800A / Sq. inches.
4. Base frame of at-least 4" made out of steel sections is to be provided.
5. Panel will have :
   Top Entry Bottom Entry
   Floor Mounted Installation/Wall Mounted Installation
6. Bus bar system supports will be CPRI or equal test laboratory approved.
7. All panel compartments shall have identification etched on Aluminum strip.
8. All MCB DB will have each MCB identification
9. Stands should be provided for the installation of switch board matching to height of the false floor.
10. All VFDs shall have an active-front-end design
11. All UPSs shall have an active-front-end design
12. KVAR Requirement for each transformer is 600 KVAR steps size should be appropriate considering data centre application & to maintain p.f .98 to unity.

Components :

1. MCCBs will be atleast 35 kA short circuit withstand or as specified.
2. MCBs will be atleast 10 kA short circuit withstand of the curve to suit discrimination
3. ALL protections will be coordinated
4. The range of the instruments be such that the readings will shown the mid-range of the instrument.
5. The load manager will be installed with communication port and win95 or similar graphic OS based software.
6. All ACBs will be draw out type with static relays provided for over-curent, earth fault.
   For DG set protection restricted earth fault protection is required.
7. MCCB to have following :
   Shunt trip , fault indications, Electronics trip mechanism.
8. All Panel Should Have Tvss Protection

Earthing :

1. All doors will have flying earth.
2. Copper earth bus is to be installed.
3. Where applicable UPS system, VS system and Raw power earth shall be separate. All the earth bus installed on suitable insulators

Drawings and Tests :

1. Shop drawings are required to be submitted for the review and approval
2. Test certificates for all components and the panel's routine tests are required to be provided in triplicate
3. Panel is required to be tested at site and works

AREA & CONSTRUCTIONAL DETAILS AS PER VENDOR

PIPE ENTRY ZONE (BELOW CONC. JACKET). AREA & CONSTRUCTIONAL DETAILS AS PER IBM

DRAINAGE LINE

100Ø HYDRANT RINGMAIN

EH

EH

100Ø HYDRANT RINGMAIN

250NB

250NB

ROAD

RETAINING WALL

40000

MV

250NB A/G PIPE

250NB A/G PIPE

6696

2250 2250 2000 2250 2000 2250

01

250NB

200NB

BFV-01 BFV-02 BFV-03 BFV-04

MV-01 MV-02

BFV-10 BFV-08 BFV-07 BFV-06 BFV-09

1320 1320

05

250NB

BFV-11 BFV-01 BFV-13

MV-02 MV-01

100NB

BFV-12

250NB

2600 2600

32NB AKV 32NB

7900 7500 7900 7500

FUTURE EXPANSION

17000

2650 2650

665 1235 665 1235 665

02

1549

733

STR-01 200NB BFV-01

STR-02 200NB BFV-02

STR-03 200NB BFV-03

STR-04 200NB BFV-04

250NB 250NB BFV-05

250NB

40NB 40NB BFV-01

04

1200 1200

EXPANSION TANK
DIA. 1.2M. X HEIGHT 1.2M
VOLUME-1000 LITERS(Approx)
NET WEIGHT-12000 KG(Approx)

PRESSURISATION UNIT

1000 1000

03

BFV-01 50NB BFV-02 DRAIN

BFV-03 NRV-01 50NB BFV-04

APPROX. WEIGHT-750KG
500 LITER PVC TANK
1.0 Dia And 1.0 Ht.

APPROX. WEIGHT-1500KG
2000 LITER PVC TANK

BFV-05

CONNECTION FROM DOMESTIC WATER

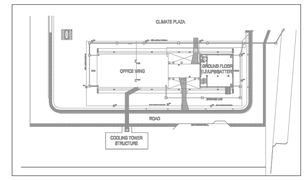
8500

AREA FOR HVAC ELECTRICAL PANEL SHED

2500

DWG.No.
IITM_DC_TD_HVAC_100 R2

RELEASED FOR TENDER



PROJECT KEY PLAN

SYMBOL	DESCRIPTION
	NRV
	BUTTERFLY VALVE
	Y SRAINER
	BALL VALVE
	PRESSURE GAUGE
	TEMPRATURE GAUGE
	2-WAY MOTORIZED VALVE
	CHW-SUPPLY
	CHW-RETURN

REVISIONS :

NO.	DATE	REMARKS
R2	29/05/13	ISSUED FOR TENDER
R1	27/05/13	ISSUED FOR TENDER
R0	06/05/13	ISSUED FOR TENDER

ENGG. SIGN

CLIENT SIGN

CLIENT:
IITM DATA CENTER.
ADDRESS

TITLE:
SITE PLAN.

DWG.No.
IITM_DC_TD_HVAC_100 R2

JOB NO :	ITM137	DRAWN BY :	YOGESH
SCALE :	1:150	CHECKED BY :	RAKESH
DATE :	02/05/13		

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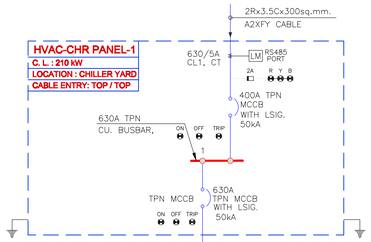
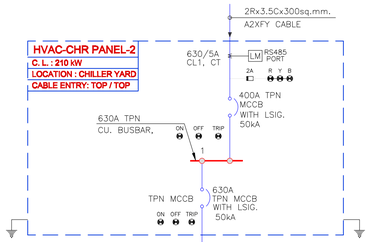
PH.91-20-66294444,460, FAX.91-020-66294699,
www.archivistaindia.com

FROM 630A ATS-1



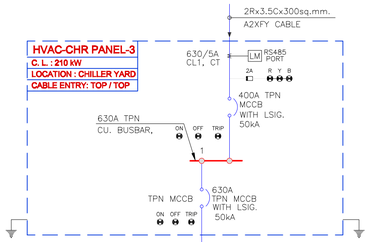
LOAD DESCRIPTION	CHILLER-1 (W)
CONN. LOAD	210 kW
CABLE SIZE	2Rx3.5Cx300 sq.mm A2XFY CABLE

FROM 630A ATS-2



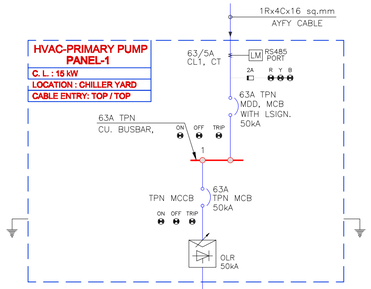
LOAD DESCRIPTION	CHILLER-2 (W)
CONN. LOAD	210 kW
CABLE SIZE	2Rx3.5Cx300 sq.mm A2XFY CABLE

FROM 630A ATS-3



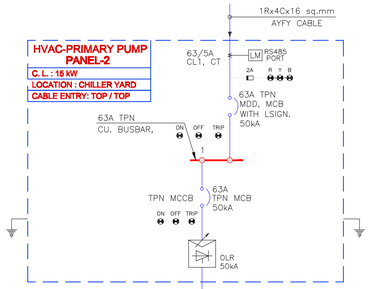
LOAD DESCRIPTION	CHILLER-3 (SB)
CONN. LOAD	210 kW
CABLE SIZE	2Rx3.5Cx300 sq.mm A2XFY CABLE

FROM 63A COS-1



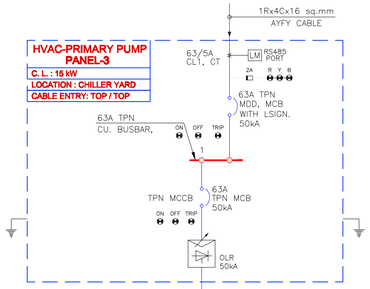
LOAD DESCRIPTION	PUMP-1 (W)
CONN. LOAD	15 kW
CABLE SIZE	1Rx4Cx16 sq.mm AYFY CABLE

FROM 63A COS-2



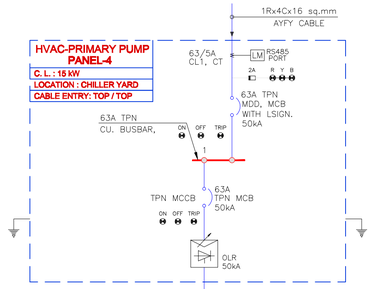
LOAD DESCRIPTION	PUMP-2 (W)
CONN. LOAD	15 kW
CABLE SIZE	1Rx4Cx16 sq.mm AYFY CABLE

FROM 63A COS-3



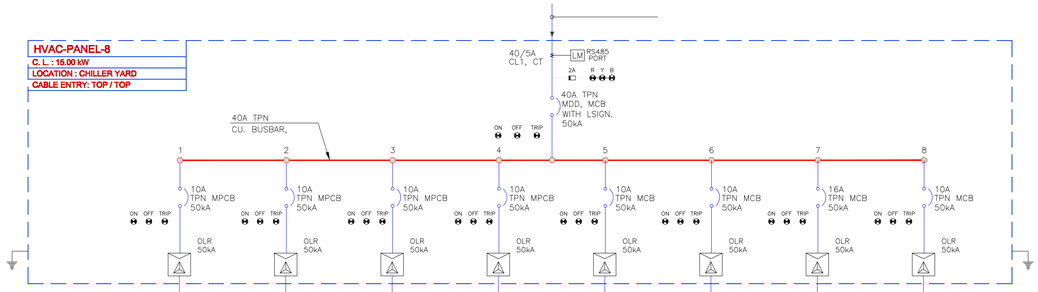
LOAD DESCRIPTION	PUMP-3 (SB)
CONN. LOAD	15 kW
CABLE SIZE	1Rx4Cx16 sq.mm AYFY CABLE

FROM 63A COS-4



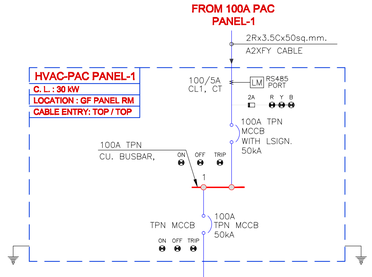
LOAD DESCRIPTION	PUMP-4 (SB)
CONN. LOAD	15 kW
CABLE SIZE	1Rx4Cx16 sq.mm AYFY CABLE

FROM PUMP PANEL



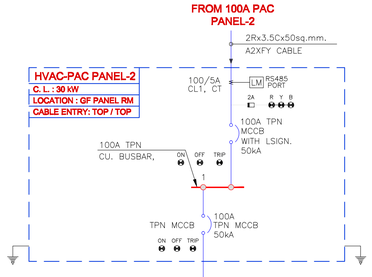
LOAD DESCRIPTION	PREZ. PUMP-1	PREZ. PUMP-1	WATER TREATMENT P-1	WATER TREATMENT P-2	SPARE	SPARE	SPARE	SPARE
CONN. LOAD	1.5 kW (W)	1.5 kW (SB)	1.5 kW (W)	1.5 kW (SB)				
CABLE SIZE	2Rx4Cx2.5 Sq.mm	2Rx4Cx2.5 Sq.mm	2Rx4Cx2.5 Sq.mm	2Rx4Cx2.5 Sq.mm				

FROM 100A PAC PANEL-1



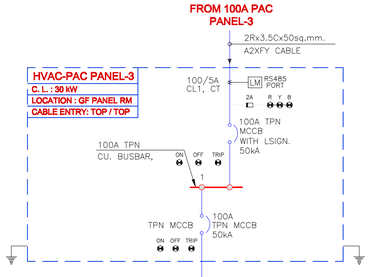
LOAD DESCRIPTION	PAC-1 (W)
CONN. LOAD	30 kW
CABLE SIZE	1Rx3.5x50 sq.mm A2XFY CABLE

FROM 100A PAC PANEL-2



LOAD DESCRIPTION	PAC-2 (W)
CONN. LOAD	30 kW
CABLE SIZE	1Rx3.5x50 sq.mm A2XFY CABLE

FROM 100A PAC PANEL-3



LOAD DESCRIPTION	PAC-3 (SB)
CONN. LOAD	30 kW
CABLE SIZE	1Rx3.5x50 sq.mm A2XFY CABLE

1) ALL THE CAPACITOR PANEL INCOMER SHALL BE INTERLOCKED TO CUT OFF DURING DG SUPPLY.
2) MAIN LT PANEL SHALL HAVE ELECTRICAL & MECHANICAL INTERLOCKING SYSTEM.
3) MCCB'S SHALL BE PROVIDED WITH VARIABLE CURRENT SETTING.
4) PANEL SHALL BE COMPARTMENTAL.
5) BUSBAR RATING MENTIONED IS ASSUMING 50%% CURRENT SHALL BE CARRIED AT EACH END.
6) ALL ACB's AND MCCB's SHALL BE MP BASED.
7) ALL LOAD MANAGERS SHALL BE WITH COMMUNICATION COMPATIBLE FACILITY.
8) ALL MCCB'S WITH LSIG PROTECTION SHALL HAVE INBUILT GROUND FAULT PROTECTION.
9) DEGREE OF PROTECTION FOR LT PANELS SHALL BE IP 42.
10) ALL TM MCCB SHOULD ADJUSTABLE SHORT CUIRCIT & OVERLOAD CURRENT SETTING
11) ALL OUTGOING ACB & MCCB SHOULD MANUAL DRAW OUT TYPE

LEGEND:-	
SYMBOL	DESCRIPTION
	DOL STARTER
	STAR-DELTA STARTER
	VFD STARTER

DWG.No.
IITM_DC_TD_HVAC_101 R0

RELEASED FOR TENDER

PROJECT KEY PLAN

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ARCHITECT SIGN

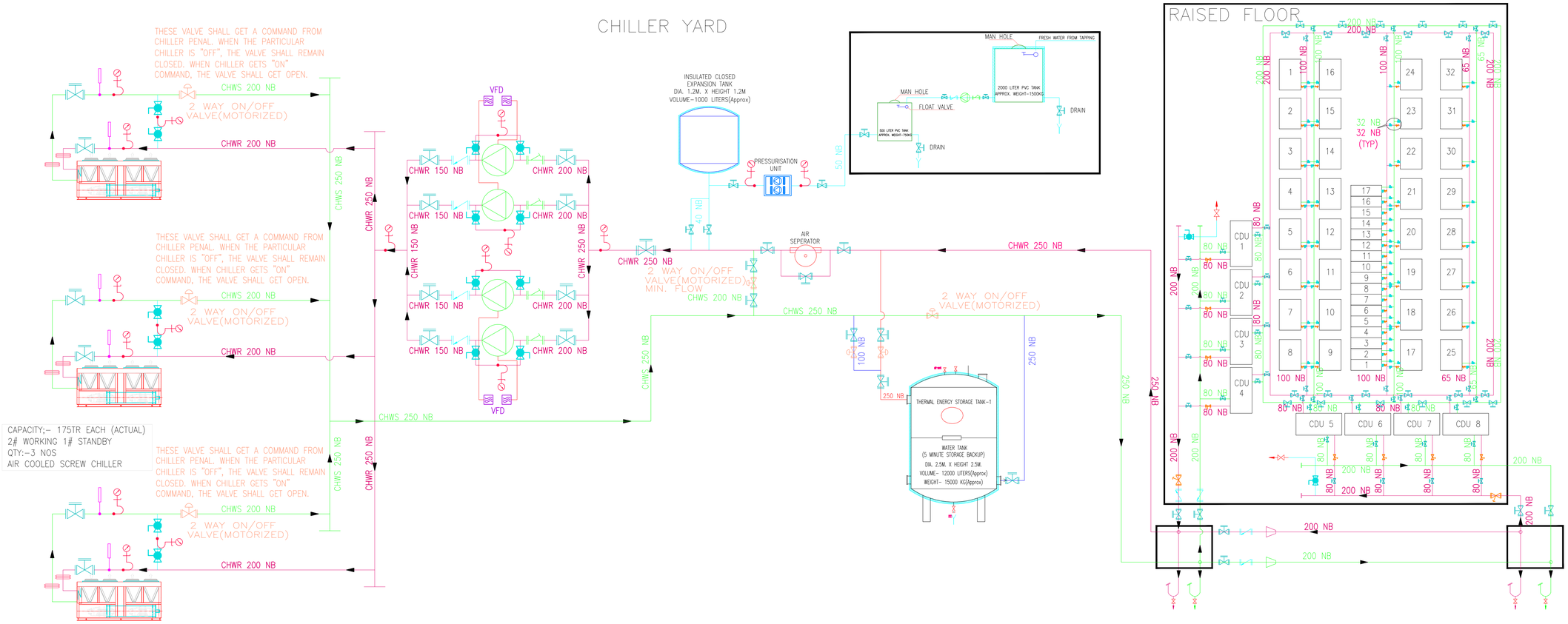
CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
ELECTRICAL SLD

DWG.No.
IITM_DC_TD_HVAC_101 R0

JOB NO :	ITM047	DRAWN BY :	
SCALE :	NTS	CHECKED BY :	
DATE :	27/04/2013		



DWG.No.
IITM_DC_TD_HVAC_102 R0

RELEASED FOR TENDER

LEGEND

	BALANCING VALVE
	DYNAMIC BALANCING VALVE
	Y-STAINER
	NON-RETURN VALVE
	BUTTERFLY VALVE
	2-WAY MOTORISED ON/OFF VALVE
	FLEXIBLE CONNECTION/BELLOWS
	THERMOMETER
	PRESSURE GAUGE
	AUTO. AIR VENT
	VICTAULIC COUPLING
	BALL VALVE
	3 WAY MODULATING VALVE(MOTORISED)
	REDUCER

TAG	ABBREVIATION
BLV	BALANCING VALVE
BV	BUTTERFLY VALVE
NRV	NON RETURN VALVE
2WMV	2-WAY MOTORISED ON/OFF VALVE
Y-STR	Y STRAINER
T	TEMPERATURE GAUGE
PG	PRESSURE GAUGE

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ARCHITECT SIGN

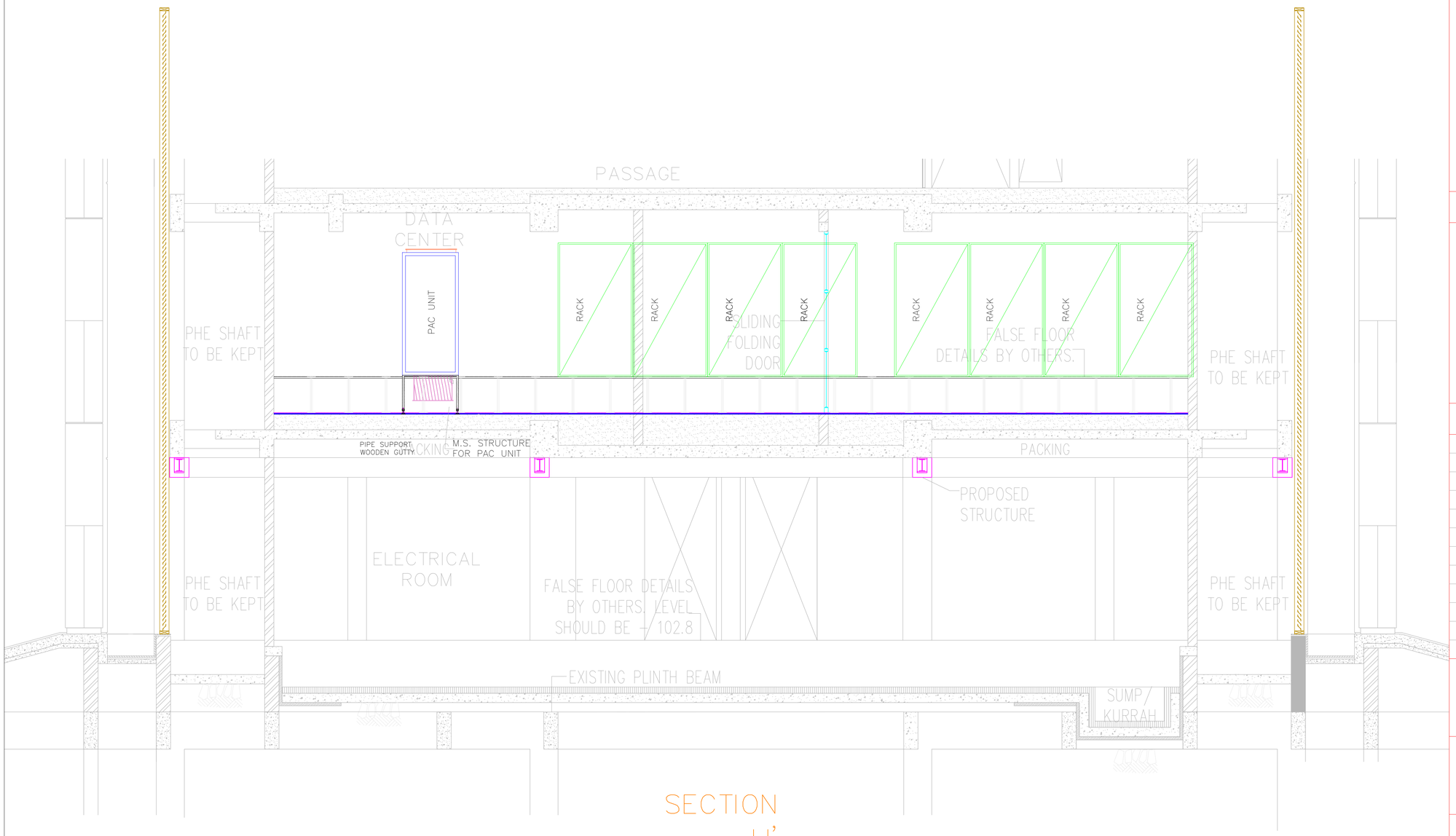
CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
P&ID FOR CHILLED WATER

DWG.No.
IITM_DC_TD_HVAC_102 R0

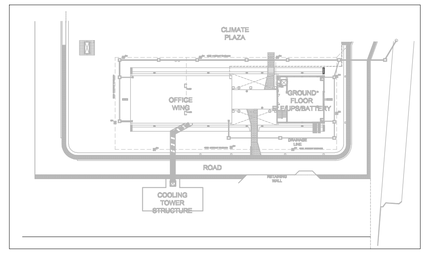
JOB NO :	ITM137	DRAWN BY :	
SCALE :	NTS	CHECKED BY :	
DATE :	27/04/2013		



SECTION
JJ'

DWG.No.
IITM_DC_TD_HVAC_103 R0

RELEASED FOR TENDER.



PROJECT KEY PLAN

SYMBOL	DESCRIPTION
	SUPPLY AIR GRILL
	HVAC GRILLE WITH BOOSTER FAN
RACK	RACK
PAC UNIT	PAC UNIT

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ENGG. SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
SERVER ROOM SECTION.

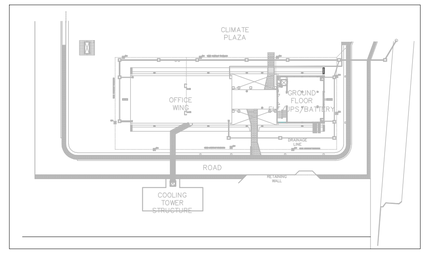
DWG.No.
IITM_DC_TD_HVAC_103 R0

JOB NO :	ITM137	DRAWN BY :	
SCALE :	1:50	CHECKED BY :	
DATE :	27/04/13		

DRAIN PIPING 1:150
50NB
300X150
500 CFM
500X300
1500 CFM
750X300
2500 CFM
5 TR
2500 CFM
1400X800X650
L*W*H
DRAIN PIPING 1:150 SLOP
50 NB
G-19.1
L-9.5
DRAIN PIPING 1:150
50 NB
65 NB
PLUMBING SHAFT TO BE KEPT
LIFT
DRAIN PIPING
32 NB
SUPPLY AIR GRILL
300X200 (TYP.)
840 CFM 10 Nos.
BATTERY ROOM
DRAIN PIPING
50 NB
FIRE SUPPRESSION CYLINDERS
I/O RACK
BMS ROOM
1.5 TR
10 TR
4200 CFM
1540X1050X900
L*W*H
UPS ROOM
G-28.6
L-12.7
2 Nos.
ODU
H'
LOBBY
DRAIN PIPING
32 NB
(TYP.) 1:150 SLOP
DRAIN PIPING 32 NB
UP
300X300
840 CFM
750X300
2520 CFM
1250X300
4200 CFM
ELECTRICAL, UPS & BATTERY ROOM
750 MM SUNK (SUBJECT TO SITE
CONDITION) FROM GROUND FLOOR FFL.
GROUND FLOOR FFL SHOULD BE 102.8
ELECTRICAL ROOM
SUPPLY AIR GRILL
600X200 (TYP.)
840 CFM 10 Nos.
58 64 71 76 81
59 67 72 77 82
60 68 73 78 83
61 69 74 79 84

DWG.No.
IITM_DC_TD_HVAC_FP01 R0

RELEASED FOR TENDER



PROJECT KEY PLAN

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
GROUND FLOOR HVAC LAYOUT.

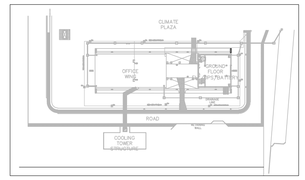
DWG.No.
IITM_DC_TD_HVAC_FP01 R0

JOB NO :	ITM047	DRAWN BY :	
SCALE :	1:50	CHECKED BY :	
DATE :	27/04/13		

SYMBOL	DESCRIPTION
	SUPPLY AIR GRILL
	HVAC GRILLE WITH BOOSTER FAN
	RACK
	PAC UNIT

DWG.No.
IITM_DC_TD_HVAC_FP02 R0

RELEASED FOR TENDER.



PROJECT KEY PLAN

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ENGG. SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

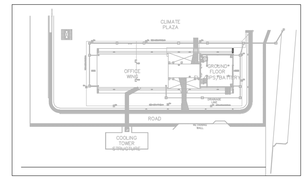
TITLE:
FIRST FLOOR HVAC LAYOUT.

DWG.No.
IITM_DC_TD_HVAC_FP02 R0

JOB NO :	ITM137	DRAWN BY :	
SCALE :	1:50	CHECKED BY :	
DATE :	27/04/13		

DWG.No.
IITM_DC_TD_HVAC_FP02_A R0

RELEASED FOR TENDER



PROJECT KEY PLAN

LEGEND

	BALANCING VALVE
	BUTTERFLY VALVE
	BALL VALVE
	NON-RETURN VALVE
	DYNAMIC BALANCING VALVE
	Y-STAINER
	2-WAY MOTORISED ON/OFF VALVE
	THERMOMETER
	PRESSURE GAUGE
	AUTO. AIR VENT
	VICTAULIC COUPLING
	FLEXIBLE CONNECTION/BELLOWS
	3 WAY MODULATING VALVE(MOTORISED)
P	REDUCER

TAG	ABBREVIATION
BLV	BALANCING VALVE
BV	BUTTERFLY VALVE
NRV	NON RETURN VALVE
2WMV	2-WAY MOTORISED ON/OFF VALVE
Y-STR	Y STRAINER
T	TEMPERATURE GAUGE
PG	PRESSURE GAUGE

REVISIONS :

NO.	DATE	REMARKS
R0	06/05/13	ISSUED FOR TENDER

ARCHITECT SIGN

CLIENT SIGN

CLIENT:
INDIAN INSTITUTE OF TROPICAL METEOROLOGY,HPC DATA CENTER.
ADDRESS Dr.HOMI BHABA ROAD,PASHAN PUNE.

TITLE:
UNDER FLOOR PIPING LAYOUT.

DWG.No.
IITM_DC_TD_HVAC_FP02_A R0

JOB NO :	ITM047	DRAWN BY :	
SCALE :	1:50	CHECKED BY :	
DATE :	27/04/13		

BOQ for DATA CENTRE-A ONLY

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	Fire Alarm System						
1.0	Supply, installation, testing & commissioning of Networkable 1 Single Loop Intelligent Analogue Addressable Fire Alarm Control Panel with minimum 80 characters LCD display including **Bacnet Gateway for Integration with BMS System**, The panel shall have the facility to be networked with other panel.	Nos	1				
2.0	Supply, installation, testing & commissioning of Analogue Addressable Multi-Sensor detectors combined (Optical + thermal) with including detector mounting base & required accessories.	Nos	29				
3.0	Supply, installation, testing & commissioning of Addressable Manual Call Points (**Pull Station Type**). The same shall be square in shape & made of ABS plastic material. Surface / Flush Mounting. It shall have a "Break glass" message embedded on the glass. The addressable module shall be enclosed along with the break glass in a junction box & with required accessories.	Nos	5				
4.0	Supply, installation, testing & commissioning of Conventional **Strobe cum Sounder**. The strobe cum sounder shall be made of ABS plastic material & have the Db level of minimum 90dBs and a multi tone facility, wall / ceiling mounted with mounting base & required accessories.	Nos	5				
5.0	Supply, installation, testing & commissioning of Addressable Monitor Module for Beam Detectors with Surface / wall mounting box & required accessories. (**UL Approved**)	Nos	RO				

6.0	Supply, installation, testing & commissioning of Addressable Control Module with surface/ wall mounting box & required accessories (**for sounders, strobe light & strobe cum sounders**)	Nos	RO				
7.0	Supply, installation, testing & commissioning of Addressable Control Module with surface/ wall mounting box & required accessories (**for Access triping off**)	Nos	7				
8.0	Supply, installation, testing & commissioning of Addressable Fault / Loop isolator module with Surface mounting backbox & required accessories.	Nos	3				
9.0	Supply, installation, testing & commissioning of Response indicator for Above false ceiling detectors with required acessories.	Nos	10				
10.0	Supply, installation, testing & commissioning of Addressable Relay Module with surface/ wall mounting box & required accessories.	Nos	RO				
11.0	Supply and laying of 2C x 1.5 Sq.mm Copper Armoured Multi stranded FRLS cable on wall / slab or structure with necessary spacer & saddles. scope shall also include required end termination using gland,lugs & required accessories. (**Red in Colour**)	Rmt	500				
12.0	Siren of 3 kms range	Nos	1				
	SUB - TOTAL OF FAS				0		0

SUMMARY

SN.	DESCRIPTIONS	SUPPLY AMOUNT	LABOUR AMOUNT
	Gas Suppression Sysyem		
1	ELECTRICAL ROOM (OPTIONAL ITEM)		
2	BATTERY ROOM (OPTIONAL ITEM)		
3	UPS ROM (OPTIONAL ITEM)		
4	BMS ROOM (OPTIONAL ITEM)		
5	SERVER ROOM		
	Total	-	-

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD

CHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR ELECTRICAL ROOM (OPTIONAL ITEM

S.No.	Item Description	Qty	Unit	Supply		Installation	
				Unit Rate	Amount	Unit Rate	Amount
	Supply,Installation,Testing & Commisioning of :						
1	120 ltrs Seamless Cylinder with valve	2	Nos				
2	Pressure Guage +Low pressure supervisory switch	2	Nos				
3	NOVEC 1230 gas	219	Kgs				
4	Electromagnetic Actuator	1	Nos				
5	Manual Actuator	1	Nos				
6	Pneumatic actuator	2	Nos				
7	Flexible Discharge Hose	2	Nos				
8	Flexible Actuation Hose	2	Nos				
9	Discharge Nozzles	7	Nos.				
10	Check Valve	2	Nos.				
11	Flow Switch	1	Nos.				
12	Manifold	1	Nos.				
13	Wall mount kit	4	Nos				
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot				

15	Gas Release panel with release module and battery back	1	Nos				
16	Manual Release Switch	2	No				
17	Abort Switch	1	No				
18	Room Integrity Test	1	Lot				
	SUBTOTAL				-		0
	GRAND TOTAL						0

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD							
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR BATTERY ROOM (OPTIONAL ITEM)							
S.No.	**Item Description**	**Qty**	**Unit**	**Supply**		**Installation**	
				Unit Rate	**Amount**	**Unit Rate**	**Amount**
	Supply,Installation,Testing & Commisioning of :						
1	120 ltrs Seamless Cylinder with valve	2	Nos				
2	Pressure Guage +Low pressure supervisory switch	2	Nos				
3	NOVEC 1230 gas	187	Kgs				
4	Electromagnetic Actuator	1	Nos				
5	Manual Actuator	1	Nos				
6	Pneumatic actuator	2	Nos				
7	Flexible Discharge Hose	2	Nos				
8	Flexible Actuation Hose	2	Nos				
9	Discharge Nozzles	6	Nos.				
10	Check Valve	2	Nos.				
11	Flow Switch	1	Nos.				
12	Manifold	1	Nos.				
13	Wall mount kit	4	Nos				
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot				
15	Gas Release panel with release module and battery backu	1	Nos				
16	Manual Release Switch	2	No				
17	Abort Switch	1	No				
18	Room Integrity Test	1	Lot				
	SUBTOTAL				-		0
	GRAND TOTAL						**0**

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR UPS ROOM (OPTIONAL ITEM)							
S.No.	**Item Description**	**Qty**	**Unit**	**Supply**		**Installation**	
				Unit Rate	**Amount**	**Unit Rate**	**Amount**
	Supply,Installation,Testing & Commisioning of :						
1	120 ltrs Seamless Cylinder with valve	2	Nos				
2	Pressure Guage +Low pressure supervisory switch	2	Nos				
3	NOVEC 1230 gas	187	Kgs				
4	Electromagnetic Actuator	1	Nos				
5	Manual Actuator	1	Nos				
6	Pneumatic actuator	2	Nos				
7	Flexible Discharge Hose	2	Nos				
8	Flexible Actuation Hose	2	Nos				
9	Discharge Nozzles	6	Nos.				
10	Check Valve	2	Nos.				
11	Flow Switch	1	Nos.				
12	Manifold	1	Nos.				
13	Wall mount kit	4	Nos				
14	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot				
15	Gas Release panel with release module and battery backu	1	Nos				
16	Manual Release Switch	2	No				
17	Abort Switch	1	No				
18	Room Integrity Test	1	Lot				
	SUBTOTAL				-		0
	GRAND TOTAL						0

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD							
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR BMS ROOM (OPTIONAL ITEM)							
S.No.	**Item Description**	**Qty**	**Unit**	**Supply**		**Installation**	
				Unit Rate	**Amount**	**Unit Rate**	**Amount**
	Supply,Installation,Testing & Commisioning of :						
1	80 ltrs Seamless Cylinder with valve	1	Nos				
2	Pressure Guage +Low pressure supervisory switch	1	Nos				
3	NOVEC 1230 gas	36	Kgs				
4	Electromagnetic Actuator	1	Nos				
5	Manual Actuator	1	Nos				
6	Pneumatic actuator	1	Nos				
7	Flexible Discharge Hose	1	Nos				
8	Flexible Actuation Hose	1	Nos				
9	Discharge Nozzles	1	Nos.				
10	Wall mount kit	2	Nos				
11	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot				
12	Gas Release panel with release module and battery backu	1	Nos				
13	Manual Release Switch	1	No				
14	Abort Switch	1	No				
15	Room Integrity Test	1	Lot				
	SUBTOTAL				-		0
	GRAND TOTAL						**0**

HPC DATA CENTRE-INDIAN INSTITUTE OF TROPICAL METEROLOGY, PASHAN, DR. HOMI BHABHA ROAD							
SCHEDULE OF QUANTITIES FOR NOVEC 1230 FIRE SUPPRESSION SYSTEM FOR SERVER ROOM							
S.No.	**Item Description**	**Qty**	**Unit**	**Supply**		**Installation**	
				Unit Rate	**Amount**	**Unit Rate**	**Amount**
	Supply,Installation,Testing & Commisioning of :						
1	120 ltrs Seamless Cylinder with valve	7	Nos				
2	Pressure Guage +Low pressure supervisory switch	7	Nos				
3	NOVEC 1230 gas	706	Kgs				
4	Electromagnetic Actuator	1	Nos				
5	Manual Actuator	1	Nos				
6	Pneumatic actuator	7	Nos				
7	Flexible Discharge Hose	7	Nos				
8	Flexible Actuation Hose	7	Nos				
9	Discharge Nozzles	23	Nos.				
10	Check Valve	7	Nos.				
11	Flow Switch	1	Nos.				
12	Manifold	1	Nos.				
10	Wall mount kit	14	Nos				
11	M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	1	Lot				
12	Gas Release panel with release module and battery backu	1	Nos				
13	Manual Release Switch	7	No				
14	Abort Switch	1	No				
15	Room Integrity Test	1	Lot				
	SUBTOTAL				-		0
	GRAND TOTAL						0

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	Access Control System						
1	Supply, installation, testing & commissioning of **Proximity card readers** having a read range of minimum 3 inches with mounting box, plate & required accessories.	No.	10				
2	Supply of **proximity cards** with the possibility of printing the company details on its facia using dye sublimation method.	LOT	25				
3	Supply, installation, testing & commissioning of TCP / IP based **Two Access Door Controllers** controlling 4 Readers (2 Entry & 2 Exit) with minimum 2 Monitor inputs & 2 Relay outputs, RS232 & RS485 communication port, complete with Encloser, in-built power supply, & Access Control Software. (**controller should have Fire trigger input facility**)	No.	2				
4	Supply, installation, testing & commissioning of TCP / IP based **Four Access Door Controllers** controlling 8 Readers (4 Entry & 4 Exit) with minimum 2 Monitor inputs & 2 Relay outputs, RS232 & RS485 communication port, complete with Encloser, in-built power supply, & Access Control Software. (**controller should have Fire trigger input facility)**	No.	1				
5	Supply, installation, testing & commissioning of surface mounted Electro Magnetic door locks having capacity of holding force of 650 lbs with Armature plate & required accessories with LED Indications.	No.	10				
6	Supply, installation, testing & commissioning of Magnetic door Sensor (Door position sensor) with required accessories.	No.	10				
7	Supply, installation, testing & commissioning of Emergency release switch (Break glass type Green in colour)	No.	5				
8	Supply and laying of 6C x 1.0 Sq.mm multi stranded, Shielded Copper FRLS Armoured cable. (**For Card Reader etc.**)	Rmt.	250				
9	Supply and laying of 4C x 1.0 Sq.mm multi stranded, Shielded Copper FRLS Armoured cable. (**For Magnetic Lock & Door Sensor etc.**)	Rmt.	150				
	SUB - TOTAL OF ACS				0		0

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	Water Leak Detection System for Server Room						
1	Supply, installation, testing & commissioning of of 8-32 Zone Water Leak Detection Control Panel with power supply & required accessories.	No.	1				
2	Supply, installation, testing & commissioning of Water Leak Detection Cable with End Connections	Rmt.	70				
3	Supply and installation of Fixing clips (At every 0.5 meter distance)	No.	Lot				
4	Supply and installation of Identification tags (At every 1 meter distance)	No.	Lot				
5	Water Leak Detection Module	No.	20				
6	Supply, installation, testing & commissioning of Sounder / Hooter having minimum 85dB.	No.	1				
	SUB - TOTAL OF WLDS				0		0

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	Rodent Repllent System for Server Room						
1	Supply, installation, testing & commissioning of Wall mount type Digital Ultrasonic Rodent Replller Control Panel having facility to connect upto 20 transducer satellites including power supply, cabinet & required accessories. Should have facility of CRMS Software & Features like Adjustment of Wave Speed, Wave Density, Frequency Band Time, Frequency & Transducer Testing. Controller Should be Password Protected.periodic pest control using However; Chemical spray can be done once in 3 months as a contingency measure to effectively fight the pest menace.	No.	1				
2	Supply, installation, testing & commissioning of Transducer Satellite Stations capable of Emitting Ultrasonic sound of frequencies between 20 Khz and 50 Khz & higher, with blinking LED Indication & mounting accessories. The transducer shall capable for covering area of minimum 500 sq.ft for ceiling / Floor void & 500 sq.ft. for room void with accessories.	No.	30				
3	Centralise Reporting & Minitoring Software for Redent Repellent System	No.	1				
	SUB - TOTAL OF RODENT REPELLENT SYSTEM				0		0

Sr. No.	Item	Unit	Qty.	Rate (Rs.)		Total (Rs)	
				Supply	Installation	Supply	Installation
	BUILDING MANAGEMENT SYSTEM						
	Supply, installation, testing & commissioning of the following controls & BMS equipments						
1	**BMS Server PC & UPS**						
1.1	Central Server with Quad Core Intel E5620 Processor 2.4GHz or better at 12M Cache, 4 GB or more of RAM, DVD RW, optical mouse, keyboard & 1 serial port. Server shall be provided with requisite MS Windows Licensed software Win ser 2008, compatible with the BMS platform	No.	1				
1.2	22" TFT color LCD monitor	No.	1				
1.3	A4 size alarm printer suitable for application with driver software	No.	1				
2	**BMS Client Workstation**						
2.1	Central Work Station **Client** with Intel processor 2 GHz or higher, with minimum 250GB HDD, 2 GB RAM, 52X DVD writer, optical mouse, keyboard & 1 serial port. Work station shall be preloaded with requisite MS Windows Licensed software compatible with the BMS platformwith Database,OS & Firewall softwares.	Nos.	1				
2.2	22" TFT color LCD monitor	Nos.	1				
3	**Graphical interface software**						
3.1	Providing necessary Software for monitoring through serial Modbus, BACnet and LONWORKS interface for the data points for all HVAC/ Electrical/ Other Equipments. The cost shall include 2 station and 2 client license for the BMS. The software shall include seamless integration with FAS / ACS / and CCTV System . The software shall be open system architecture type which facilitates interoperability with other systems supporting BACnet/Modbus protocols. The software shall have minimum 5000 addresses with Future Expansion Capability. The software shall have SMS, pging & email facility for transmitting specified alarms to designated personnel	No.	1				

4	**Protocol Convertors / Software Integrators for the following systems capable of integrating any Industrially acceptable Communication Protocols including but not limited to : Modbus RTU / Modbus ASCII / BACnet / Lonworks / M Bus / J Bus / C Bus; Made Available either on Serial RS 485 Network or TCP / IP Network.** **(Quantity & protocol mentioned in IO summary)**						
4.1	Energy meter for electrical panels and integration through Modbus protocol	Lot	1				
4.2	VFD integration through Modbus/BACnet protocol	Lot	1				

5	**System interface unit for connecting database server to DDC controllers. System interface unit should be of native BACnet type with built in BACnet router. External gateway device or proprietary software driver is not acceptable.**	Lot	1				
6	**Portable Operator Terminal (POT)** Capable to be hooked to any DDC controller to monitor & change set points of any parameter	No.	1				
7	**DDC Controller**						
	32 bit microprocessor based programmable DDC controller, expansion module compatible to native BACnet protocol. Controller shall be standalone & networkable type with built in real time clock. Controller shall support peer to peer communication. DDC controller shall be housed in IP 55 rated MS powder coated control panel duly internally wired & tested. Panel should be provided with necessary accessories, relay boards etc. DDC controller & panel quantity will be as per the IO summary for following areas						
7.1	In Substation Room	Lot	1				
7.2	In BMS Room Ground Floor	Lot	1				
8	**Field Devices duly wired to DDC: supply, installation with all necessary fixtures, site calibration with documentation, testing and commissioning.**						
8.1	Level Sesors for HSD Tank	No.	4				
8.2	Outdoor temp sensor	No.	1				
8.3	Combined Room type temp & RH sensor	Nos.	6				
8.4	Supply water temp sensor (PT-100) immersion type with thermowell	Nos.	2				
8.5	Return air temp sensor	Nos.	UR				
8.6	Room type temp & RH transmitter	No.	6				
8.7	DPDT relay with 230 VAC, 1A cont rating for fire damper actuators	Nos.	4				
8.8	Battery fumes detector sensor	Nos.	2				
8.9	Level sensors for thermal storage	Nos.	2				

8.10	Temperature sensor for Thermal storage	Nos.	1				
9	**2 way valves with actuator**						
	Supply, Installation, Testing and Commisioning of globe type 2 way chilled water valves with electric actuators for ON/OFF control for following sizes,						
9.1	DN 32,	Nos.	UR				
9.2	DN 40,	Nos.	UR				
9.3	DN 50,	Nos.	UR				
9.4	DN 65,	Nos.	UR				
9.5	DN 80,	Nos.	1				
9.6	DN 100,	Nos.	UR				
9.7	DN 125,	Nos.	UR				
9.8	DN 150,	Nos.	4				
9.9	DN 200,	Nos.	2				
9.10'	DN 250,	Nos.	UR				
10	**Supply, installation, testing & commissioning following cables**						
10.1	2 core, screened 1 sq mm ATC cable	Lot	1				
10.2	4 core, screened 1 sq mm ATC cable	Lot	1				
10.3	6 core, screened 1 sq mm ATC cable	Lot	1				
10.4	3 core 1.5 sq mm ATC shielded cable for power	Lot	1				
10.5	2 core 1 sq mm ATC shielded cable DDC communication	Lot	1				
10.6	CAT 6 cable for communication between supervisory controller & BMS server	Lot	1				
11	**Supply, installation, testing of following PVC conduits**						
11.1	1" dia	Lot	1				
11.2	1 1/2 " dia	Lot	1				
	SUB - TOTAL OF BMS					0	0

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	IP CCTV Surveillance System						
1	Supply, installation, testing & commissioning of 1/3" Progressive Scan CMOS Sensor, 3 MegaPixel Colour Dome Camera with 2.8 ~ 12.0mm Manual Verifocal Auto iris Lens, WDNR, Day & Night function with required accessories. Should be ONVIF Complaint.	No.	11				
2	Supply, installation, testing & commissioning of 16 Channel Embedded Network Video Recorder, having features like Third Party Camera Support, HDD Management & with Redundancy. 8 HDD SATA Capacity. HDMI & VGA Out Put at up to 1920 X 1080 Pixel Resolution. Should have up to 5 Megapixel recording capacity. Should be RAID 0,1,5,10 Supported. Should have minimum 30 days of recording. The system shall have auto back up tape slot for data storage	No.	1				
3	Supply, installation, testing & commissioning of Wall mount 32" High resolution Flat LCD Monitor with wall mount accessories.	No.	1				
4	Supply & installation of 30U wall mount Rack for mounting the DVR	No.	1				
5	Supply, installation, testing & commissioning of DC Power supply pack with battery backup for all Cameras.	No.	1				
6	8 Port POE Network Switch	No.	2				
7	Supply and laying of CAT 6 Shilded Cable in PVC Conduit	RMT	130				
	SUB - TOTAL OF IP CCTV Surveillance System				0		0

Sr. No.	Item	Unit	Qty.	Rate (Rs.)		Total (Rs)	
				Supply	Installation	Supply	Installation
	VESDA SYSTEM						
	Supply, installation, testing & commissioning of the following System						
1	**Sampling Unit**						
1.1	Supply, Installation, Testing & Commissioning, calculations of flow and hole sizes in pipe network. Sampling unit shall be prepared for laser chamber or optical smoke detectors. Detected smoke density shall be able to be adjusted between high sensitivity to equal as ordinary smoke detector. Sampling system is connected to loop for ordinary fire alarm via address unit. Operation of sampling unit and status shall be able to display in fire alarm central unit. Sampling unit shall have 4 exits for: 1) Pre-alarm 1 2) Pre-alarm 2 3) Fire 4) Fault 25 mm pipe network shall be connected to sampling system, each unit shall be capable of minimum 1x160 m M-pipe system. Sampling unit shall have indications for operation, fault, prealarm1 and pre-alarm 2. Smoke testing shall be done when commissioning to secure functionality of the system Power supply. 240 volts AC power supply with fault alarm connected too fire alarm system.	No.	20				

2	**Sampling Pipe**						
2.1	ABS piping should be used due to its strength and heat resistant properties. The pipe sections should be glued together using a suitable ABS glue to avoid separation orleaks. If a section of pipe is likely to need to be disconnected for some reason in the future, removable unions should be used instead. Fixings The means of fixing the pipe to the structure will depend on site conditions. The normal methods are pipe clips, saddle clamps or even tie wraps. End Cap The end of the pipe is terminated with an end cap with a hole, typically 6mm diameter in it. If the end cap is not used, then practically no air will be drawn through the side holes. If the end cap does not have a hole then the contributions from the side holes will tend to be very unbalanced. Bends Bends are either 45 or 90 degrees. For the 90-degree bends it is very important that slow radii are used and not a sharp elbow, as this will introduce unacceptable pressure losses, and significantly increase the response times from holes beyond the bend. T Pieces Use of T joints should be avoided as much as possible in these types of low pressure wide bore systems. They make the pipe design and air flow calculation very difficult to predict with any accuracy.	Rmt.	250				
	SUB - TOTAL OF VESDA SYSTEM					0	0

Sr. No.	Description	Unit	Qty.	Supply Rate, INR	Supply Amt, INR	Labour Rate, INR	Labour Amt, INR
	Dry Powder Base Sprinkler system						
1	Automatic Fire Extinguisher with Clean Agent Type - The container shall be made with MIG welded MS body. The upper part shall be with flange. - The extingisher shall be fixed with sprinkler head which shall operate at an temperature of 72 Deg C. - The unit shall be fitted with pressure guage. - The propellent shall be with Nitrogen						
1.1	15 Kg Capacity	No.	47				
	SUB - TOTAL OF Dry Powder Type Sprinkler System				0		0

Sr. No.	DESCRIPTION	SUPPLY AMOUNT, INR	LABOUR AMOUNT, INR	SUB - TOTAL, INR
1	Fire Alarm System			
2	Gas Suppression Sysyem			
3	Access Control System			
4	Water Leak Detection System for Server Room			
5	Rodent Repllent System for Server Room			
6	BUILDING MANAGEMENT SYSTEM			
7	IP CCTV Surveillance System			
8	VESDA SYSTEM			
9	Dry Powder Base Sprinkler system			
	GRAND TOTAL - BASIC ONLY			0

PROPOSED CONSTRUCTION OF DATA CENTRE FOR IITM , PASHAN.					
SR.NO	**DISCREPTION**	**QUANTITY**	**UNIT**	**RATE**	**AMOUNT**
1a	**FALSE FLOORING …**				
	Providing and Fixing of Unifloor FS1000H access floor system shall be made from steel cementitious infill and provide for adequate fire properties, acoustic barrier and air leakage resistance. The system shall be able to withstand a UDL of 1670kg. Per sqmt. And a point load of 450 kg. Panels shall be finished with High Performance Anti Static Laminate.				
	Panels shall be made from steel. The bottom of the panel shall be embossed in hemispherical shape to give strength and flexural rigidity. The top sheet shall be plain and resistant welded at various locations after the top and bottom sheets have been degreased and phostated to form a single composit unit. The entire panel shall be quoted with epoxy coating on the exposed surface and then the hollow panel shall have an infill of light weight cementitious material, panel shall remain flat through and stable unaffected by humidity or fluctuation in temp through out its normal working life. Panel shall provide for impact resistance top surfaces minimal deflection, corrosion resistance properties and shall not be combustible or aid surface spread of flame, panels shall be insulated against heat and noise transfer. Panels shall provide qualities of concrete slabs, panels shall be of size 600x600mm and 35mm thick fully interchangeable with each other within the range of a specified lay out. Panels shall be free standing onto the structure.				

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Pedestal - Pedestals installed to support the panel shall be suitable to achieve a specified floor height from the existing floor level and shall be placed 600mm distance in both directions to form a grid of 600x600mm. Pedestal should have GI Base plate of 100 x100 x 2.5mm thk, GI Pipe 22 Dia x 2.2 mm Thk, check nut for level adjustment, 16 mm dia threaded stud with GI pedestal head of size 75 x 75 x 3.5 mm thk, stringe, all scews etc and design shall confirm speedy assembly and removal for relocation and maintenance. Pedestal assembly shall provide for easy adjustment of levelling and accurately align panels to ensure lateral restrain. for prevention of corrosion pedestals are either powder coated or zinc electroplated as required. Pedestal shall support an axial load of 2200kg. without permanent deformation and an ultimate load of 3500kg. The pedestal flat head then shall receive the panel which shall be fastened by screws to the pedestal head to form a rigid grid to achieve FFH of 750mm. Mode of measurement : Cut tiles less than 300mm shall be considered as 300mm and more than300mm shall be considered as 600mm.				
a	High Performance Anti Static Laminate Panels	475.00	SQM		
b	Raised Floor Pedestals includings Stringer for panel support	500.00	SQM		
c	Perforated Panel 26 % with out damper	70.00	NOS		
d	Panel Lifter - Heavy Duty	4.00	NOS		
e	Grommets for cable Access	100.00	NOS		
1b	**Item as Above but for**				
	i) For Height of 300 mm	20.00	SQM		
	ii) For Height of 450 mm	20.00	SQM		
2	**EPOXY FLOORING**	250.00	SQM		
	Providing and laying 'SIKA' make self leveling type 2 mm thick epoxy screed flooring of approved color, over 4mm thick base coat as per manufacturer's instructions including surface preparation, building up the desired thickness with layers, top coat, cleaning, testing complete with 5 years guarantee.				
3	**ALUMINIUM CHEQURED PLATE …**	250.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing fabricating and fixing Aluminium Chequred plate 6 mm thick for platform as per the detailed drawings including fabrication, fixing and placing in position, leveling etc. complete.				
4	**NEOPRENE ACOUSTICAL SHEET…**	250.00	SQM		
	Providing and fixing Neoprene rubber sheets of 5 mm thk for Noise / Vibration Control Underlayed aluminium chequered Plate. Including Fixing and placing in position, leveling etc. complete.				
5	**MODULAR FALSE CEILING…**	500.00	SQM		
	Providing and fixing false ceiling system manufactured by Armstrong or Equivalent make using hot dipped galvanized steel section, rotary stitched main tee of size 15mm x 42 mm web height, having 0.36 mm gauge at every 600 mm centre to centre maximum and rotary stitched cross tee of size 15 mm x 42 mm, having 0.33 mm gauge at every 600 mm. c/c. and wall angle of size 19 x 19 mm., having 0.35 mm gauge fixed to the periphery of the wall. The above grid is suspended at every 600mm c/c. in both directions using 2.0 mm. thick pre-straightened GI wire laying FINE FISSURED MICROLOOK WITH SILHOUETTE GRID(BLACK REVEAL) ceiling tiles manufactured by Armstrong or Equivalent make of size 600mm x 600mm x 15mm having NRC 0.55, Light reflectance of >84% (WT), thermal conductivity k = 0.052-0.057 W/m0K, Humidity Resistance of 99% , having Fire Performance CLASS O / CLASS 1 (BS 476) - 2 hr, surface having 3 coats of white paint with Fine Fissured, back of the tile duly sanded and finished with a coat of protective paint over the formed grid etc. complete				
6	**FIRE RATED PARTITION…**	285.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing and fixing Min. 2 Hour fire rated 132mm thick Gypsteel Ultra™ stud partition which includes two layers of tapered edge 15mm thick Gyproc® Fireline boards (conforming to IS:2095 – 1996-Part-I) is screw fixed with drywall screws of 25mm & 50mm at 300mm centres to either side of 70mm Gypsteel Ultra™ C stud (0.5mm thick having one flange of 34mm and another flange of 36mm made of GI Steel) placed at 610mm centre to centre in 72mm Gypsteel Ultra™ floor and ceiling channel (0.5mm thick have equal flanges of 32mm made of GI steel), which is anchored to the floor & true ceiling using suitable anchor fasteners. The boards are to be fixed to the framework with joints staggered to avoid leakage through joints. A Gypsteel Ultra 70mm Noggin channels has to be provided at the horizontal joints of the outer layer of boards screw fixed to the studs using metal to metal flat head screws.				
	Finally square and tapered edges of the boards are to be jointed and finished so as to have a flush look which includes filling and finishing with Gyproc Jointing compound, Gyproc Joint Paper tape and two coats of Drywall Top Coat (as per recommended practices of Saint- Gobain Gyproc India) . The junction of the partition with masonry & all penetration through the partition has to be treated with a intumescent fire sealant of equivalent fire rating.				
7	**FIRE RATED STEEL DOORS…**				

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	providing and fixing 2 hr fire rated doubble skin steel door constructed from 1.25mm thick galvanized steel sheet formed to provide a 46mm thick fully flush door shell with lock seam joints at stile edges and the internal construction of the door is a specially designed Honey Comb structure with reinforcements at top, bottom and stile surrounds. As per IS 3614 part-1 & part-2 for stability and integrity and Pressed Galvanized steel confirming to IS 277. Fire door should be tested at CBRI or ARAI for maximum rating of 2hrs with vision panel. Vision Glass panel should be 6mm thick clear glass provided in square in standard dimensions of 300mm x 300mm. Door Frame should be produced from 1.6 MM thick galvanized steel sheet formed to double rebate profile of size 143mm X 57mm (+/- 0.3mm) with a maximum bending radius of 1.4mm and fixed as per manufacturers specification. Including all approved type(Dorma Make) heavy duty fastenings and fixtures comprising of :S.S. Ball Bearing Butt hinges 3 mm thk, Mortise Sash Lock with Lever Handles,D handles, Mortise Dead Bolt, Mortise Latch, Door Closer, air seal gaskets between shutter and frame, etc complete.				
	The door frames and door shutters are primed with Zinc-Phosphate Stoving Primer and finished with Polyurethane Aliphatic grade or epoxy paint as per approved manufacturer specifications. (Supplier -Shakti Met-dor or approved equivalent). (Note - Test certificates should be available for vision panels as part of the fire door assembly. Independent glass test certificates will not be accepted. Manufacturer test certificate shall cover doors both single and double leaf and all doors supplied should be within the tested specimen, deviation in specification and sheet thickness other than what is mentioned in the test certificates are not allowed. Proper label confirming the type of door and the hourly rating is mandatory.)				
a	Single Leaf Door - 2 Hr Fire Rated				
	i) 1200 x 2100 with vision panel	1.00	NOS		
	ii) 900 x 2100 without vision panel	10.00	NOS		
b	Doubble Leaf Door - 2 Hr Fire Rated				
	i) 1800 x 2100 with vision panel	4.00	NOS		
	ii) 1800x 2400 without vision panel	1.00	NOS		
c	Doubble Leaf Door - 4 Hr Fire Rated				

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	i) 1800 x 2100 with vision panel	1.00	NOS		
8	Item same As Above but for 2 hr fire rated Sliding door with Vision panel				
	i) 1800 x 2100 with vision panel	1.00	NOS		
9	**PANIC BARS …**				
	Supplying and fixing Dorma or Equivalent make panic bar with all fittings etc complete.				
	i) for Single Leaf Door	2.00	NOS		
	i) for Doubble Leaf Door	2.00	NOS		
10	**LUSTER...**	1270.00	SQM		
	Providing and applying Luster of approved make and shade on all surfaces at all heights in three coats including scaffolding, preparing the surface by brushing and brooming down, applying primer two coats and final luster paint applying and levelling the surface with coat of Birla white putty before and after the primer coat and also after the first coat etc. complete. The dry/wet cleaning of floors/pipes/glass etc. after painting is to be carried out, protection of surfaces before painting is included in the item.				
11	**FIRE PAINT…**	200.00	SQM		
	Providing and applying 2 hr fire rated paint of approved make and shade on all surfaces as per manufacturers specifications at all heights including scaffolding, preparing the surface by brushing and brooming down, applying primer coat and top coat, applying and levelling the surface with coat of Birla white putty before primer. The dry/wet cleaning of floors/pipes/glass etc. after painting is to be carried out, protection of surfaces before painting is included in the item. Flat area in horizontal and vertical plane will be measured for payment. No additional payment will be made for grooves, cornices, vatta, moulding etc complete.				
12	**FIRE EXPANDING FOAM…**	5.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing and applying fire Expanding Foam having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 and UL 1479 for horizontal and vertical openings in RCC slabs, Beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The service lines could be of various types like electrical cables, cable trays or metal pipes etc. The foam shall have Acoustic property as per DIN 4109 and Smoke and Air Seal. The Foam should have the feature of Repenetrability for future maintance or repair activities. item includes scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 620/3M or approved equivalent)				
13	**FIRE BARRIER MORTAR…**	5.00	SQM		
	Providing & applying fire Barrier Mortar having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 and UL 1479 for horizontal and vertical openings in RCC slabs,beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The mortar shall have minimum hardened density of 0.8 g/cm3 and compressive strength of 2.9N/Sq mm . The service lines could be of various types like electrical cable trays , metal pipes, GI Ducts for AC etc. It should be Smoke & Air Seal. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 636/3M or approved equivalent)				
14	**WATER SOLUBLE CABLE COATING…**	50.00	RMT		
	Providing & applying water soluble cable coating applied with brush or airless spray to prevent the propagation of fires along internal electrical cables. Should be suitable for protectiing against spread of flame on timber panels and tested as per IEC 332 part 3 standard for reduced spread of flame & tested as per FM Class 3971. It should have no derating effect on cables, free from fibre,asbestos, odourless and solvent free, flexible when dry after application. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti /3M or approved equivalent)				
15	**FIRE RESISTANT BOARD SYSTEM…**	5.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing & fixing fire resistant board system having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 for horizontal and vertical openings in RCC slabs,beams, walls, Brick masonry or Gypsum partitions for passing service shafts. The fire resistant board system shall comprise of a mineral wool board having a minimum density of 160kg/m3 coated with an ablative coating at 0.7mm dft. All contact surfaces and cavities shall be sealed with an firestop filler. The service lines could be of various types like electrical cables trays, metal pipes, etc.The Mineral Wool Board should also have the Acoustic property ,Air and Smoke seal. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 678/3M or approved equivalent)				
16	**GRAPHITE BASED INTUMESCENT FIRESTOP SEALANT…**	5.00	SQM		
	Providing & applying graphite based intumescent firestop sealant having minimum of 2 hours fire rating when tested in accordance with BS 476 part 20 suitale for annular space for combustible pipes and cables.It should expand in fire , protecting pipe and cable penetration and must be halogen, solvent free and odourless. Firestop sealent should have property of Accoustic, Smoke and Air sealing. Item include scaffolding, finishing, cleaning etc. complete at. all heights, levels & floors. (Make:Hilti CP 611 A/3M or approved equivalent)				
17	**MAKING THROUGH HOLES...**				
	Making through holes in plain or reinforced cement concrete with Diamond core drilling system by using Bosch power tools.of following diameters. Rate in Dia/mm				
	a) 52 mm	1500.00	Dia/mm		-
	b) 82 mm	3000.00	Dia/mm		-
	c) 112 mm	2000.00	Dia/mm		-
	d) 122 mm	4000.00	Dia/mm		-
	e) 152 mm	4000.00	Dia/mm		-
	f) 202 mm	4000.00	Dia/mm		-
18	**SOFT BOARD WITH FIRE RATED FABRIC…**	5.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing and Fixing approved shade and make FR grade Polyester-Cotton fabric over 12mm thick softborad of required size, on partition/wall etc. The fabric shall be certified to pass Surface Abrasion test of no yarn breakage after abrasion test across 10000 cycles; Fire Retardant finish as per BS EN 1021-1:1994, BS 7176:1995 low hazard section, IS 15061-2002 Clause 3.3 annex. B (Vertical test) and water repellent as per standard AATCC-118. Item to include all accessories, tools & labour, getting mock-up for approved by Architect/Engineer in charge; with Protecting with min. 20 micron polythene sheet cover till handover of facility, item complete with tight wrinkle free wrapping around soft board or approved boarding substrate, finished cleaned complete. The board shall be fixed on prepared surface with necessary hardware fittings etc. complete. Rate quoted shall be for the complete finished work including all the materials and labour mentioned above. Item to be completed in all respects as per instructions from Project- in-charge.				
19	**White board-Portable**	5.00	SQM		
	Providing and placing on location Portable framed Magnetic Glossy finish type White board avg. 900 x 1200 size, as per approved model and make, with particle board backer and encasing. Item to include all fixing accessories, a marker/duster tray, including keeping in packaged condition till handover, cleaned complete. The item shall be supplied with necessary accessories such as magnetic symbols, magnetic letters, magnetic strips, magnetic eraser, magnetic dry marker 4 Nos., spare felt for eraser, board fixing clips etc. complete and all as per manufacturer's specification and as directed by the EIC / Architect.				
20	**EXECUTIVE TABLES**	1.00	NO		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing & fixing in position Executive tables with 18 mm MDF with drawers & storages, should have 1 mm thick Laminte of approved quality and shade of Laminate for all exposed surface .All unlaminated faces should have a melamine polish of matching shade of Laminate. Polish and chamfered for edge. The cost includes all necessary hardware like brass hinges/ locks, drawer channel, provision of cable manager, preparation of mockup etc complete. (For keeping keyboard special fixtures like INNOFITT or Equivelent to be provided)				
a	TRAVEL DESK (1350L x 750W x 750H)				
21	**LOW BACK CHAIRS**	3.00	NO		
	Providing and supplying in position revolving chairs having 5 prong FR nylon in black finish or 5 prong aluminium in chrome finish with castors. The seat should be having gas lift adjustment with gas stroke. The mechanism for the chair should be synchronized tilt mechanism with multiple locking position. The seat and back of the chair should be made up of injection moulding PU foam with 12mm thick double ply backing. The seat and back should have fabric upholstry in specified colour and texture. The chair should have adjustable seat depth. The back rest should be made up of poly propylene with height adjustment. The arm rest should have height adjustment and to be made up of injection moulded PU foam and should be supported on a polypropylene hand rest assembled to the main body of the chair which is made up of polypropylene with fabric/rexine upholstry of approved color & texture. The colour of the fabric/rexine should be as specified by Architect. The chair should confirm the ANSI/BIFMA X5.1 standard. The cost of the chair includes preparation of mock up etc. complete. (The density of the foam should be 45 Kg/m3)				
22	**Room Signages/ Manager Cabins/ Utility Rooms(150x300)**	10.00	NOS		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing & fixing Aluminium Modular Signage using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish. **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Photo paper Insert				
23	**Way Finding Sign/Department Identification (150x600)**	10.00	NOS		
	Providing & fixing Aluminium Modular Signage using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish. **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Photo paper Insert				
24	**Fire Evacuation Map (400x300)**	2.00	NOS		
	Providing 7 fixing Aluminium Modular Signage , fire evacuation map using Aluminium Alloy 6063 extrusion with Anodising (The thickness of the anodization is typically 30 microns. The integrity of the anodize coating is tested to meet the international specifications ISO 2143-1981.) With lifetime Warranty in normal working condition. **Clear Cover :** Clear UV protected 1mm thick Poly carbonate Sheet with Non Glare/Glossy Finish. **Plastic End Cap :** High Quality ABS End Caps with Screws which can be fastened into the extrusion. **Graphics :** Night Glow Vinyl with clear film Printing				

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
25	**Structural steelwork in hot rolled tubular sections...**	4.50	MT		
	Providing fabricating & erecting structural steelwork in hot rolled tubular Sections for trusses, purlins etc. with all bracings, gusset plates etc. as per detailed drawing or as directed at all heights and levels including removing the scales & burrs, cleaning with phosphoric acid ,marking, Cutting, fabrication, hoisting, erecting & fixing in position, making alignment of members making welded / bolted / riveted connections with one coat of approved red-oxide paint etc complete				
26	**Structural steelwork in hot rolled sections...**	1.50	MT		
	Providing fabricating & erecting structural steelwork in hot rolled sections (ISMB, ISMC, ISA) For columns, tie beams, trusses, purlins, gantry, monorail columns, plates, cable trays, pipe racks, castellated beams, staircase & other structural members with all bracings,gusset plates etc.as per detailed drawing or as directed at all heights and levels including removing the scales & burrs, cleaning with Phosphoric acid, marking, cutting, fabrication, hoisting, erecting & fixing in position, making alignment of members making welded / bolted / riveted Connections and finishing with two coats of synthetic enamel paint of approved quality and colour over one coat of approved red-oxide paint etc complete. Yield Stress FY = 250Mpa as per IS 2062				
27	**Auto Clave Masonry (Light weight blocks Masonry)**	40.00	SQM		
	Providing and constructing 200 mm thick Auto clave block masonry at all elevations and heights in cement mortar 1:4 using (150 x 300 x 600)size with required size block bats , including all scaffolding, staging, racking the joints, curing etc., at all heights, elevations above and below finished floor level etc., all complete shall be as per specification and laid as directed.				
28	**Internal cement plaster (neeru finish)...**	80.00	SQM		

SR.NO	DISCREPTION	QUANTITY	UNIT	RATE	AMOUNT
	Providing and applying Plastering of internal walls and ceiling with cement mortar 1:4, 12 - 15 mm thick with neeru finish according to specifications. Rate includes providing & fixing in position expanded metal plaster mesh [Arpitha make] or equivalent minimum 6" wide strips at the junctions of R.C.C columns/ beams/slab with brick work or wherever necessary, properly fixed, abutting the wall surfaces so as to get the plaster in line and plumb, necessary staging,scafolding and curing at all levels and elevations etc.complete as directed.				
29	**Granite stone, skirting, treads, risers...**	8.00	SQM		
	Providing and laying high polished approved quality and shade 20 mm thick Granite stone for treads, risers and skirting in line and level on a bed of 1:4 cement plaster including cement float, filling joints with matching color Cement slurry, curing, edge high polishing, chamfering, cleaning, etc. complete. (Basic Rate - 150 Sqft)				
30	**Fire Rated Vision Glass Window…**	10.00	SQM		
	Min. 2 hr Fire Rated Vision Glass Window with all Framing & Fixtures (Note - Fire Rating should be for Hole Assembly ie Glass + framing)				
	TOTAL				

Sr. No.	Description	Unit	Qnty	Supply		Installation	
				Rate	Amount	Rate	Amount
	SECTION - I : LV Panels & Distribution Boards						
1.0	Supply ,Installation, testing and commissioning of L.T. panel boards Compartmental cubicle type, freestanding with appropriate cable entries, with **Cu** busbars & manufactured based on IS 8623, AEPPL specifications and single line diagrams. Scope shall include unloading, shifting, unpacking, Section assembly from storage place to desired Installation.All required protections will be as per SLD. **(Panels will be supplied by Contractor, M.S. steel angle support fabrication shall be considered separately.)(As per Main SLD No.ITM_137_PD_ELEC_SLD_001)**						
1.1	4000A Outdoor Isolation Panel Consisting of 4000A,ACB,Ics=Icu=60kA & 2 nos of 4000/5A,15VA,CL-PS & 5P20 Resp..Bottom incoming & top Outgoing	Set	2				
1.2	ATS Panel-01 Consisting of 4000A,ATS & 4000A,ACB,60kA,LSIG Protections	Set	1.00				
1.3	ATS Panel-02 Consisting of 4000A,ATS & 4000A,ACB,60kA,LSIG Protections	Set	1.00				
1.4	Main LT Panel - 01	Set	1.00				
1.5	Main LT Panel - 02	Set	1.00				
1.6	Utility Panel	Set	1.00				
1.7	Chiller Panel-01	Set	1.00				
1.8	Chiller Panel-02	Set	1.00				
1.9	UPS OUTPUT Panel-A	Set	1.00				
1.10	UPS OUTPUT Panel-B	Set	1.00				
1.11	Power Distribution Board -01A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.12	Power Distribution Board -02A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				

1.13	Power Distribution Board -**03A with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.14	Power Distribution Board -04A **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.15	Power Distribution Board -01B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.16	Power Distribution Board -02B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.17	Power Distribution Board -03B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.18	Power Distribution Board -04B **with 325 KVA 415/415V,K-4 Isolation Transformer with Off circuit tapps-380/400/415V**	Set	1.00				
1.19	Variable Primary Pump Panel -01	Set	1.00				
1.20	Variable Primary Pump Panel -02	Set	1.00				
1.21	Server Area PAC DB-A	Set	1.00				
1.22	Server Area PAC DB-B	Set	1.00				
1.22	Other Area UPS PDB	Set	1.00				
1.23	600 kVAR RTPFC-1 with 7% detuned reactor with Thyristor Switch	Set	1.00				
1.24	600 kVAR RTPFC-2 with 7% detuned reactor with Thyristor Switch	Set	1.00				
1.25	CDU Panel-01	Set	1.00				
1.26	GF Cooling Panel-Wall Mounted Group type Construction	Set	1.00				
1.27	Supply installation,testing & commissioning of 630A 3P,35kA Automatic, Transition,Overlaping Neutral with enclosure ATS Switch	Set	3.00				
1.28	Supply installation,testing & commissioning of 100A 3P,25kA Automatic, Transition,Overlaping Neutral with enclosure Change Over Switch(COS)	Set	3.00				
1.29	Supply installation,testing & commissioning of 70A 3P,25kA Automatic, Transition,Overlaping Neutral with enclosure COS	Set	4.00				

2.00	Supply,Installation, Testing & Commissioning of Copper, indoor/ Outdoor Sandwitch type **busduct** as per location/ specification of busduct. Busduct shall include all horizontal / vertical lengths, bends, phase cross over chamber if necessary, flexible Al./Cu. jumper at Panel/ Trafo. end. Scope shall include unloading, unpacking, section assembly, shifting from storage place to desired location. **(M.S. steel support fabrication shall be considered separately.)(Actual lengths shall be measured at site prior to procurement.**						
2.1	4000 Amps, 55kA TPN Aluminium, Sandwitch type Busduct Indoor/Outdoor as per datasheet.	Rmtr	50.00				
2.2	PCC end tinned copper flexible	Set	4.00				
3.0	Supply, Installation, Testing and Commissioning of double door prefabricated recessed type MCB DB with CRCA sheet fabrication with powder coated body concealed in wall or on support structure. Steel support fabrication shall be considered separately						
3.1	Phase Segrigated 8 way TPN DB with 40A, TP MCB as Incomer & 40A, 30mA,DP, RCBO as subincomer 3 Nos & 24Nos. of 10-20A SP MCB as O/Gs.**(LDB 1)**	Set	2.00				
3.2	Phase Segrigated 4 way TPN DB with 63A, TP MCB as Incomer & 63A, 30mA,DP, RCBO as subincomer 3 Nos & 12Nos. of 10-20A SP MCB as O/Gs.**(RPDB 1)**	Set	2.00				
3.3	12 way VTPN DB with 100A TP MCCB as incomer & 2 Nos. of 63A TP MCB,5 Nos. of 16A TP MCB & 2 Nos of 32A TP MCBs, & 9 nos. 20A SP MCB as O/Gs. **(ACDB)**	Set	1.00				
3.4	12 Way SPN DB with 25A,DP,30mA,RCCB as incomer & 10Nos 10A SP MCB as O/Gs.(Main **ELDB**)	Set	1.00				
4.0	Pre-fabricated, **IP 42** enclosure with power sockets, necessary cable glands & spare knockout holes comprising of:-						
4.1	1 No. - 20A 1ø 3 pin Industrial socket + 20A SP MCB.	Set	10.00				
5.0	Supply,Installation,Testing Commissioning of power sockets, necessary cable glands & spare knockout holes comprising of:-						
5.1	Pug & Sockets 32Amps 3Ph + N + G (IEC 309)	Set	215.00				
5.2	Plug & Socket 16 Amps P + N + G (IEC309)	Set	35.00				

	TOTAL : SECTION - I				**0**		**0**
	SECTION II : L.V. Cables. (XLPE Insulated)						
1.0	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Note:-Actual cable lengths shall be measured at site prior to procurement.)**						
1.1	3.5C x 400 Sq.mm. A2XFY Cable.	Rmtr	#####				
1.2	3.5C x 300 Sq.mm. A2XFY Cable.	Rmtr	1900.00				
1.3	3.5C x 95 Sq.mm. A2XFY Cable.	Rmtr	70.00				
1.4	3.5C x 50 Sq.mm. A2XFY Cable.	Rmtr	500.00				
1.5	4C x 25 Sq.mm. A2XFY Cable.	Rmtr	130.00				
1.6	4C x 16 Sq.mm. AYFY Cable.	Rmtr	700.00				
1.7	4C x 16 Sq.mm. AYFY FRLS Cable.	Rmtr	300.00				
1.8	4C x 10 Sq.mm. AYFY FRLS Cable.	Rmtr	300.00				
1.9	4C x 6 Sq.mm. YWY FRLS Cable.	Rmtr	110.00				
1.10	4C x 4 Sq.mm. YWY Cable.	Rmtr	700.00				
1.11	4C x 2.5 Sq.mm. YWY Cable.	Rmtr	250.00				
1.12	4C x 2.5 Sq.mm. YWY FRLS Cable.	Rmtr	600.00				
1.13	3C x 2.5 Sq.mm. YWY Cable.	Rmtr	500.00				
1.14	3C x 2.5 Sqmm YY FRLS Cable	Rmtr	800.00				
1.15	5C x 6 Sqmm YY FRLS Cable	Rmtr	8500.00				
1.16	1C x 300sqmm YY FRLS Cable	Rmtr	#####				
1.17	1C x 70 Sqmm YY FRLS Cable	Rmtr	800.00				
1.18	24C x 2.5 Sqmm YWY Cable	Rmtr	250.00				
2.0	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.						
2.1	3.5C x 50 Sq.mm. A2XFY Cable.	Nos.	28.00				
2.2	4C x 25 Sq.mm. A2XFY Cable.	Nos.	4.00				
2.3	4C x 16 Sq.mm. AYFY Cable.	Nos.	24.00				

2.4	4C x 16 Sq.mm. AYFY FRLS Cable.	Nos.	8.00				
2.5	4C x 10 Sq.mm. AYFY FRLS Cable.	Nos.	18.00				
2.6	4C x 6 Sq.mm. YWY FRLS Cable.	Nos.	4.00				
2.7	4C x 4 Sq.mm. YWY Cable.	Nos.	4.00				
2.8	4C x 2.5 Sq.mm. YWY Cable.	Nos.	4.00				
2.9	4C x 2.5 Sq.mm. YWY FRLS Cable.	Nos.	28.00				
2.10	3C x 2.5 Sq.mm. YY Cable.(PG Gland)	Nos.	50.00				
2.11	5C x 6 Sqmm YY Cable (PG Gland)	Nos.	450.00				
2.12	1C x 300sqmm YY Cable PG Gland Termination	Nos.	376.00				
2.13	1C x 70 Sqmm YY Cable PG Gland Termination	Nos.	40.00				
2.14	24C x 2.5 Sqmm YWY Cable	Nos.	4.00				
3.0	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking etc						
3.1	3.5C x 400 Sq.mm. A2XFY Cable.	Nos.	148.00				
3.2	3.5C x 300 Sq.mm. A2XFY Cable.	Nos.	88.00				
3.3	3.5C x 95 Sq.mm. A2XFY Cable.	Nos.	2.00				
	TOTAL : SECTION - II				**0**		**0**
	SECTION III : Earthing						
1.0	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete**(Eqvt toSGI,JEF,Ashlok T 39)** with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder/compound, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling.	Nos.	32.00				
2.0	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. or in ready made trenches or on ready tray with necessary clamps & bimetallic srips as per specification. (excavation required for this will be ensured separately.) Refer layout & tender spec for various applications						
2.1	75 x 10 mm. GI strip.	Rmtr	400.00				
3.2	50 x 10 mm. Cu strip.	Rmtr	600.00				

3.3	50 x 10 mm. GI strip.	Rmtr	500.00				
3.4	50 x 6 mm. GI strip. (Main Grid+ Cable Tray)	Rmtr	500.00				
3.5	32 x 6 mm. GI strip.	Rmtr	300.00				
3.6	32 x 6 mm. Cu strip.	Rmtr	250.00				
3.7	25 x 3 mm. Cu. strip	Rmtr	2500.00				
3.8	32 x 6 mm. GI strip. Supported on Porcelain insulator/ J bolt at every 1.5 mtr interval for building L.A.	Rmtr	200.00				
3.9	8 SWG GI Wire.	Rmtr	500.00				
3.10	1C X 10 Sqmm YY FRLS Cable	Rmtr	250.00				
4	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" to cover protection radius of 65.0 mtr. With 3 mtr rod height & with stem and fixing arrangement. (Indelec). Required installation/ mounting details shall be submitted prior to installation.	Nos.	1.00				
5	Supply, installation, testing of disconnecting link box for lightning down conductor at 1 mtr. from GL with SMC insulator and Gunmetal 50 x 6 mm disconnecting link.	Nos.	2.00				
	TOTAL : SECTION III				**0**		**0**
	SECTION IV : UPS						
1	Supply, Installation, testing and commissioning of 500 kVA UPS , consisting of following Input 433V 3 Ph + N + E +/-10% 50Hz Output 400V 3 Ph + N + E , -2% 50Hz Unsymmetrical load with SMF battery backup for 15 min. Racks & Intercell connectors suitable for batteries UPS to battery DC cable to be consider Installation & commissioning of Batteries & UPS (Lenghths as per actuals)	Set	6				
2	Supply, Installation, testing and commissioning of 100 kVA UPS consisting of following Input 433V 3 Ph + N + E +/-10% 50Hz Output 400V 3 Ph + N + E , -2% 50Hz Unsymmetrical load with SMF battery backup for 15 min.	Set	2				

2	Racks & Intercell connectors suitable for batteries UPS to battery DC cable to be consider Installation & commissioning of Batteries & UPS (Lenghths as per actuals)	Set	2				
3	As above but 2 x 2.5 + 1 x 1.5 Sq.mm. wires. In provided floor Truff / PVC conduit	Rmtr	500.00				
4	Providing & fixing 2 Nos. modular 5 A socket & switch (on UPS) and 1 no 5A & socket & switch (on Raw Power) with modular plate and box at one place for UPS & mains connections above table top	Set	10.00				
5	Supply & Installation of MS boxes in flooring made from 16 SWG M.S. sheet with Stainless steel cover of 14 SWG of following sizes						
5.1	Supply and installation of Surface / concealed 25mm dia **PVC Conduit** with spacer saddles for computer and telephone / speaker wiring concealed in office area walls & open other places with pull boxes etc.	Rmtr	200.00				
5.2	Supply and installation of Surface / concealed 25mm dia **GI Conduit** with spacer saddles for transformer area wiring walls & open other places with pull boxes etc.	Rmtr	100.00				
	TOTAL SECTION - IV				**0**		**0**
	SECTION V : Point Wiring						
1.0	Surface / concealed point wiring for light / fan call bell / 5 A points with 2 x 2.5 + 1 x 1.5 Sq.mm. multistrand Cu. wires 1100 V gr. in suitable 25mm **PVC conduits** / flexible conduits wherever required as submains and 2 x 1.5 + 1 x 1.5 Sq.mm. **FRLS** wires for each point complete (submains will not be measured separately) with necessary modular switch board, switch plates and Blanking plates & accessories as required etc. to complete the task.. Primary Point shall mean first point wired from switchboard and Secondary point shall mean successive points next to Primary point. **(Areas : Office, canteen, Security cabin, Toilets,Production Shop)**						

	Note:- All conduits in area with false ceiling shall be concealed in wall below false ceiling,**point wiring height will be 3-4 mtr from FFL**						
1.1	Primary Light point wiring with necessary 5 A SP Switch , ceiling rose / Holders compete. (Maximum 2/3 points controlled by one Switch) as reqiured to complete the job.	Pt.	40.00				
1.2	As above but Secondary Light point wiring.	Pt.	50.00				
2.0	Fan point with modular 5 A SP Switch, 5 step Electronic fan Regulator, switch box plate & fan hook box etc. modular, fan box.	Pt.	20.00				
3.0	**Supply, installation,** testing and commissioning of lighting fixtures/ fans/Ex. fans etc. including necessary electronic ballast, lamp, accessories, wiring connection, support arrangement like suspension chain, M.S. conduit drop with ball socket. down drops, etc. All FTL fixtures shall be with triphosphor source						
3.1	2 X 28 Watt TL-5 Weather Proof Luminaire suitable for TL-D and TL5 Lamps. high grade Polycarbonate housing and cover.TCW450 2xTL5-28W EBT	Nos.	50.00				
3.2	4 x 14 Watt high efficiency Surface mounted luminaire suitable for T5 lamp with dimmable balast. (Make:- Philips Cat no.- TPS814 4xTL'5'14W/EBP D8 (4xTL'5'14W) or equivalent)	Nos.	60.00				
3.3	1x 28 watt Saviour Slim Channel luminaire (Wipro WRF 20128 SGW)	Nos	10.00				
4.0	Supply, installation testing of Ceiling/Exhaust fans with necessary acessories to complete the job.						
4.1	Supply, installation testing of 150mm exhaust fans with mounting frame & louvers.	Nos.	5.00				
5.00	Supply, Installation of Junction Boxes made out of CRCA Sheet (16SWG) with 4way Terminal Strip and appropriate knock out for loop in loop out of cables. (For Lighting)	Nos.	150.00				
6.00	Supply,Installation,Testing & Commissioning of Exit Signages						
6.1	Exit	No	10.00				
6.2	Emergency Exit	No	5.00				
	TOTAL SECTION - V						

	TOTAL : SECTION VI: Data & Telephone Provisions						
1.0	Supply, installation, testing & commissioning of jelly filled armoured twisted pair 0.51 mm Cu. telephone cable with PVC insulation in ready trenches / trays / pipes etc.						
1.1	20 Pair.	Rmt	100.00				
1.2	2 Pair Unarm. cable	Rmt	500.00				
2.0	Supply and laying of CAT 6 cable for Data points in existing raceways.	Rmt	500.00				
3.0	Supply and installation of 2 mm thickness Aluminium extruded raceway for under floor installation including necessary cutting of floor providing couplers and clamps for raceway fixing as details provided making good the surface of floor complete as per sizes provided						
3.1	82mm X 38mm deep Al raceways.	Rmt	100.00				
4.0	Supply, installation of following set of modular sockets with box, switch plates for telephone & data cables etc. as required as detailed below.						
4.1	1 No. RJ 45 data socket with modular box & cover plate.	No.	10.00				
4.2	1 No. RJ 11 telephone socket with modular box & cover plate.	Nos.	10.00				
	TOTAL : SECTION VI						
	SECTION VII - CABLE TRAYS & FABRICATIONS						
1.0	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)						
1.1	100mm, 50x50 perforated tray. (16 SWG)	Rmtr	50.00				
1.2	150mm, 50x50 perforated tray. (16 SWG)	Rmtr	60.00				
1.3	300 mm, 50x50 perforated tray. (14 SWG)	Rmtr	100.00				
1.4	450 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	400.00				
1.5	750 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	200.00				
2	Cable Tray Covers suitable for following size trays						
2.1	100mm perforated tray.	Rmtr	60.00				
2.2	150mm perforated tray.	Rmtr	25.00				

2.3	300 mm perforated tray.	Rmtr	50.00				
3.0	Supply, Fabrication, Installation of M.S. angle/ Channel/ Square tube of 3mm thick of 50x50mm size including base plates supports arrangement, fastners, hardware etc. as per requirement (Duly approved by AEPPL and Client) for trays, frames etc. including necessary painting with 2 coats of primer and 2 coats of enamel black paint	Ton	5.00				
	TOTAL : SECTION VII				**0**		**0**
	SECTION VIII - ITEMS MAY BE EXECUTED						
	Distribution Boards & Industral Socket						
1	Supply, Installation, Testing and Commissioning of double door prefabricated recessed type MCB DB with CRCA sheet fabrication with powder coated body concealed in wall or on support structure. Steel support fabrication shall be considered separately						
1.1	8 way TPN DB with 25A 4P 30mA RCBO as incomer & 18Nos. of 10-20A SP MCB as O/Gs.	Set	1.00				
1.2	8 way VTPN DB with 63A TP MCCB as incomer & 4 Nos. of 10A TP MCB,2 Nos. of 25A TP MCB & 2 Nos of 16A TP MCBs as O/Gs.	Set	1.00				
1.3	8 way VTPN DB with 63A TP MCCB as incomer & 6 Nos. of 10A TP MCB,2 Nos of 16A TP MCBs as O/Gs.	Set	1.00				
1.4	4 way TPN DB with 63A, TPN RCBO 30 mA as incomer & 12Nos. of 20A SP MCB as O/Gs.	Set	1.00				
2	Pre-fabricated, **IP 42** enclosure with power sockets, necessary cable glands & spare knockout holes comprising of:-						
2.1	1 Nos. - 63A 3ø 5 pin Industrial socket + 63A TP MCB.	Set	1.00				
2.2	1 Nos. - 32A 3ø 5 pin Industrial socket + 32A TP MCB.	Set	1.00				
	LT Cables & Termination						
3	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Note:-Actual cable lengths shall be measured at site prior to procurement.)**						

3.1	3.5C x 240 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.2	3.5C x 185 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.3	3.5C x 150 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.4	3.5C x 120 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.5	3.5C x 70 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.6	3.5C x 35 Sq.mm. A2XFY Cable.	Rmtr	1.00				
3.7	4C x 10 Sq.mm. YWY Cable.	Rmtr	1.00				
3.8	4C x 6 Sq.mm. YWY Cable.	Rmtr	1.00				
3.9	4C x 1.5sqmm YWY Cable	Rmtr	1.00				
3.10	3C x 6 Sq.mm. YWY Cable.	Rmtr	1.00				
3.11	3C x 4 Sq.mm. YWY Cable.	Rmtr	1.00				
3.12	1C x 6sqmm YY Cable including Termination	Rmtr	1.00				
3.13	6C x 2.5 Sqmm YWY Cable	Rmtr	1.00				
3.14	8C x 2.5 Sqmm YWY Cable	Rmtr	1.00				
4	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.						
4.1	3.5C x 70 Sq.mm. A2XFY Cable.	Nos.	1.00				
4.2	3.5C x 35 Sq.mm. A2XFY Cable.	Nos.	1.00				
4.3	4C x 10 Sq.mm. YWY Cable.	Nos.	1.00				
4.4	4C x 6 Sq.mm. YWY Cable.	Nos.	1.00				
4.5	4C x 1.5 Sqmm. YWY Cable.	Nos.	1.00				
4.6	3C x 6 Sq.mm. YWY Cable.	Nos.	1.00				
4.7	3C x 4 Sq.mm. YWY Cable.	Nos.	1.00				
4.8	3C x 2.5 Sq.mm. YWY Cable.	Nos.	1.00				
4.9	1C x 6sqmm YY Cable PG Gland Termination	Nos.	1.00				
4.10	6C x 2.5 Sqmm YWY Cable	Nos.	1.00				
4.11	8C x 2.5 Sqmm YWY Cable	Nos.	1.00				
5	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.						
5.1	3.5C x 240 Sq.mm. A2XFY Cable.	Nos.	1.00				

5.2	3.5C x 185 Sq.mm. A2XFY Cable.	Nos.	1.00				
5.3	3.5C x 150 Sq.mm. A2XFY Cable.	Nos.	1.00				
5.4	3.5C x 120 Sq.mm. A2XFY Cable.	Nos.	1.00				
	Spare ACB's and MCCB's						
6.0	Supply and Installation of Spare Switchgear for modification and alteration work in LT Panels.						
6.1	4000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.2	4000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.3	3200A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.4	3200A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.5	2500A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.6	2500A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.7	2000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.8	2000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.9	1600A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.10	1600A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.0				
6.11	1250A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.00				
6.12	1250A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.00				
6.13	1000A, 4P, EDO, 55kA, LSIG mp based release ACB.	Set	1.00				
6.14	1000A, TPN, EDO, 55kA, LSIG mp based release ACB.	Set	1.00				
6.15	630A,TPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.16	400A TPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.17	315A TPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.18	250A TPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.19	200A TPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.20	160ATPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.21	125ATPN. 55kA,Thermal Release, MCCB	Set	1.00				
6.22	100A TPN. 55kA,Thermal Release, MCCB	Set	1.00				
	Earthing System & L.A.						

7.0	Earthing station as per IS 3043 - 1987, using Pipe / plate electrode complete with watering pipe & suitable GI strip up to chamber, soil treatment with charcoal and salt / bentonite powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link etc. And all other work required to complete the task.						
7.1	Earthing station as per IS 3043 - 1987 as above using 600 x 600 x 3 mm. Cu. Plate as electrode and other items required to complete the task.	Nos.	1.00				
7.2	As per IS 3043 - 1987 as above but bore type earthing with 3mtr. long 40 mm. dia. GI pipe as earth electrode treatment with bentonite / earth powder complete including required Boring, earth strip connection to GI pipe electrode shall be with 2nos. GI half round clamps duly welded and bolted at 2 distinct points treatment with bentonite / earth powder complete including required dia Boring.	Nos.	1.00				
8	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. or in ready made trenches or on ready tray with necessary clamps & bimetallic srips as per specification. (excavation required for this will be ensured separately.) Refer layout & tender spec for various applications						
8.1	75 x 10 mm. Cu strip.	Rmtr	1.00				
8.2	75 x 6 mm. GI strip.	Rmtr	1.00				
8.3	50 x 6 mm. Cu strip.	Rmtr	1.00				
8.4	32 x 6 mm. Cu strip.	Rmtr	1.00				
8.5	25 x 6 mm. GI strip.	Rmtr	1.00				
8.6	25 x 3 mm. GI. strip.	Rmtr	1.00				
8.7	25 x 3 mm. GI strip. Supported on Porcelain insulator/ J bolt at every 1.5 mtr interval for building L.A.	Rmtr	1.00				
8.8	4 SWG GI Wire.	Rmtr	1.00				
8.9	12 SWG GI Wire.	Rmtr	1.00				
8.10	10 SWG GI Wire.	Rmtr	1.00				

9	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" Protection level III to cover protection radius of 75.0 mtr. With 5 mtr rod height & with stem and fixing arrangement. (Indelec or Eqvt.). Required installation/ mounting details shall be submitted prior to installation	Nos.	1.00				
10	Supply, installation, testing & commissioning of Transducer type Building lightning arrester "EARLY STREAMER" Protection Level III to cover protection radius of 95 mtr. With 5 mtr rod height & with stem and fixing arrangement. (Indelec). Required installation/ mounting details shall be submitted prior to installation	Nos.	1.00				
11	Supply, installation, testing & commissioning of 5 Spikes Copper Building lightening arrester to be installed on top most point of building with stem and fixing arrangement etc. complete	Nos.	1.00				
	Point Wiring & Light Fixtures						
12	Mains Circuit as required						
12.1	2 x 4.0 + 1 x 2.5 Sqmm FRLS Cu wires as above but in provided AL floor Truff / in PVC conduit.	Rmtr	1.00				
12.2	Supply and installation of main for UPS power points in plant area with 2 x 4 + 1 x 2.5 Sq.mm. wires including 25mm PVC Conduits.	Rmtr	1.00				
12.3	As above but 2 x 2.5 + 1 x 1.5 Cu wires in 25mm PVC conduit.	Rmtr	1.00				
13	Supply & Installation of MS boxes in flooring made from 16 SWG M.S. sheet with Stainless steel cover of 14 SWG of following sizes						
13.1	300 x 300 x 50 mm. Floor boxes.	Nos.	1.00				
13.2	150 x 150 x 50 mm. Floor boxes.	Nos.	1.00				
14	**Supply, installation,** testing and commissioning of lighting fixtures/ fans/Ex. fans etc. including necessary electronic ballast, lamp, accessories, wiring connection, support arrangement like suspension chain, M.S. conduit drop with ball socket. down drops, etc. All FTL fixtures shall be with triphosphor source						
14.1	1x 28 watt Decorative luminaire (Wipro WRF 81128 SG)	Nos	1.00				
14.2	1x 18 watt Decorative luminaire (Wipro WRF 21118)	Nos	1.00				

14.3	4 x 14 Watt STELLAR - Recess mounted special geometric MO luminaire(Wipro WVF 20414)	Nos.	1.00				
14.4	2 x 18 Watt Low Depth Recessed downlighter(Wipro WCP 28218)	Nos	1.00				
15.0	Supply, installation testing of Ceiling/Exhaust fans with necessary acessories to complete the job.						
15.1	Supply, installation testing of 1200mm Ceiling fans with 300mm down rod canopies but without regulator.	Nos.	1.00				
15.2	Supply, installation testing of 1400mm Ceiling fans with 300mm down rod canopies but without regulator.	Nos.	1.00				
16.0	Supply, installation testing of wall mounted fans with mounting frame & louvers.	Nos.	1.00				
16.1	Supply, installation testing of 305mm exhaust fans with mounting frame & louvers.	Nos.	1.00				
17	Supply,Installation,Testing & Commissioning of Exit Signages						
17.1	Emergency Exit Door	No	1.00				
17.2	Emergency Exit Right from here	No	1.00				
17.3	Emergency Exit Left from here	No	1.00				
17.4	Staire case up or down	No	1.00				
	Data & Telephone						
18.00	Supply & installation of Krone type telephone junction box fabricated and painted as per panel specifications.						
18.1	50 Pair Box.	No.	1.00				
18.2	20 Pair Box.	No.	1.00				
18.3	10 Pair Box.	No.	1.00				
19.0	Supply, installation, testing & commissioning of jelly filled armoured twisted pair 0.51 mm Cu. telephone cable with PVC insulation in ready trenches / trays / pipes etc.						
19.1	50 Pair.	Rmt	1.00				
19.2	10 Pair Unarm. cable.	Rmt	1.00				
20.0	Supply & laying of CAT 5E cable for Data points in existing raceways or in pre laid FRPVC blank conduits.	Rmt	1.00				
	Raceway & J.B.						

21	Supply and installation of 2 mm thickness Aluminium extruded raceway for under floor installation including necessary cutting of floor providing couplers and clamps for raceway fixing as details provided making good the surface of floor complete as per sizes provided						
21.1	100mm X 45mm deep Al. raceways.	Rmt.	1.00				
21.2	125mm X 25mm deep Al. raceways.	Rmt.	1.00				
22.0	Supply and installation of good quality floor junction boxes of appropriate sizes for raceways with folded frames including counter sunk screw arrangements such that covers are in level with the floor level. The cover will be M.S, power coated & have 4 Nos. 25 / 32 mm Ø holes with rubber grommets at appropriate location						
22.1	100mm X 100mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00				
22.2	125mm X 125mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00				
22.3	225mm X 225mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00				
22.4	330mm X 330mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00				
22.5	450mm X 450mm X 50mm deep 16SWG junction box with 14 SWG cover.	No.	1.00				
23.0	Supply, installation of following set of modular sockets with box, switch plates for telephone & data cables etc. as required as detailed below.						
23.1	2 Nos. RJ 45 socket for data with box & cover plate at one place.	No.	1.00				
23.2	3 Nos. RJ 45 for 1 telephone and 2 data socket with boxes & cover plates at one place.	No.	1.00				
	Cable Tray with Covers & Fabrication						
24	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)						
24.1	50mm, 50x50 perforated tray. (16 SWG)	Rmtr	1.00				

24.2	200mm, 50x50 perforated tray. (16 SWG)	Rmtr	1.00				
24.3	600 mm, 75x75 Ladder tray. (14 SWG)	Rmtr	1.00				
25	Cable Tray Covers suitable for following size trays						
25.1	50mm perforated tray.	Rmtr	1.00				
25.2	200mm, perforated tray.	Rmtr	1.00				
25.3	450 mm perforated tray.	Rmtr	1.00				
26.0	Supply, Fabrication, Installation of M.S. square tube of 3mm thick of 40 x 40mm size. including painting with 2 coats of primer & 2 coats of final enamel black paint as specified. And all other items required to complete the task.	Rmtr	1.00				
	TOTAL : SECTION VIII				**0**		**0**

HT BOQ							
Sr. No.	**Description**	**Unit**	**Qnty**	**Supply**		**Installation**	
				Rate	**Amount**	**Rate**	**Amount**
	SECTION-I:-HT SYSTEM						
1	Supply,Erection, Testing and Commissioning of **22 kV / 0.433 kV, 2500 kVA, Dyn 11, 6.25% Impedance, Oil Insulated Transformer with OLTC and all accessories** complete on readymade plinth, Scope shall includes unloading shifting from stores to plinth and BDV test & topping up of fresh transformer oil as per requirement to complete the task.If required filteration of oil .	Set	2.00				
2	Supply,Erection, Testing & Commissioning of Ring Main Unit(RMU) & HT Switchgear equipment including necessary support structure, hardware & testing of the equipment at site after Erection as per specification. All other work to complete the erection of equipment						
2.1	Supplu,Installation,Testing & Commissioning of 22 kV, 630A, **26kA, Indoor Compact RMU type (Extendable)** including relay and control panel .Consisting of 1 I/C SF6 , 3 O/G SF6,and Metering module Feeders as per SLD.(HT Panel 1).	Set	1.00				
2.2	Supply,Installation,Testing & Commissioning of 22 kV, 630A, 26kA VCB **HT PANEL** 22kV,630A,26kA as incomer & 2nos. 22kV, 630A, 26kA Vacuum Circuit Breaker as outgoing Panel **Extensible type** including Power Pack as per specifications , Data sheet and SLD	Set	1.00				
2.3	Removing Existing RMU 1 incoming & One out going including cable termination,handover to Client as desired location guide by Client	job	1.00				

3	Supply,Testing, tagging, laying, & commissioning of following **22 kV grade XLPE HT cable** on readymade Trench/Excavation with (sand cushioning of 75mm, laying bricks on both sides of cable) & covering with RCC / PCC tiles or half round hume pipe of 200 mm dia. and refilling of cable trench, leveling of cable trench etc. as required. (Note: Quantity is tentative as Route is tentitively desided). (Only Hard rock excavation shall be						
3.1	3C x 240sqmm Al.XLPE HT Cable	Rmtr	####				
4	Supply, installation, testing & commissioning of heat shrink jointing for **22kV HT cables** of following sizes including necessary accessories, spider supports, plated hardware like lugs / ferrules, insulation tapes etc. complete. Standard make. Scope also includes making suitable cutouts in gland plate & sealing them after connections.						
4.1	Indoor End Termination.	Set	5.00				
4.2	Outdoor End Termination.	Set	2.00				
5	Providing Chainlink Fencing with 10SWG, 1.5" Chainlink jali with 50 x 50 x 6 mm M.S. Angle supports at proper intervals (@2.0m C/C). Fencing height should be 2.4M above Ground Level. The rate shall be inclusive of **2No. 3M wide**, double leaf gate made out of 40mm dia., 2mm thk. MS pipe with proper channel supports and **1Nos. of 1.0M wide** single leaf gate same as above gate etc. complete including painting with 2 coats of red oxide primer & 2 coats of silver paint. The rate shall be inclusive of the required civil work. **(Total perimeter of fencing -- 100M)**.	job	1.00				

6	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete**(Eqvt to Ashlok T 39)** with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling.	Nos.	14.00				
7	Statutary Approval from local EB	job	1.00				
8	Supply, installation, material equipment required as per statutory provision & safety.						
8.1	22 kV grade Rubber matting 1000 mm width.	Mtr	4.00				
8.2	22 kV class Hand gloves.	Pair	1.00				
8.3	22 kV Danger boards of appropriate size & marking.	Nos	6.00				
8.4	433 V Danger boards of appropriate size & marking.	Nos	12.00				
8.5	1.1 kV grade Rubber matting 1000 mm width.	Mtr	30.00				
8.6	First Aid Box	Nos	3.00				
8.7	Laminated First aid chart with frame.	Nos	3.00				
8.8	4.5 Kg fire extinguisher ABC type	Nos	5.00				
8.9	9 Kg fire extinguisher ABC type	Nos	5.00				
9.0	Fire Buckets with stand 04 Nos. of Buckets filled with Fine Sand	Nos	4.00				
10.00	HT Cable Route Marker	Nos	50.00				
	Total Of Section-I				**0**		**0**
	SECTION-II ITEM MAY BE EXECUTED						
1	Supply, installation, testing & commissioning of heat shrink jointing for **22kV HT cables** of following sizes including necessary accessories, spider supports, plated hardware like lugs / ferrules, insulation tapes etc. complete. Standard make. Scope also includes making suitable cutouts in gland plate & sealing them after connections.						
1.1	Straight through Joints.	Set	1.00				

2	Excavation of cable trenches upto a depth of 1000mm refilling and reinstating the trenches and removing excess soil after proper 4" sand bedding/ coushioning above & below cables with bricks as per specifications & IS standards						
2.1	Excavation in soil, soft murm & Hard murm.	M3	1.00				
2.2	Excavation in soft Rock.	M3	1.00				
2.3	Excavation in Hard Rock.	M3	1.00				
3	Supply, laying of following different types of Hume pipes/pipes in trenches for road crossing for electrical, telephone cables etc. complete as required including excavation of trench in all types of strata except hard rock and refilling, leveling of trench, shifting of extra earth or debris to dump yard complete as required						
3.1	300 mm dia. RCC Pipe.	Mtr	1.00				
3.2	200 mm dia. Half round RCC hume Pipe.	Mtr	1.00				
	Total Of Section-II				**0**		**0**

BILL OF QUANTITY -DG Set							
Sr. No.	**Description**	**Unit**	**Qty**	**Supply**		**Installation**	
				Rate	**Amount**	**Rate**	**Amount**
	SECTION-I						
1.0	Design, Supply, Installation, Testing & Commissioning at site 3-phase, 415V, 1500RPM, 50 HZ, Diesel generator set as per DG Technical Document, of **1 x 625 KVA** Prime Rating at 0.8 pf lagging diesel engine with **Radiator cooled** and alternator set mounted on common base frame in Outdoor Type Acoustically Treated Enclosure, with day tank of adequate capacity in liters for backup of 8-10hr running of DG set, battery, battery charger, return fuel color, anti vibration mounting pads including residential silencer, engine alternator safeties with accessories, **1No. of 1000A, 25kA, mp based, LSIG, MCCB Isolator inside acoustic enclosure** as per the attached SLD, engine control panel, ventilation system, inside conopy lighting, etc. as per specification complete as required. DG shall have appropriate Building Management System integration provisions / ports as well as hardwired alarm/ critical monitoring provisions with details of integrationDiesel engine shall conform to IS:10000 and alternator shall be self excited co from Project- in-charge. ndles, Mortise Dead Bolt, Mortise Latch, Door Closer, air seal gaskets between shutter and frame, etc complete. and air flow calculation very difficult to predict with any accuracy.□□	Set	**6**				
2.0	Supply, Installation, Testing & Commissioning of Cu. Unarmoured cables of following size from Alternator to 1000A MCCB Isolator Panel inside DG Set.						
2.1	1C X 95 sq.mm. 2XY Cu. UnArm. Cable **(4 Runs/phase + 2 Runs - Neutral)**	Mtrs.	550				
3.0	Cable Termination of above cable						
3.1	1C X 95 sq.mm. 2XY Cu. UnArm. Cable	Nos	72				

4.0	Supply Installation testing Commissioning of Synchronisation cum AMF Panel as per SLD and Technical Document. Synchronizing panel should be incorporated with Auto Load sharing, Load Dependent "Start & Stop"	Set	1				
5.0	**Design Supply, Installation, Commissioing of Exhaust System as per below mentioned**						
5.1	10"M.S.Pipe Class B from Exhaust Bellow to Silencer	Mtrs.	12				
5.2	Supply of 10" MS Class B Exhaust pipe	Mtrs.	50				
5.3	Aluminium Cladding for the Exhaust Pipe	Mtrs.	62				
5.4	Cladding for the Residential Silencers	Nos	6				
5.5	Bends & Flanges 250 mm Dia or required size.	Nos	6				
5.7	Steel for Exhaust Support structure (for 6No. Of D.G.Sets)	Ton	4				
6.00	SITC of GI ladder and Perforated Cable Trays of following sizes						
a	600mm x 75mm ladder tray.	Mtrs.	60				
b	300mm x 50mm perforated tray.	Mtrs.	20				
7.0	**FUEL PIPING**						
7.1	Supply ,Installation and Commissioning of ASTM Grade, seamless Pipe 40 mm (40NB)	Mtrs.	50				
7.2	Supply ,Installation and Commissioning of ASTM Grade, seamless Pipe 25 mm (25NB)	Mtrs.	60				
7.3	Ball Valve						
a	40NB	Nos	4				
b	25NB	Nos	6				
7.4	Non Return Valves						
a	40NB	Nos	2				
7.5	Y Stainers	Nos	2				
7.6	Solenoid Valves for 25NB tapping lines for auto operation of Fuel pumping system.	Set	6				
7.7	Flow Meter	Nos	6				
7.8	Hardware for fuel piping	Set	1				
8.0	Supply installation of Earthing station as per IS 3043 using SIP/PIP electrode complete (Eqvt to Ashlok T 39) with watering pipe & suitable GI strip up to chamber, soil treatment with suitable backfill powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including excavation or earth pit, refilling	Nos	26				

9.0	Supply, installation, testing of GI/ Cu. earthing strips & wires in ground at a depth of 600 mm. in trenches or tray with necessary clamps & bimetallic srips as per specification. (excavation required for this to be ensured in the scope.) Refer layout & tender spec for various applications						
9.1	50 x 10 mm. GI strip.	Mtrs.	200				
9.2	50 x 10 mm. Cu strip.	Mtrs.	150				
10.0	Supply, Installation, Testing and Commissioning of Al./Cu. LT XLPE cable for Power/Control cabling as mentioned below. Schedule for the same shall be submitted by the DG Vendor prior execution of the job						
10.1	3.5C X 400 sq.mm. A2XFY	Mtrs.	1950				
10.2	24C X 2.5 sq.mm. 2XWY	Mtrs.	650				
10.3	2C X 4 sq.mm. 2XWY	Mtrs.	500				
10.4	6C X 2.5 sq.mm. 2XWY	Mtrs.	500				
10.5	3C X 1.5 sq.mm. Cu. Sheilded Cable	Mtrs.	1500				
10.6	2C X 2.5 sq.mm. 2XWY	Mtrs.	200				
11.0	Cable Termination of above cables with glands and lugs.						
11.1	3.5C X 400 sq.mm. A2XFY	Nos	36				
11.2	24C X 2.5 sq.mm. 2XWY	Nos	6				
11.3	2C X 4 sq.mm. 2XWY	Nos	6				
11.4	6C X 2.5 sq.mm. 2XWY	Nos	6				
11.5	3C X 1.5 sq.mm. Cu. Sheilded Cable	Nos	18				
11.6	2C X 2.5 sq.mm. 2XWY	Nos	2				
13.0	**Approvals**						
13.1	Approvals and registration from Statutory Authorities like pollution control board, electrical inspector etc. necessory to complete the job.	Job	1				
14	Under Ground Diesel Storage Tank (UG Tank)						

15.1	Supply , Installation Testing and commissioning of Under ground Diesel Storage Tank of Capacity 50 KL **including Approval from CCOE**, NOC from various authorities, MPCB, Fire authority approval and any other statutary bodies approval. Necessory civil work along with fencing and gate. In the area of UG tank necessory flame proof light fitting along with lighting poles to be considered. Necessory Pumping arrangement (Electrical Driven) with one working and one stand by pumps, along with Diesel Piping to be considered. Fuel storage pumping system shall be designed to have a trouble-free automated system without manual intervention for auto-filling of Day Tanks for 6No. of DG sets. Level sensors, flow meters to be considered by bidders. Monitoring provision shall be included with Potential free contacts/option to connect Flow Meters inside fuel lines / Underground Level Sensor Provision on tanks etc which shall provide for smooth operation.	Job	1				
	TOTAL Of SECTION-I				**0**		**0**
	SECTION-II ITEM MAY BE EXECUTED						
1	**Design Supply, Installation, Commissioing of Exhaust System as per below mentioned**						
1.1	Supply, Installation and Commissioning of Single self supported standalone chimney as common exhaust outlet for 3Nos. Of DG Sets with all related & required accessories, support structure, LA, Aviation lamp etc	Job	1				
2	SITC of GI ladder and Perforated Cable Trays of following sizes						
2.1	750mm x 75mm ladder tray.	Mtrs.	1				
3	Supply , Installation , Testing and Commissioing external Fuel Tank of suitable capacity 990 lts as per CPCB norms.	Job	1				
4	Supply, Installation, Testing and Commissioning of Earthing station as per IS 3043 using Pipe / plate electrode complete with 50mm dia. watering pipe & suitable GI/Cu strip up to chamber, soil treatment with charcoal and salt / bentonite powder, brick inspection chamber with 450x450 mm CI cover, disconnecting link complete including rate of excavation for earth pit, refilling and any other item required to complete the task.						

4.1	Earthing station as above but using 600 x 600 x 6 mm. GI. Plate as electrode complete.	Nos	1				
4.2	Earthing station as above but using 600 x 600 x 3 mm. Cu. Plate as electrode complete.	Nos	1				
5	Supply, Installation, Testing and Commissioning of Al./Cu. LT XLPE cable for Power/Control cabling as mentioned below. Schedule for the same shall be submitted by the DG Vendor prior execution of the job						
5.1	10C X 2.5 sq.mm. 2XWY	Mtrs.	1				
5.2	4C X 25 sq.mm.	Mtrs.	1				
5.3	3C X 4 sq.mm. 2XWY	Mtrs.	1				
6	Cable Termination of above cables with glands and lugs.						
6.4	10C X 2.5 sq.mm. 2XWY	Nos	1				
6.5	4C X 25 sq.mm.	Nos	1				
6.6	3C X 4 sq.mm. 2XWY	Nos	1				
	TOTAL Of SECTION-II				**0**		**0**

BILL OF QUANTITY							
Sl.No	**Description of Work**	**Unit**	**Qty**	**Rate (Rs.)**		**Total (Rs)**	
				Supply	**Installation**	**Supply**	**Installation**
	PRICISION CHILLERS						
1	Supply, installation, testing & commissioning of 175 TR 'TWIN SCREW' type Air-cooled liquid chillers, complete with spring loaded anti vibration mounts, With first charge of Refrigerant Gas, Lubricating oil etc., for the following operating conditions. The chillers shall be complete with screw compressors (Single / Multi Screw), Fin and Tube Air cooled condensers, Flooded evaporator, Drive Motor, Control panel etc., Star delta Starter, stepless capacity control, etc.,as per specifications mentioned in the technical specification sheet. The Chiller shall be capable of opearting in open ambient temperature of local ambient of Pune City, and shall use R-134 a Refrigerant. The Chiller should be installed on Spring Mounted Antivibration mounts.Chiller shall be selected for 45 deg.C abmient temp.with starting to full load timing as 3.0 min. maximum.	Nos	3				
1.1.	**Cooling Capacity (175 TR x 3 Nos) (2 W + 1 SB)**						
	Chiller Flow rate : 335 US GPM Chiller tubes to be designed for the above flow rate.						
	Fouling Factor : 0.0005 ~ 0.0001						
	IKW/TR : 1.25 ~ 1.36 Kw/TR						
	EWT : 12.00 Deg C						
	LWT : 7.00 ° C						
	EER ratio (To be Furnished with technical bid)						
	OR						
	Supply, installation, testing & commissioning of 175 TR 'TWIN SCREW' type Air-cooled liquid chillers, complete with spring loaded anti vibration mounts, With first charge of Refrigerant Gas, Lubricating oil etc., for the following operating conditions. The chillers shall be complete with screw compressors (Single / Multi Screw), Fin and Tube Air cooled condensers, Flooded evaporator, Drive Motor, Control panel etc., Star delta Starter, stepless capacity control, etc.,as per specifications mentioned in the technical specification sheet. The Chiller shall be capable of opearting in open ambient temperature of local ambient of Pune City, and shall use R-134 a Refrigerant. The Chiller should be installed on Spring Mounted Antivibration mounts.Chiller shall be selected for 45 deg.C abmient temp.with starting to full load timing as 3.0 min. maximum.	Nos	3				
1.2	**Cooling Capacity (175 TR x 3 Nos) (2 W + 1 SB)**						
	Chiller Flow rate : 335 US GPM Chiller tubes to be designed for the above flow rate.						
	Fouling Factor : 0.0005 ~ 0.0001						
	IKW/TR : 1.25 ~ 1.36 Kw/TR						
	EWT : 20.00 Deg C						

	LWT : 14.00 ° C						
	EER ratio (To be Furnished with technical bid)						
	TOTAL VALUE FOR CHILLERS					0	0
2	**CENTRIFUGAL PUMPS**						
2.1	Supply of Chilled water pump, End Suction Back pull out type horizontal , Single Stage Pumps, running at 2900 rpm bareshaft fitted with drip tight Make mechanical seal with O ring silicone carbide seat retainer. along with accessories like fabricated MS base frame , coupling guard , foundation bolts , flexible spacer coupling & coupled to foot mounted TEFC three phase motor (EFF-1) , Class F insulation & IP 55 protection of suitable rating. The motor shall be compatible with VFD drive as specified in the enquiry document. Pump design parameters to be designed as follows. Flexible bellows at pump inlet and pump outlet as per suction and delivery sizes to be considered in the rate. **Metallurgy:** **Body : Cast Iron (IS 210 FG260), Impeller : LT Bronze (IS 318 Grade LTB2), Shaft : SS 410, Shaft Sleeve : SS 410**						
	Pump design parameters to be designed as follows.						
	Primary chilled water pump module						
	Flow rate : 335 US GPM @ 50 Mtr head required as per site condition. (2W+2SB).	Nos	4				
2.2	Control Panel consisting of Panel + VFD (Common for both pumps) housed in a single enclosure with incomer and two nos outgoing feeder. The terminations shall be suitable as per cable. Please read the control panel logic in technical specification section.	Nos	1				
	TOTAL VALUE FOR PUMPS					0	0
3	**CHILLED WATER SYSTEM**						
3.1	Supply, installation, testing & commissioning of Polyethylene High Density (PE 100) from **+GF+** piping of PN-16 with all necessary **GF Elctronic Fusion welding/Victaulic** Fitting only such as Couplings, Bends, Reducers, T, expanders, flanges etc, supports such as u clamps, threaded rod, pre insulated pedestals, nut and washers as per site condition and 19 thick Closed cell rubber nitrile of Class "O". The insulation of shall be covered with 26 G aluminium cladding with superior workmanship.						
3.1.1	250 mm Dia	RMT	125				
3.1.2	200 mm Dia	RMT	350				
3.1.3	150 mm Dia	RMT	RO				
3.1.4	100 mm Dia	RMT	75				
3.1.5	80 mm Dia	RMT	75				

3.1.7	65 mm Dia	RMT	40				
3.1.8	40 mm Dia	RMT	RO				
3.1.9	32mm Dia	RMT	125				
4.1	Centric Disc Butterfly valve with a single piece Rubber lined body. Short Wafer body. Integrally moulded seat. Rating PN 16. General design and manufacturing as per API 609 category A/BS 5155/MSS SP-67. Flange ANSI 150 , properly insulated with 25 mm rubber nitrile class O closed cell insulation with 26G Al. cladding.						
4.1.1	250 mm Dia						
4.1.2	200 mm Dia	Nos	30				
4.1.3	150 mm Dia	Nos					
4.1.4	100 mm Dia	Nos	8				
4.1.5	80 mm Dia	Nos	32				
4.1.6	65 mm Dia	Nos	4				
4.1.7	40 mm Dia	Nos					
5	Flow Switch suitable for 200 mm Dia Pipe	Nos	3				
6	Diferential pressure switch suitable for 200 mm Dia Pipe	Nos	2				
7	100 mm dia dial type pressure gages with needle valve & as per specifications mentioned in technical data sheet. Pressure gauge, scale range 0-10 bar. Complete with 3 valves an piping. To be mounted over all pumps. Size 10 DN	Nos	4				
8	100 mm dia dial type pressure gages with needle valve & as per specifications mentioned in technical data sheet.		6				
9	Dial type industrial type imported thermometer with 100mm dia dial & as per specifications mentioned in technical data sheet	Nos	8				
10	Chiller Inlet & Outlet Rubber Expansion Bellows - 200 mm Dia	Nos	6				
11	Supply, Installation of ball valve CS body SS 304 Ball full three piece design full port end connection socket weld type class # 150.	Nos	6				
11.1	15 mm Dia	Nos	6				
11.2	25 mm Dia	Nos	12				
11.3	32 mm Dia	Nos	92				
12	Balancing valve with measurement points (STA-D). Pressure class PN 16. Made up of AMETAL, Seat seal: Stem with EPDM O-ring Spindle seal: EPDM O-ring Handwheel: Polyamide and TPE.						
12.1	25 mm Dia	Nos	46				

13	Flanged Balancing Valve With measurement points (STAF - SG). Pressure class PN 16. Body: Ductile iron EN-GJS-400-15. spindle of AMETAL Seat seal: Cone with EPDM ring. Bonnet bolts: Chromed steel.						
13.1	200 mm Dia	Nos	2				
13.2	SITC of Y-Strainer with SS mesh of following sizes;						
	200 mm Dia	Nos	3				
14	Automatic Air vent of 1/2 "	Nos	8				
15	Closed Expansion Tank with Expansion Vessel and pressurizing Pumps 1 Working + 1 Standby. The tank capacity to be 1000 Ltr . Expansion tank to be of M S Construction with Armaflex / K- Flex Insulation 32 mm thick & 26 Gage Aluminum Cladding with diamond finish and with related piping, Isolating valves , Safety valves , Drains, Overflow and Guages.Tank shall be internally coated with anti-corrosive coating. **Pressurisation unit** with double pump(0.85HP) 230V, 50Hz, single phase) pressure transmitter, IP65 control panel(Remote operation, Duty cycling, Dry-Run protection)	Nos	1				
16	Centrifugal Air Separator for Chilled Water in MS construction with SS internal perforated sheet,Tank shall be internally coated with anti-corrosive coating. with Armaflex / K Flex insulation 32 mm & 26 Gage Aluminum Cladding with diamond finish and necessary valves etc.suitable for the following flow rates.						
16.1	Suitable to mount on 250 mm Dia pipe	Nos	1				
17	SITC of chemical dosing plant suitable for above system for flushing and treating the water including following 1. 500 Ltr make up water storage tank x 01 nos 2. FIrst charge of Dosing chemicals for the commissioning of the system and chemicals for the 6 months operation. 3. Treated water tank of capacity 2000 Ltr. Interconnecting piping, accessories and valves complete in all respect. 25 mtr of 25 NB size pipe to be considered as interconnecting pipe. 03 Nos of ball velves and 02 nos of ball float vales to be considered in the item.	Lot	1				
18	SITC of MS tank with capacity of 15000 Ltr to be used as thermal storage for 5 mins back up supply. The tank to be of M S Construction and with anti corrosive coating from inside with Armaflex / K- Flex Insulation 32 mm thick & 26 Gage Aluminum Cladding with diamond finish and with related piping, Isolating valves , Safety valves , Drains, Overflow and Guages. 8 mm Shell thickness and 12 mm Dish thickness. The tank shall have necessary ports with flanges Table F	Lot	1				

19	SITC of cooling distribution unit (CDU) to provide cooling water close control and above the dew point. Shall be capable of 150 KW cooling capacity. The CDU shall be approved to work with IBM 'iDataPlex / RDHX' racks. It shall have full run and stand by capabilities with redundant pumps. It shal have internalmanifold with leak free quick release couplings. It shall have a auto fill and bleed off connection. FUll alarm monitoring and connectivity to MODBUS. Complete in all respect. **(This is an optional item)**	Nos	8				
20	Structural steel such as Channel, Angles, Plates, I section, Beam section etc with two coats of red oxide and two coats of synthetic enamale quick drying paint. The colour shall be approved by the Architect.	Ton	5				
	TOTAL VALUE FOR CHILLED WATER PIPING					0	0
21	**ELECTRIFICATION WORK**						
21.1	Electrical Panel No 1 - 3 : Chiller panel						
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,400 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication,and BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation, and outgoing feeder as below	NOS	3				
	Outgoing Feeder:- As per SLD						
21.2	Electrical Panel No 4 - 7, Chiller Pump panel						
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,40 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication, BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation, and outgoing feeder as below	NOS	4				
	Outgoing Feeder:- As per SLD						
21.3							
	Electrical Panel No 8, Pump Panel						

	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,40 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	1				
	Outgoing Feeder:- As per SLD						
21.4	Electrical Panel No 9-11, PAC panel.						
	HVAC Utility Panels comprising of 1 Incoming Feeder (4 Pole ,100 Amp with Overload Earth Fault and Short Circuit protection, MCCB and Outgoing Feeders as per SLD, The Panel shall be IP-55 Protection for Indoor use,duly powder coated by 7 tank painting process & fabrication of 14/16 Gauge CRCA Sheet.Panel kWH meter, R-Y-B indication Lamps, Control Fuses & AL Bus Bar. Feeders complete with MCCB, Push Buttons, ON, OFF, & Trip indication, BMS connectivity etc. Location: Panel Room, with bottom entry. The panel should be with appropriate cooling/heating arrangement. Supplier to furnish the power/Heat loass calculation. and outgoing feeder as below	NOS	1				
	Outgoing Feeder:- As per SLD						
22	Supply and installation of prefabricated (hot dip Galvanised) G.I. ladder/ perforated trays with 50/ 75 mm C channels & Runges at 200mm cc and including prefabricated accessories like Bends, Tee, Right-angles & tray coupling arrangement etc.(Bends fabricated at site will not be allowed.)						
22.3.1	50mm, 50x50 perforated tray. (16 SWG)	Rmt.					
22.3.2	100mm, 50x50 perforated tray. (16 SWG)	Rmt.					
22.3.3	150mm, 50x50 perforated tray. (16 SWG)	Rmt.					
22.3.4	200mm, 50x50 perforated tray. (16 SWG)	Rmt.					
22.3.5	300 mm, 50x50 perforated tray. (14 SWG)	Rmt.					
22.3.6	450 mm, 50x50 perforated tray. (14 SWG)	Rmt.	65				
22.3.7	600 mm, 50x50 perforated tray. (14 SWG)	Rmt.	50				
22.3.8	450 mm, 75x75 Ladder tray. (14 SWG)	Rmt.					
22.3.9	600 mm, 75x75 Ladder tray. (14 SWG)	Rmt.	75				
22.3.10	750 mm, 75x75 Ladder tray. (14 SWG)	Rmt.					
23	Cable Tray Covers suitable for following size trays						
23.4.1	50mm perforated tray.	Rmt.	R.O.				
23.4.2	100mm perforated tray.	Rmt.	R.O.				
23.4.3	150mm perforated tray.	Rmt.	R.O.				
23.4.4	200mm, perforated tray.	Rmt.	R.O.				
23.4.5	300 mm perforated tray.	Rmt.	R.O.				
23.4.6	450 mm perforated tray.	Rmt.	R.O.				

24	Supply, Installation, Testing and Commissioning of 1100V grade L.T. XLPE/ PVC insulated multistrand Al./ Cu. conductor cables on provided prefabricated trays/ pipe/ in trenches with necessary clamps, identification tag. & all other items required to complete the task. **(Actual cable lengths shall be measured at site prior to procurement.)**						
24.6.1	3.5C x 400 Sq.mm. A2XFY Cable.	Rmt.					
24.6.2	3.5C x 300 Sq.mm. A2XFY Cable.	Rmt.	400				
24.6.3	3.5C x 240 Sq.mm. A2XFY Cable.	Rmt.					
24.6.4	3.5C x 185 Sq.mm. A2XFY Cable.	Rmt.					
24.6.5	3.5C x 150 Sq.mm. A2XFY Cable.	Rmt.					
24.6.6	3.5C x 120 Sq.mm. A2XFY Cable.	Rmt.					
24.6.7	3.5C x 95 Sq.mm. A2XFY Cable.	Rmt.					
24.6.8	3.5C x 70 Sq.mm. A2XFY Cable.	Rmt.					
24.6.9	3.5C x 50 Sq.mm. A2XFY Cable.	Rmt.	375				
24.6.10	3.5C x 35 Sq.mm. A2XFY Cable.	Rmt.					
24.6.11	3.5C x 25 Sq.mm. A2XFY Cable.	Rmt.					
24.6.12	4C x 25 Sq.mm. AYFY Cable.	Rmt.					
24.6.13	4C x 10 Sq.mm. YWY Cable.	Rmt.					
24.6.14	4C x 16 Sq.mm. YWY Cable.	Rmt.	350				
24.6.15	4C x 6 Sq.mm. YWY Cable.	Rmt.					
24.6.16	4C x 4 Sq.mm. YWY Cable.	Rmt.					
24.6.17	4C x 2.5 Sq.mm. AYFY Cable.	Rmt.	600				
24.6.18	3C x 6 Sq.mm. YWY Cable.	Rmt.					
24.6.19	3C x 4 Sq.mm. YWY Cable.	Rmt.					
24.6.20	3C x 2.5 Sq.mm. YWY Cable.	Rmt.					
25	Supply & installation of End termination for cables as above with Brass, heavy duty, **Single compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.						
25.7.1	3.5C x 70 Sq.mm. A2XFY Cable.	Nos					
25.7.2	3.5C x 50 Sq.mm. A2XFY Cable.	Nos	12				
25.7.3	3.5C x 35 Sq.mm. A2XFY Cable.	Nos					
25.7.4	3.5C x 25 Sq.mm. A2XFY Cable.	Nos					
25.7.5	4C x 16 Sq.mm. AYFY Cable.	Nos					
25.7.6	4C x 10 Sq.mm. YWY Cable.	Nos					
25.7.7	4C x 16 Sq.mm. YWY Cable.	Nos	8				
25.7.8	4C x 4 Sq.mm. YWY Cable.	Nos					
25.7.9	4C x 2.5 Sq.mm. YWY Cable.	Nos	8				
25.7.10	3C x 6 Sq.mm. YWY Cable.	Nos					
25.7.11	3C x 4 Sq.mm. YWY Cable.	Nos					

25.7.12	3C x 2.5 Sq.mm. YWY Cable.	Nos					
26	Supply & installation of End termination for cables as above with Brass, heavy duty, **Double compression** glands, lugs, other consumable, crimping, gland hole drilling, ferrulling, marking, etc.						
26.8.1	3.5C x 400 Sq.mm. A2XFY Cable.	Nos					
26.8.2	3.5C x 300 Sq.mm. A2XFY Cable.	Nos	16				
26.8.3	3.5C x 240 Sq.mm. A2XFY Cable.	Nos					
26.8.4	3.5C x 185 Sq.mm. A2XFY Cable.	Nos					
26.8.5	3.5C x 150 Sq.mm. A2XFY Cable.	Nos					
26.8.6	3.5C x 120 Sq.mm. A2XFY Cable.	Nos					
26.8.7	3.5C x 95 Sq.mm. A2XFY Cable.	Nos					
27	Supply, laying and connection of copper earthing 25mm x 3mm thick copper strip.	Rmt	150				
	TOTAL VALUE FOR ELECTRIFICATION WORK					0	0
	SUMMARY						
	TOTAL VALUE FOR CHILLERS						
	TOTAL VALUE FOR PUMPS						
	TOTAL VALUE FOR CHILLED WATER PIPING						
	TOTAL VALUE FOR ELECTRIFICATION WORK						
	SUB TOTAL OF HVAC SYSTEM					0	0

Proposed Schedule Of Quantity For DATA CENTRE SERVER ROOM for Provision of Precision AC for IITM Pune.							
Sl.No	**Description of Work**	**Unit**	**Qty**	**Rate (Rs.)**		**Total (Rs)**	
				Supply	**Installation**	**Supply**	**Installation**
1	Supply of Precision AC as per the technical specification. (2W+1SB)						
1.1	30 TR Net Cooling Capacity	Nos	3				
	EER ratio (To be Furnished with technical bid)						
2	Refrigerant Piping as per manufacturing standard with armaflex 25 mm thk rubber nitrile insulation. The distance between the IDU and ODU shall be 20 RMT ea only.	LOT	1				
3	PVC drain piping. Insulated with 13 mm rubber nitrile armaflex insulation. The pipe shall be of finolex make only.						
3.1	40 mm	RMT	80				
4	GI Class B, ERW pipe for fresh water						
4.1	25 NB	RMT	60				
5	Refrigerant gas R 407 C as per manufacturers specification and quantity	LOT	3				
6	Deep pleated 4" filters with an ASHRAE 52.2 MERV 8 rating (Spare)	Lot	3				
8	Fan Aided Floor Grills in front of Tape Library (600x600mm). To be used as floor diffuser in powder coated MS construction. The Diffuser shall be able to take a load of 1000 Kg UDL. The top shall have an anti static coating.	Nos	14				
9	SITC of GI Ducting (180 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.						
9.1	18 guage	SQM	R.O				
9.2	20 guage	SQM	R.O.				
9.3	22 guage	SQM	R.O.				
9.4	24 guage	SQM	20				
10	SITC of Aluminum eggcrate powder coated return air grill with aluminum border and grid in in ½ x ½ x ½-inch sizes.						

10.1	600 mm X 600 mm	Nos	R.O.				
	TOTAL VALUE FOR PAC					0	0
	SUMMARY						
	TOTAL OF HVAC WORKS (A+B)						

HVAC Works for UPS Room

Sl.No	Description of Work	Unit	Qty	Rate (Rs.)		Total (Rs)	
				Supply	Installation	Supply	Installation
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '						
1	The system should be with necessary IDU's & ODU's.Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type.The refrigerat shall be R407 C, R 410 Aonly.						
	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refergerant Charge as per piping Insttalation, IDU & ODU Supports (ODU Support with painted MS Channel of suffient size). The unit shall be with necessary corded remote and the holder for the same.						
1.1	10 TR / 4000 CFM Capacity	Nos	4				
	EER ratio (To be Furnished with technical bid)						
2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclussive of necessary Supports as per standard practices.						
	Gas Line (inch.) Liquid Line (inch.)						
2.1	41.3 19.1	RMT	R.O.				
2.2	34.9 19.1	RMT	R.O.				
2.3	34.9 15.9	RMT	100				
2.4	28.6 12.7	RMT	R.O.				
2.4	19.1 12.7	RMT	R.O.				
2.5	12.7 6.4	RMT	R.O.				
2.6	15.9 6.4	RMT	R.O.				
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	135				
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	15				
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.						
5.1	50 mm dia.	Rmt.	0				
5.2	40 mm dia.	Rmt.	20				

5.3	25 mm dia.	Rmt.	40				
6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.						
6.1	18 guage	SQM	R.O				
6.2	20 guage	SQM	R.O.				
6.3	22 guage	SQM	R.O.				
6.4	24 guage	SQM	40				
7	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	2				
8	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1				
9	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 2 W + 2 SB. Each unit shall run for 8 hrs.	Nos	1				
10	Supply ,Installation And commissioning of following Hi-wall Type Split Units including indoor - Outdoor Combination, Refrigerent piping and Interconnecting control cabling of 15 Mtr. length, Refergerant Charge as per piping Insttalation, Automatic Timer of 4 Hrs. Cycle, IDU & ODU Supports as per std. Practice, And must be atleast 5- Star rated	Nos	2				
10.1	1.5 TR High Wall Unit (1W+1 SB) BMS Room						
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")					0	0
	SUMMARY						
1.1	**TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")**						
					TOTAL		
	TOTAL OF HVAC WORKS (A+B)						
	VAT on Supply Part						
	Service Tax on Installation / Labour Part						
	Grand Total						

HVAC Works for Battery Room

Sl.No	Description of Work	Unit	Qty	Rate (Rs.)		Total (Rs)	
				Supply	Installation	Supply	Installation
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '						
1	The system should be with necessary IDU's & ODU's.Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type.The refrigerat shall be R407 C, R 410 Aonly.						
	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refergerant Charge as per piping Insttalation, IDU & ODU Supports (ODU Support with painted MS Channel of suffient size). The unit shall be with necessary corded remote and the holder for the same.						
1.1	5 TR / 2000 CFM Capacity	Nos	2				
	EER ratio (To be Furnished with technical bid)						
2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclussive of necessary Supports as per standard practices.						
	Gas Line (inch.) Liquid Line (inch.)						
2.1	41.3 19.1	RMT	R.O.				
2.2	34.9 19.1	RMT	R.O.				
2.3	28.6 15.9	RMT	R.O.				
2.4	28.6 12.7	RMT	R.O.				
2.4	19.1 12.7	RMT	50				
2.5	12.7 6.4	RMT	R.O.				
2.6	15.9 6.4	RMT	R.O.				
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	50				
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	5				
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.						

5.1	50 mm dia.	Rmt.	R.O				
5.2	40 mm dia.	Rmt.	20				
5.3	25 mm dia.	Rmt.	R.O				
6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.						
6.1	18 guage	SQM	R.O				
6.2	20 guage	SQM	R.O.				
6.3	22 guage	SQM	R.O.				
6.4	24 guage	SQM	15				
7	Door Louver in extruded AL consutruction. The Grill shall be powder coated. The color shall be approved by the architect / consulting engineer before the delivery at site.	SQM	0.5				
8	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	1				
9	Propeller fan of capacity 500 CFM for exhaust. The fan shall be Industrial type and shall have safety grill at inlet and mesh at outlet to prevent any bird entry. 4 P, 1400 RPM, single phase, Motor IP 54 Protection, F Class insulation, Motor 0.12 KW (For Batery room Exhaust provision)	Nos	1				
10	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1				
11	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 1W + 1 SB. Each unit shall run for 8 hrs.	Nos	1				
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")					0	0
	SUMMARY						
1.1	**TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")**						
					TOTAL		
	TOTAL OF HVAC WORKS (A+B)						
	VAT on Supply Part						

	Service Tax on Installation / Labour Part						
	Grand Total						

HVAC Works for Electrical Room

Sl.No	Description of Work	Unit	Qty	Rate (Rs.)		Total (Rs)	
				Supply	Installation	Supply	Installation
	PART-A ' LOW STATIC DUCTABLE SPILT SYSTEM '						
1	The system should be with necessary IDU's & ODU's.Out Door Unit shall be complete with Invertor/ scroll compressor, The system should be with necessary combinations of IDU's & ODU's along with necessary interconnecting refrigerant piping, Cabling, Drain Piping, Drain pumps, Flexible connection of fire retardant type, etc. of followings capacities, The ODU Shall be of Top discharge type.The refrigerat shall be R407 C, R 410 Aonly.						
	Supply ,Installation And commissioning of following Ductable Type Low static Split Units including indoor - Outdoor Combination, Refergerant Charge as per piping Insttalation, IDU & ODU Supports (ODU Support with painted MS Channel of suffient size). The unit shall be with necessary corded remote and the holder for the same.						
1.1	10 TR / 4000 CFM Capacity	Nos	2				
	EER ratio (To be Furnished with technical bid)						
2	Refrigerant Piping with 19 mm thick Closed Cell rubber nitrile,Class "O"- armaflex insulation of following sizes- Inclussive of necessary Supports as per standard practices.						
	Gas Line (inch.) Liquid Line (inch.)						
2.1	41.3 19.1	RMT	R.O.				
2.2	34.9 19.1	RMT	R.O.				
2.3	34.9 15.9	RMT	50				
2.4	28.6 12.7	RMT	R.O.				
2.4	19.1 12.7	RMT	R.O.				
2.5	12.7 6.4	RMT	R.O.				
2.6	15.9 6.4	RMT	R.O.				
3	Interconnecting control cabling between IDU's & ODU's. The cabling shall be well supported / tied up with the ref line.	Rmt.	50				
4	Acoustical insulation with Armaflex/ K flex / Sekisui open cell sound insulation.Armasound/eq.super sileance duct lianer with micro ban, open cell, elastomaric nitrile rubber.	SQM	5				
5	SLC of Drain Piping shall be HARD PVC . Drain Piping shall be insulated 13 mm Armaflex rubber nitrile closed cell insulation. The drain shall be released into the nearest toilets or as instructed by consulting engineer.						

5.1	50 mm dia.	Rmt.	R.O				
5.2	40 mm dia.	Rmt.	20				
5.3	25 mm dia.	Rmt.	R.O				
6	SITC of GI Ducting (120 GSM) Factory Fabricated with Duct Mate Flanges as per SMACNA for supply air, with 19 mm insulation of Closed Cell Rubber Nitrile Armaflex/Kflex/Sekisui pilon make.inclussive of supports 10 mm GI Threaded rod and C channel 25x25x25 mm size, As per site condition.						
6.1	18 guage	SQM	R.O				
6.2	20 guage	SQM	R.O.				
6.3	22 guage	SQM	R.O.				
6.4	24 guage	SQM	20				
7	Door Louver in extruded AL consutruction. The Grill shall be powder coated. The color shall be approved by the architect / consulting engineer before the delivery at site.	SQM	0.5				
8	Supply air grille with adjustable horizontal and vertical vanes, made of white painted steel, with mounting frame and air volume damper made of galvanized steel sheet.	SQM	2				
9	Propeller fan of capacity 250 CFM for Fresh AIr. The fan shall be Industrial type and shall have safety grill at inlet and mesh at outlet to prevent any bird entry. 4 P, 1400 RPM, single phase, Motor IP 54 Protection, F Class insulation, Motor 0.12 KW (For Electrical room FA provision)	Nos	1				
10	Pressure Testing, Nitrogen flushing, gas charging,& commissioning testing of the air conditioning system.	Lot	1				
11	SITC of auto chnageover timer for cyclic operation of ductable units as a combination of 1W + 1 SB. Each unit shall run for 8 hrs.	Nos	1				
	TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")					0	0
	SUMMARY						
1.1	**TOTAL VALUE FOR AIR CONDITIONING WORK (PART"A")**						
	TOTAL OF HVAC WORKS (A+B)						

	VAT on Supply Part						
	Service Tax on Installation / Labour Part						
	Grand Total						