SECTION - I

SYSTEM REQUIREMENT & SCHEDULE OF QUANTITIE

1. Introduction

IIT Bombay was established in 1958. The second of its kind, IIT Bombay was the first to be set up with foreign assistance. Since then, IITB has grown from strength to strength to emerge as one of the top technical universities in the world.

The institute is recognized worldwide as a leader in the field of engineering education and research. Research and academic programmes at IIT Bombay are driven by an outstanding faculty, many of whom are reputed for their research contributions internationally.

IIT Bombay also builds links with peer universities and institutes, both at the national and the international levels, to enhance research and enrich its educational programmes. The alumni have distinguished themselves through their achievements in and contributions to industry, academics, research, business, government and social domains.

IIT Bombay Computer Centre invites System Integrators to submit their bids for the contract for building a state-of-the-art High-Performance Computing Data Centre in the Ground Floor of the old CSE building in IIT Bombay campus. The Data Centre will have about 5000 sq. ft of floor space for computing infrastructure and support facilities, and is expected to have computing facility of 1.5 petaflop capacity requiring up to 2 MW of power. The work involves renovation of an allotted area in an existing building.

The Data Centre needs to be designed and built conforming to the current global best practices, modular scalable design incorporating energy efficient technologies. The Data Centre will have a Server Room area of approximately 3314 square feet including existing HPC Server Room and will have other areas such as Transformer Room, MLT Panel Room, UPS and Electrical Panel Room, Battery Room, BMS Room, IT Manager Room, etc.

IIT Bombay invites proposals from prospective bidders for the turnkey implementation of the Data Centre as per the scope and specifications outlined in this RFP document.

2. Scope of Work

The scope of work for System Integrator is given below

1) Design, Supply, Installation, Testing and Commissioning of HPC-BYOH Data Centre at Old Computer Science and Engineering Department building at IIT Bombay campus, Mumbai with the following subsystems:

   a. Civil and Interiors comprising construction of fire rated walls, partitions, flooring, ceiling, painting, DG set foundations, Chiller foundations with underground thermal storage tank and associated works as per specifications.

   b. Supply, installation, testing and commissioning of **2 MVA (22/0.415 KV)** transformer, MLT panels, Augmentation/laying of HT/LT cable, UPS system, LT panels, DG sync panels, Electrical power distribution boards, Bus bars, and earthing as per specifications.

   c. Statutory documentation & approvals for Electrical systems installed from competent authorities (CEA etc.)

   d. Precision Cooling System: Design, supply, installation, testing and commissioning of Precision Air-conditioning System for Server Room, HPC Rooms and UPS & Electrical panel Room.

   e. Comfort Air-Conditioning System: Design, supply, installation, testing and commissioning of comfort air-conditioning system for all other rooms as specified in the schedule of quantities.

   f. Safety and Security System: Design, supply, installation, testing and commissioning of security systems comprising the following components:

      i. Fire Detection and Alarm System

      ii. Aspiration based fire detection system (VESDA)

      iii. Novec 1230 based Fire Suppression System

      iv. Access Control System

      v. CCTV Surveillance System

      vi. Water Leakage Detection System

      vii. Rodent Repellant System

      viii. Public Address System

   g. Passive networking solution: Design, supply, installation, testing and commissioning of copper-based cabling system for data outlets other than the server room.

   h. Intelligent Building Management System

   The project is a turnkey project and hence any additional supply/works, which are not explicitly mentioned in this RFP but required to complete the installation, are in the scope of the bidder.

2) Integrated Testing of all the components of the Data Centre using resistive loads for designed capacity.

3) Comprehensive on-site warranty for all the critical equipment i.e. DG, UPS, Air Conditioning System, Electrical Switchgear, Safety & Security System and IBMS for a period of three years from the date of issue of provisional acceptance certificate.

4) Data Centre Onsite Operation and Maintenance 24x7 support for 6 months from the date of issue of Provisional Acceptance Certificate.

5) Supply of Mandatory Spares and Maintenance Tools required for the operation and maintenance of the Data Centre as per the Technical specification.

6) Documentation of the project consisting of as built drawings, O&M Manuals, Cable Schedules, Warranty certificates and consolidated Project Implementation report.

7) Training to IIT Bombay personal for operation and maintenance of the Data Centre. Necessary training shall be provided for configuration, trouble shooting of all the data Centre equipment and software installed.

8) Construction of 6m x 6m Transformer Room and 6m x 6m MLT Panel Room attached to the existing substation behind CRNTS building as per the EMD requirement including obtaining permission for this new construction from Building Planning (Special Cell) department of MCGM.

9) Supply, installation, testing and commissioning of 2MVA indoor type transformer in the proposed Transformer Room.

10) Supply, installation, testing and commissioning of Utility Panel.

11) Supply and installation of busbar trucking from transformer to utility panel and from utility panel to MLT panel as per the Electrical SLD.

12) Providing 2 numbers of 1m x 1m underground trench from MLT Panel Room to LT Panel Room, and from existing 625kVA DG set to Sync Panel 1 & 2.

13) Existing 625 KVA DG set ATS Panel to be removed with minimum downtime for the existing HPC server rack.

14) Water supply for chillers, thermal storage tank and In-row cooling units will be under SI scope (tapping point to be identified by IIT Bombay at one point nearer to Data Centre area).

15) Temporary water & power supply to be provided by IIT Bombay during the time of project execution time (On chargeable basis).

3. Data Centre Design Requirements

1.1.1 Location and Environment

The location of the proposed Data Centre is at Ground Floor, Old Computer Science Engineering Department Building, IIT Bombay, Maharashtra.

The Data Centre subsystems shall be designed for the following ambient conditions:

- Temperature (Max): 41.4° C

- Temperature (Min): 10.9° C

- Relative Humidity: 0 to 95%

- Seismic: Zone III

The site is part of the Computer Science & Engineering Department building. The bidders are advised to visit the site and carry out detailed site survey before submission of the bid.

1.1.2 Functional Areas

IIT Bombay is proposing to construct a Data Centre compliant to Uptime Institute's Tier III standard except for the redundancy of DG sets. Area allocated for the Data Centre is around 9100 Sq. ft (Indoor approx. 5100 Sq. ft and Outdoor approx. 4000 Sq. ft) in Old CSE Building. Data Centre shall have the following functional areas:

1. Server Room: 3314 Sq. ft (including existing HPC Room)
2. UPS & Electrical Panel Room
3. Battery Room
4. IT Manager Room
5. BMS Room
6. Transformer Room
7. MLT Panel Room

The proposed layouts of various functional areas of the Data Centre are as per the Ground Floor Interior Layout drawing and overall Site Layout Drawing.

1.1.3 Server Room

Server Room will have 33 server racks and 6 network racks. Proposed HPC Room will have 2 HPC clusters. The proposed layout is as shown in Ground Floor Interior Layout drawing.

1.1.4 UPS and Electrical Panel Room

UPS and Electrical Panel Room is located in the ground floor of CSE Department.
UPS with 2(N+1) redundancy is required for the Server IT Load of the Data Centre.

1.1.5 Power Supply Distribution

The total IT load in the Server Room is calculated as below:

Sl. No.	Load	Number of Racks/Clusters	Power/ Rack or Cluster in kW	Total in kW
1	Server Racks – High Density	33	10	330
2	End-of-Row Network Racks	6	5	30
3	Proposed HPC Clusters	2	125	250
4	Existing HPC Cluster	1	140	140
	TOTAL			**750**

Maximum IT load in the Server Room is 750kW.

Total capacity requirements are:

UPS: 6 x 400kVA in 2(N+1) redundancy (for the total IT load of 750kW)

DG Set: 4 x 625 kVA without redundancy

1.1.6 Cooling System

- The cooling system shall be compliant to TIER III specifications of Uptime Institute/TIA942.
- The cooling system shall be designed as per ASHRAE standards and recommendations.
- Outside Ambient Temperature to be considered for the design is 41.4° Celsius.
- Precision Air Conditioning system is required for Server Room and UPS & Electrical Panel Room.
- N+1 redundancy required for the Server Room for each bay.
- N+N redundancy required for the UPS and Electrical Panel Room.
- The Precision cooling system shall be designed for Cold Aisle temperature of 22±1° Celsius.
- Relative Humidity shall be maintained at 50% ± 5 for the Server Room.
- Redundancy for Comfort Air Conditioning (to achieve N+N redundancy) is required for Battery Room, BMS Room and IT Manager Room.
- Nominal room temperature for comfort cooling system shall be 25° Celsius.

Redundancy and concurrent maintainability shall be ensured for all critical capacity components (UPS, AC Units, etc.) and distribution components (panels, cables, switch gears, etc.).

1.1.7 Safety and Security Systems

Sl. No.	Parameter	Requirement
1	Fire Detection	Addressable Sensors Mix of heat detectors and optical smoke detectors. Multiple zones and redundancy. Sensor level and controller level redundancy is required. VESDA System.
2	Fire suppression	Automatic Gas based suppression. Novec 1230 Gas based suppression system Multiple zones are required.
3	Access Control	Biometric and Smart card for critical areas. Centralized monitoring and recording. Access logs storage for 3 months.
4	CCTV	IP Based CCTV Cameras. Centralized monitoring and recording. Backup for 1 month on storage system with RAID 1. Archiving solution is required.
5	Other security systems	Rodent Repellant System Water Leakage Detection System Public Address System Aspiration System
6	Standards	NFPA, TIA942, Local standards/regulatory codes.

1.1.8 Fire Detection and Suppression coverage requirement

Area	FAS	VESDA	Automatic FSS	RRS	Clean Agent
Server Room	✓	✓	✓	✓	✓
Proposed HPC Room	✓	✓	✓	✓	✓
Existing HPC Room	✓	X	X	✓	✓
UPS and Electrical Panel Room	✓	✓	✓	✓	✓
Battery Room	✓	✓	✓	✓	✓
BMS Room	✓	X	X	✓	✓
IT Manager Room	✓	X	X	✓	✓
DC IT Store Room	✓	X	X	X	✓
Existing Server Room	✓	X	X	X	✓
Existing Electrical Room	✓	X	X	X	✓
Existing Battery Room	✓	X	X	X	✓
Ground Floor Corridor	✓	X	X	X	✓
Transformer Room	✓	X	X	X	✓
MLT Panel Room	✓	X	X	X	✓

The above are minimum requirements. The design shall be as per the relevant NFPA and local standards.

Note:

1. Electrical power and cooling to be provided for the existing HPC racks with minimum downtime.

1.1.9 Design Requirement

The following are the design considerations of the Data Centre:

1. **High Availability:** All subsystems of the Data Centre shall be designed and implemented as per the Tier III guidelines specified by the Uptime Institute's topology and TIA942 standards except redundancy of DG sets.

2. **Energy Efficiency:** The Data Centre shall be designed with an energy efficient design and shall conform to the best practices of Green Data Centre. The target average PUE shall be better than 1.8.

3. **Modular Design:** The Data Centre design shall be modular so that the capacities can be added on demand.

SCHEDULE OF REQUIREMENTS

4. Schedule of Requirements

1.1.10 Civil Works

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
A	**Civil Works**							
1	**Design of Data Centre layout, interior design, and submission of engineering drawings**	Lot	1					
2	**Partitions, Flooring & Doors**							
2.1	DATA CENTRE PARTITION WALLS							
2.1.1	Supply & construction of partition walls of 230mm thickness using Aerocon lightweight fire-retardant bricks or equivalent.	SQM	86					
2.2	DOORS							
2.2.1	Supply and installation of fire rated steel door of 2000 x 2400 mm: Double leaf (of equal width)	Nos.	2					
2.2.2	Supply and installation of fire rated steel door of 1500 x 2400 mm: Double leaf (of equal width)	Nos.	3					
2.2.3	Supply and installation of fire rated steel door of 1500 x 2100 mm: Double leaf (of equal width)	Nos.	2					
2.2.4	Supply and installation of Emergency fire rated steel door of 1200 x 2400 mm: Single leaf with panic bar	Nos.	1					
2.2.5	Supply and installation of fire rated steel door of 1200 x 2400 mm: Single leaf	Nos.	2					

2.2.6	Existing 1200mm x 2400mm fire-rated emergency steel door to be shifted 600mm above from the existing FFL.	No.	1						
2.2.7	Supply and installation of 2000x1800 mm sliding door	No.	1						
3	**Flooring and Ceiling**								
3.1	Supplying and installation of 2mm thick Vinyl flooring - roll type for UPS and Electrical Panel Room and Battery Room	SQM	146						
3.2	Supply and installation of Access Floor System consisting of cement filled double skinned panels with antistatic laminate finish as per technical specifications for Server room, Ante room and Proposed HPC Room.	SQM	258						
3.3	Supplying and laying of 600mm x 600mm vitrified tiles for BMS Room & IT Manager Room	SQM	40						
3.4	Supply and laying of Class O fire rated thermal insulation for the true ceiling and flooring in Server Room & Proposed HPC Room	SQM	576						
4	**Furniture**								
4.1	Supply and installation of worktables in BMS Room of size 1200x600mm	Nos.	2						
4.2	Supply and installation of worktables in IT Manager Room of size 1500 (w) x 750mm(d) x 750mm(h)	Nos.	1						
4.3	Supply of Executive Chairs	No.	5						
4.4	Supply and installation of 1-hour Fire Rated Data Safe of 300 liters capacity at IT Manager Room	No.	1						
4.5	Supply and fixing of magnetic white boards of 600 x 900mm in BMS Room	Nos.	1						
4.6	Supply of min 10 pairs of shoe rack at Ground floor corridor	No.	1						

5	**PAINTING**								
5.1	Supply and applying of Fire rated painting of two coats of paint finish with putty finish for all the Data Centre walls and partitions including rubbing of existing wall partitions	Lot	1						
6	**Miscellaneous Works - Data Centre**								
6.1	Supply and fixing of Glow Signage: Providing & fixing glow signage on both sides of the door shutters marking PUSH / PULL along with other signages marking different work areas and emergency exit signs of Data Centre.	Lot	1						
6.2	Removing of existing partition walls, removal of windows, Cutting & Chipping of existing floors, removal of existing lighting fixtures, raceways, closure of all openings and disposing of debris.	Lot	1						
6.3	All the glass windows and glass panels in the server room and proposed HPC room to be removed and properly packed with 2 hors fire rated materials.	Lot	1						
6.4	Supply and installation of Ramp: 5400mm x 2000mm for Server Room entry	No.	1						
6.5	Supply and installation of Steps at two locations in Server Room and one location nearer to Server Room emergency exit door	Nos.	3						
6.6	Supply and applying of Pest Control	Lot	1						
6.7	Construction of trench at UPS & Electrical panel Room as per the interior design layout	Lot	1						
7	**Any other Civil Works**								
7.1	Any other Civil works as required to complete the works	Lot	1						

1.1.11 Electrical Works

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
B	**Electrical Works for Data Centre**							
1	Engineering design of MLT, LT electrical capacity components, power distribution, Lighting and Earthing for Data Centre and preparation of drawings and design documents in accordance with the Uptime Tier III guidelines and TIA 942 standards except DG sets. All panels shall be designed with redundancy and concurrent maintainability.	Lot	1					
2	Supply of Low Voltage Electrical Distribution Panels consisting of but not limited to:							
2.1	Supply, installation, testing and commissioning of MLTpanels in MLT Panel Room as per the SLD layout and technical specifications	Nos.	2					
2.2	Supply, installation, testing and commissioning of LT panel at UPS & Electrical panel Room as per the SLD layout and technical specifications	Nos.	2					
2.3	Supply, installation, testing and commissioning of UPS outgoing panel as per the technical specifications and SLD layout	Nos.	2					
2.4	Supply, installation, testing and commissioning of Server Room Power Distribution panels at Server Room as per the technical specifications and SLD layout	Nos.	2					
2.5	Supply, installation, testing and commissioning of Circuit breakers as mentioned in the SLD documents	Lot	1					
2.6	Supply, installation, testing and commissioning of appropriate mobile industrial socket as mentioned in the SLD documents	Lot	1					
2.7	60 KVA UPS Output Power Supply Panels with incoming and outgoing of suitable rating, Metering, earthing provisions and other accessories as per specifications	No.	1					

2.8	AC Power distribution panels with incoming and outgoing of suitable rating, metering, earthing provisions and other accessories as per the specifications	Lot	1						
2.9	Redundant power distribution system for the Server and Network Racks as per the technical specifications	Lot.	1						
2.10	Redundant power distribution system for HPC Racks, Safety and Security Systems and other critical components	Lot	1						
2.11	UPS output power supply switchboards for PCs and other related loads, at least two spare circuits	Lot	1						
2.12	Power supply switch boards with appropriate Ampere TPN incoming, required number of outgoing circuits for all lighting systems	Lot	1						
3	**Earthing**								
3.1	Redundant Interconnected Earthing Grid system and distribution using suitable copper conductors for UPS grounding, UPS neutral, Panel earthing, Rack Earthing and other requirements as per relevant IS and IEEE standards and specifications	Nos	36						
4	**Lighting**								
	Lighting System for the entire Data Centre consisting of but not limited to:								
4.1	Lighting system with 600mm x 600mm aesthetically designed fittings of adequate numbers, LED energy efficient lamps for providing uniform lighting intensity of 500 LUX at Server Room and HPC Room. The system should include necessary switches for each Data Centre zone and room fixed at locations as per specifications and approved drawing.	Nos.	41						
4.2	Lighting system with 600mm x 600mm aesthetically designed fittings of adequate numbers, LED energy efficient lamps for providing uniform lighting intensity of 300 LUX in UPS & Electrical Panel Room, Battery Room, BMS Room and IT Manager Room as per specifications. The system should include necessary switches for each Data Centre zone and rooms fixed at locations as per specifications and approved drawing.	Nos.	24						

4.3	UPS powered emergency lighting system for all areas within the Data Centre as per specifications	Nos.	35					
5	**Cabling**							
5.1	Supply, installation, testing and commissioning of 4000A IP55 rated cast resin Aluminium Bus bar trunking from Transformer to Utility Panel & from Utility panel to MLT Panel with canopy as per the tender specifications & electrical SLD	Lot	1					
5.2	Supply, installation, testing and commissioning of 1600A IP 55 rated cast resin Aluminium Bus bar trunking from UPS O/G panel at UPS & Electrical Panel Room to UPS O/G Panel at Server Room with canopy as per the tender specifications & electrical SLD	Lot	1					
5.3	Supply 1.1 KV grade fire retardant, XLPE armored aluminum conductor cables and copper conductor cables as mentioned in the SLD confirming to IS 1554 of suitable sizes on cable trays with proper tie and clamping as per specifications. Cables should be tagged with name plate near end terminals and at an interval of 4 Mts.	Lot	1					
5.4	Supply of Termination materials including supply of cable glands, crimping sockets and glands earthing including copper foil with all accessories required to complete the work.	Lot	1					

6	**Cable Trays and Misc. items**								
6.1	Supply of Hot dip galvanized G.I Perforated cable tray of 2mm thickness as per the sizes mentioned in the Technical Specifications. Supply shall be inclusive of Elbow, cross, tee, bend, coupler plate with necessary grip bolts, grid plates, earthing provision and all other accessories/mountings required. The cable trays should have spare capacity of at least 25% after laying the cables as per the approved drawings	Lot	1						
6.2	Supply of Miscellaneous safety items such as safety mats, visual safety warning indications (in Marathi, English and Hindi), discharge earth rods and other necessary equipment/accessories as per the requirements of local electrical code	Lot	1						
7	**Uninterrupted Power Supply**								
7.1	Supply of 400kVA 0.9 power factor UPS System with 15 minutes Li ion battery backup at full load as per the specifications (For Data Centre)	Nos.	6						
7.2	Supply of 60kVA 0.9 power factor UPS System with 15 minutes Li ion battery backup at full load as per the specifications (For Data Centre Non-IT Critical load)	Nos.	2						
7.3	Supply of 10kVA 0.8 power factor UPS System with 15 minutes SMF/VRLA battery backup at full load per UPS (for BMS and Emergency Lighting, Safety & Security Systems, and Workstations in BMS Room and IT Manager Room). These UPSs shall be working in parallel mode.	No	2						
8	**Isolation Transformer**								
8.1	Supply, installation, testing and commissioning of 450kVA K1 Type isolation transformer as per the technical specification and Electrical SLD	Nos.	6						
9	**Exhaust Fan**								
9.1	Supply of exhaust fan for the Battery Room with a Digital Time Switch for switching on for fixed duration every day	No.	1						

10	**Electrical Safety Equipment**								
10.1	Supply of Rubber Mat of 10mm thickness of appropriate size in front and rear of all the floor mount electrical panels in 'UPS and Panel Room', 'MLT Panel Room' and 'Battery Room'	Lot	1						
10.2	Supply and fixing of First Aid Box	No.	4						
10.3	Supply and fixing of First Aid Chart	No.	4						
11	**Services**								
11.1	Installation, configuration, commissioning, documentation and training of Electrical System as per above requirements.	No.	1						
12	**Miscellaneous Works - Data Centre**								
12.1	Any other Electrical works required to complete the Data Centre requirement	Lot.	1						

1.1.12 HVAC System

S. No.	Description	Unit	Qty	Unit Supply Rate	Unit Installation Rate	Total Supply Rate	Total Installation Rate	Total SITC Rate
C	**HVAC System**			(in Rs.)	(in Rs.)	(in Rs.)	(in Rs.)	(in Rs.)
1	**Design, engineering and preparation of drawings for the HVAC system for Data Centre and other areas as per the specifications.**	Lot	1					
	Chiller Package							
1.1	Supply, installation, testing and commissioning of 120TR actual Capacity Air Cooled Screw chillers with preferably multiple compressors, etc. The chillers shall be suitable for DATA CENTRE application. The unit mounted starter panel shall be complete with ≥ IP54 as mentioned in the tender specifications	Nos	3					
1.2	Supply & Installation of Integrator for transferring the data available on the chiller microprocessor panel to third party BMS for remote monitoring & operation.	Lot	1					
1.3	Lifting, Shifting & Erection of Chillers at Ground Floor	Lot	1					
1.4	End Suction Pumps Factory assembled Primary Water circulation pump set with mechanical seal including SS 316 gland plate compressing of primary pump (1W+1S), Head pressure to be ascertained by contractor and should meet the system requirement	Nos	3					
2	**PIPING, Valves & Accessories**							
2.1	Supply, installation, testing & commissioning of Mild Steel Chilled Water Piping of class 'C' heavy duty, cut to required length, and installed with welded joints, including all necessary fittings such as elbows, tees, bends, reducers, flanges, supports and other associated pipes as required includes Butterfly valves, Motorized Butterfly Valves, Ball valve, Y Strainers, NON RETURN VALVES (Check Valves),	Lot	1					

	Manual Balancing Valve with full lug, 100 mm dia dial type pressure gauges, 100 mm dia thermometer, Auto Air Vents, Closed expansion pressurization tank with pressurization pump unit, Flexible Connections as per the piping layout Pressure rating of all items should be of minimum PN24								
2.2	SITC of drain piping in hard CPVC with 9 mm thick Closed cell foam insulation as required.	Lot	1						
2.3	Supply and fabrication of Structural MS steel for supporting & base frame structures for piping & ducting, supports shall be duly painted.	Lot	1						
2.4	Supply, installation of MS Air separators of connecting Size: min 150mm of PN 24 pressure rated	Set	2						
2.5	Supply, Installation, testing & Commissioning of underground Thermal storage tank with necessary support arrangement. The Tank capacity shall be 22500 Liters.	Sets	2						
2.6	Supply, Installation, testing & Commissioning of M.S. Fabricated Dozer pot with Chemical for pre-cleaning.	Lot	1						
2.7	Pre insulated pipes with PUF 48 +/-2 Kg/Sq. cm covered with 22GI jacketing, Joints and tapings to be with nitryl rubber covered with 2 G aluminum cladding	Lot	1						
2.8	Insulation of accessories with closed cell insulation of 32mm, finished with Fiber glass cloth and 26 AL Cladding	Lot	1						
2.9	Pressurization tank	Lot	1						
3	**Precision Cooling System for Server Room & HPC Rooms**								
3.1	Microprocessor based Precision In-row Cooling units (Chilled Water unit) with EC Fan, Motor, Heater & Humidifier. The unit shall have inbuilt BMS card and sequential controller as per the HPC rack specifications	Lot	1						
3.2	Supply of Precision In-row Cooling unit Model 12.0 TR (3 Working + 1 Standby) for each bay	No.	12						
3.5	Supply of valves, piping and other accessories for providing cooling water supply for proposed and existing HPC racks	Lot	1						

4	**Precision Cooling System for UPS and Electrical Panel Room**								
4.1	Supply of Bottom/Top Discharge, Humidity Controlled (optional) Chilled water type perimeter Precision Air Conditioning system and necessary accessories of at least 10.0TR actual capacity at 25°C return air and 41.4°C ambient for the UPS & Electrical Panel Room using 2 numbers of PAC units so as to provide N+N redundancy as per the specifications	No.	2						
4.2	Supply & Installation of MS Stands for indoor PAC units of above-mentioned capacities with rubber pads.	Nos.	2						
4.3	Sequencing cable for interconnecting PAC's – 2C x 0.5sqmm copper flexible shielded cable	RMT	10						
4.4	Supply, installation, testing & commissioning of CPVC pipes cut to required lengths and installed with all joints.	RMT	15						
4.5	Installation, handling, Lifting, Shifting, Positioning and Commissioning of PAHU – CW	set	1						
4.6	Supply and installation of Isolation Valve.	Lot	1						
4.7	Supply, Installation and commissioning of drain pumps (1 Working + 1 redundant pump) with controller, drain pan, Socket & cabling, float switch, etc.	Set	3						
4.8	Misc. items like labelling, tagging, etc.	Lot	1						
4.9	Supply and Installation of motorized butterfly valve/ ball valve & associated valves.	Lot	1						
4.10	Supply and installation of volume control damper for PAHU units	Nos.	2						
5	**Comfort Cooling System for Battery Room, BMS Room and Tech Support Room**								
5.1	SITC of 2.0TR Chilled water Based High Wall Mount air-conditioned unit (FCU) for Battery Room, BMS Room and Tech Support Room with required Kits, Accessories & Low side works.	Nos.	6						

5.2	SITC of 3.0TR Chilled water Based Floor Mount air-conditioned unit (FCU) for Server Room with required Kits, Accessories & Low side works.	Nos.	5					
5.3	SITC of Sequencer for FCUs in Battery Room and BMS Room	Nos	2					
6	**Comfort Cooling System for Server Room**							
6.1	SITC of 3.0TR Chilled water Based Floor Mount air-conditioned unit (FCU) for Server Room with required Kits, Accessories & Low side works.	Nos.	5					
7	**Thermal insulation**							
7.1	Under deck insulation with 25 mm thick class 'O' Nitryl rubber with aluminum foil faced for conditioned area for ceiling & flooring	SQM	568					
8	**Services**							
8.1	Installation, configuration, commissioning, documentation and training of HVAC System	No	1					

1.1.13 Safety and Security System

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
D	**Safety and Security System**							
1	**Design, engineering and preparation of drawings for safety and security systems for the Data Centre as per the specifications.**	Lot	1					
2	**Fire Alarm System**							
2.1	Supply of Addressable fire alarm system with fire sensors in all the voids with detector spacing as per NFPA standards, combination of smoke & heat detectors as per the technical specifications. The areas covered shall be the entire Data Centre area including Server Room, HPC Rooms, UPS and Electrical Panel Room, Battery Room, BMS Room, IT manager Room, Transformer Room, MLT Panel Room and Ground floor corridor of old CSE building	No	1					
2.2	SITC of Addressable Multi-sensor Photo electric detectors	No.	78					
2.3	SITC of Addressable Manual Call Point	No.	9					
2.4	SITC of Addressable Hooter cum Strobe	No.	11					
2.5	SITC of addressable Control module	No.	20					
2.6	SITC of addressable Monitor module	No.	10					
2.7	SITC of addressable Fault Isolator module	No.	6					
2.8	SITC of Response Indicator	No.	30					
2.9	SITC of 2C x 1.5 Sq.mm. Cu. Armoured FRLS Cable	Lot	1					
2.10	SITC of 4Kgs Clean agent manual fire extinguisher	Nos.	16					
3	**Fire Suppression System**							
	Supply of Novec 1230 Gas based Fire Suppression System for Server Room, Proposed HPC Room, UPS & Electrical Panel Room and Battery Room as per the technical specifications and shall meet							

	the relevant NFPA Standards.								
3.1	SITC of Novec 1230 Cylinder with beta valve	Lot	1						
3.2	Supply of Novec 1230 agent	Kgs	1116						
3.3	SITC of primary cylinder kit	Nos.	4						
3.4	SITC of End Slave cylinder kit	Nos.	4						
3.5	SITC of discharge nozzles	Nos.	30						
3.6	SITC of manifold	Nos.	4						
3.7	SITC of M.S. Seamless pipes as per ASTM A 106 Gr. B, schedule 40 with necessary fittings.	Lot	1						
3.8	SITC of release switch with accessories	Nos.	4						
3.9	SITC of abort switch with accessories	Nos.	4						
3.10	Hooter cum Strobe	Nos.	5						
3.11	Warning Signages "Do Not Enter" / "Exit-Gas Released" working on 24V DC power supply	Lot	1						
3.12	Supply and laying of 2 Core 1.5 Sqm armoured cable with accessories	Lot	1						
3.13	Supply of 4 kg Clean Agent based manual fire extinguishers in all the rooms as per the requirement	Nos.	13						
4	**Aspiration Based Detection System**								
	Supply of VESDA aspiration-based smoke detection system with required piping, panels, sounders and accessories as per specifications. The system shall be integrated with BMS using potential free Digital I/O.								
4.1	Early warning smoke detection system control panel with detection & all required accessories i) Server room ii) Proposed HPC room iii) UPS & Electrical Panel Room and Battery Room	Nos.	3						
4.2	Power Supply Unit for above VESDA Panels	Nos.	3						
4.3	Capillary Tubes	Nos.	3						

4.4	Air Termination Nozzles	Lot	25					
4.5	25mm dia PVC conduit	Lot	1					
4.6	Hooter cum Strobe	Nos.	3					
4.7	2 core 1.5 sq.mm Cu. Arm. FRLS cables	Lot	1					
5	**Access Control System**							
	Supply of Access Control System with all accessories and software as per the specifications for: i. Biometric and PIN as per the ACS layout							
5.1	SITC of 4 reader access controllers with enclosure and power supply units with required accessories	Nos.	3					
5.2	Supply and installation Access Control System Software	No.	1					
5.3	Supply and installation of fingerprint, PIN based biometric reader with accessories	Nos.	12					
5.5	Supply and installation of 1200lbs electromagnetic lock for double leaf with accessories	Nos.	6					
5.5	Supply and installation of 1200lbs electromagnetic lock for single leaf with accessories	Nos.	2					
5.6	Supply and installation of Emergency release switch	Nos.	8					
5.7	2 Core 1.5 Sq. mm armoured shielded cable with accessories	Lot	1					
5.8	8 Core 1.0 Sq. mm armoured shielded cable	Lot	1					
5.9	Supply and laying of CAT 6A unarmored cable along with conduit	Lot	1					
6	**CCTV Surveillance System**							
	Supply of IP based CCTV Surveillance system with 30 days of storage for covering the rooms in the Ground Floor area of Data Centre, DG Set area, Chiller unit's area as per the specifications							
6.1	Indoor dome cameras	Nos.	23					
6.2	Outdoor PTZ cameras	Nos.	2					
6.3	32 Channel Network Video Recorder with recording storage to 30 days.	No.	1					
6.4	SITC of 24 port layer 2 managed switch	No.	1					
6.5	Supply, Installation, Testing and Commissioning of 15 U rack along	No.	1					

	with all the accessories like PDUs, blanking panels, etc.,								
6.6	Supply & laying of Cat 6 UTP cable (305m box) with all termination crimping etc.	No.	4						
6.7	25mm PVC Conduits with GI Saddle & Spacers, flexible extensions, back boxes and gang boxes, junction boxes with elmex terminals etc., complete as required to fulfill the desired objective of cabling	Lot	1						
7	**Rodent Repellant System**								
	Supply of Rodent Repellant System for the rooms in the Ground floor of the Data Centre. All the room voids and false floor voids must be considered.								
7.1	Supply and installation of master controller with accessories	Nos.	3						
7.2	Supply and installation of Transducer with accessories	Nos.	64						
7.3	Supply and laying of 2 Core 1 Sq. mm unarmored cable with pvc conduit	Lot	1						
8	**Water Leakage Detection System**								
	Supply of Water Leakage Detection System for i) Server Room ii) Proposed HPC Room iii) Existing HPC Room								
8.1	Water leak detection panel with 4 zone detection modules, sound cum strobe units, Potential free contacts for status indication and accessories	Nos.	3						
8.2	Water Leakage Detection System sensing cables	Lot	1						
9	**Public address system**								
9.1	Call Station Table top microphone with 15M Cable	Nos	1						
9.2	Controller and Amplifier (240 W)	Nos	1						
9.3	20W Wall Mount Speaker	Nos	11						
9.4	Music Player for BGM Application	Nos	1						
9.5	2 core 1.0 sq. mm armoured FRLS	Lot	1						
9.6	25 mm FRLS PVC Conduit with accessories	Lot	1						
9.7	Installation and Commissioning of PA System	Job	1						

10	**Intelligent Building Management System**								
10.1	Supply, Installation, Testing & Commissioning of Temp & RH sensors	Nos	14						
10.2	Supply, Installation, Testing & Commissioning of Hydrogen sensor for Battery Room	No	1						
10.3	Supply of Intelligent Building Management System (IBMS) for the Data Centre for monitoring and control of Access Control System, Fire Alarm System, Fire Suppression System, Temperature and Humidity monitoring for the entire Data Centre, Hydrogen Gas Detection for the Battery Room, Monitoring for main panels, UPS parameters, Chillers, Cooling units, RRS, VESDA and DG parameters, IT racks as per the technical specifications. The software should be capable of monitoring all the specified parameters for the total Data Centre	No	1						
11	**Services**								
11.1	Installation, configuration, commissioning, documentation and training of all Safety and Security System as per the above requirements	Lot	1						

1.1.14 Passive Network Cabling

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
E	**Racks**							
1	**Design, engineering and preparation of drawings for Passive Networking systems for the Data Centre as per the specifications.**	Lot	1					
1	**Server Rack**							
1.1	Supply of Server Racks (42U height x 600 width x 1200mm depth) and 2 no's of IPDUs with required accessories as per specifications	No	33					
1.2	Installation and commissioning of Server racks	No	33					
2	**Network Racks**							
2.1	Supply of Network Racks (42U height x 800mm width x 1200mm depth) and 2 no's of IPDUs with required accessories as per specifications	No	6					
2.2	Supply of 9U wall mount rack with horizontal cable manager (2 Nos), power manager (1 no.), 24-port fully loaded patch panels (2 no's) and fan module (1 no.)	No	1					
2.3	Installation and commissioning of Network Racks	No	6					
3	**Cabling for Other Areas**							
3.1	Supply of CAT6A cabling for other Data Centre areas as per the approved drawings and specifications including IO points, Cable terminations, Patch panels, Patch chords, etc.	Lot	1					
3.2	Supplying of CAT6A 1-meter patch cord	Nos.	60					
3.3	Supplying of CAT6A 2-meter patch cord	Nos.	60					

4	**Services**							
4.1	Installation, configuration, commissioning, documentation and training of Network Cabling System as per the specifications.	No	1					

1.1.15 Arranging Power sources

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
F	**Transformer**							
1	Construction of 6m x 6m Transformer Room and 6m x 6m MLT Panel Room as per the EMD requirement	Nos.	1					
2	Supply, installation, testing and commissioning of 2MVA indoor type transformer in the proposed Transformer Room.	Nos.	1					
3	Power supply service connections of 22kV from Electricity Board for the Data Centre	Lot	1					
4	Supply, installation, testing and commissioning of Utility Panel.	Lot	1					
5	Supply and installation of busbar trucking from transformer to utility panel and from utility panel to MLT panel as per the Electrical SLD	Nos.	1					
6	Providing 2 numbers of 1m x 1m underground trench from MLT Panel Room to LT Panel Room, and from existing 625kVA DG set to Sync Panel 1 & 2	Nos.	2					
7	Existing 625 KVA DG set ATS Panel to be removed with minimum downtime for the existing HPC server rack.							
8	Obtaining approval for new construction as per F-1 from Building Planning Special of MCGM	Job	1					

| 9 | Laying of HT cable (3c x 300 sq.mm) from Main power house to ACRE substation. | Mtr | 385 | | | | | |
| 10 | Obtaining approvals from CEA & Electricity board for statutory compliances & energization of systems. | Job | 1 | | | | | |

1.1.16 Miscellaneous

S. No.	Description	Unit	Qty	Unit Supply Rate (in Rs.)	Unit Installation Rate (in Rs.)	Total Supply Rate (in Rs.)	Total Installation Rate (in Rs.)	Total SITC Rate (in Rs.)
F	**Miscellaneous items**							
1	Supply and installation of Personal Computer with Windows 8 Operating System as per the technical specifications for BMS Room	Nos.	2					
2	Supply and installation of Professional grade 49" Video Wall LED Monitors for the BMS Room as per the technical specifications	Nos.	2					
3	Supply of maintenance equipment and tools for the Data Centre as per the technical specifications	Lot	1					
4	Supply of mandatory spares as per the technical specification	Lot	1					
5	Onsite Operation and Maintenance from the date of issue of Provisional Acceptance (4 trained resources)	months	6					
6	Onsite User Training for O&M of the Data Centre	LS	1					

Important Note:

1. The bidder shall enclose detailed Bill of Materials for each system with rates in the price bid for each component/subsystem as per their design (in line with the design requirements). The detailed BOQ without prices shall be included in the technical bid.

2. Quantities mentioned in the enclosed drawings for the Safety and Security Systems are the minimum numbers required.

3. All products supplied shall have 3 years warranty from the date of Provisional Acceptance.

4. All Li Ion supplied shall have 10 years warranty from the date of Provisional Acceptance.

5. The bidder should indicate the taxes, duties and other levies for each item separately.

6. Power supply up to the MLT Panels from Transformer & Utility Panel is in IIT Bombay scope

SECTION - II

TECHNICAL SPECIFICATIONS

1. Civil and Interior Works

The scope of civil works shall include but not limited to the following:

a) Walls and partitions (Fire rated)
b) Doors (Fire rated)
c) Access Flooring
d) Vinyl Flooring
e) Thermal insulation
f) Painting (Fire rated)
g) Furniture
h) Pest Control

i) Any civil, masonry, trenching and fabrication works required for DG Sets installation, Electrical installation, Earthing, HVAC installation and other subsystems installations.
j) Any other civil works required at site
k) All the Civil works are to be carried out as per the interior layout drawings and approval of IIT Bombay
l) Interior Design and Layout
m) The interior has to be aesthetically designed and as per the approved color scheme of IIT Bombay committee.

1.1 Walls and Partitions

a) All the partitioning walls in the Data Centre shall be at least 230mm thick constructed using Aerocon lightweight blocks of minimum 2 hours fire rating.

b) All piercings on walls for conduiting / cabling on all the rooms of the Data Centre shall be closed with appropriate fire sealant.

c) All the partition walls must be constructed from the true floor to true ceiling

1.2 Doors

a) All metal doors should be 2-hour fire rated metal doors with sizes as per drawing and requirement.

b) All doors should be equipped with door closers or floor spring and other required hardware.

c) All doors should have all accessories to fit devices for access control system as per design.

d) All fire rated metal doors shall have a fire rated vision glass of size 12" x 9".

e) All doors to be openable outwards or inwards strictly as dictated in the interior design layout

1.3 Access flooring

Server Room should be equipped with raised floor of 600mm.

False Floor Panels

- Access floor shall have false flooring panels of 600 x 600 mm size 18-gauge steel coated with 50-micron epoxy conductive paint. Floor panel shall be finished with 1.5mm thick antistatic high-pressure laminate with 2mm thick PVC trim edge all-round.

- The interior of the panels shall be filled with non-combustible lightweight cementitious compound.

- The false floor should have a load bearing capacity of at least 1250kg per square meter (UDL) and at least 450kg point load.

- Ramps to be provided for transitioning to elevated floor area at entrance of Server Room as per the drawing. Ramp shall be designed and slope shall be min 1:9 ratio.

- Ensure the landing platform surface is at-least same size in a square. Additionally, a hand rail is strongly recommended for safety purposes. Special tools and tackles required for operation and maintenance of access flooring should be supplied in two sets.

Under Structure

- Pedestal assembly shall be of snap lock type consisting of base assembly 100 x 100 x 2 mm with full bead weld to steel base plate with embossing and four numbers of holes which shall be fixed to the floor with screws.

- Steel pipe riveted to base plate shall engage the pedestal head assembly. Head shall be formed steel and full bead weld to stud, with four flanges having shape and size as per standard approved manufacturers' specifications.

- Pedestal head flanges shall be provided with holes for screws for fastening the G.I. Stringers. No sharp edges or corners shall be exposed from pedestal head when floor panel is removed.

- G.I. rod fully threaded shall be locked to pedestal head. The entire head assembly is engaged in the base assembly by means of nut and check nut.

Stringer

- Stringer system is hot dipped galvanized sheet, construction having channel, with pre-punched counter and holes at both ends of the top face for securing the stringers on to the pedestal head to be fixed with screw ensuring maximum lateral stability in all directions.

- The grid formed by the pedestal and stringer assembly shall receive the floor panel. The stringer system shall be earthed properly by using copper wire. This is required for some of the servers for transient grounding.

1.4 Vinyl Flooring

a) 2mm thick Antistatic vinyl flooring to be provided for Electrical & Panel Room, Battery Room and Ramp for the Server Room and the indoor trench slab.

b) The floor shall be permanently conductive.

c) The flooring shall be chemical resistant and slip resistant.

1.5 Painting

a) Anti-dust type fire rated painting shall be used for Data Centre.

b) Birla wall care putty paste of thickness min 2mm over cement plaster shall be provided to ensure a level and smooth texture to the exposed walls and columns.

c) The existing surfaces are to be cleaned and scratched and markers are kept before the application of putty.

d) After the material has dried upon application, it is to be smoothened by means of rubbing it with sandpaper.

e) Upon this smoothened surface one coat of primer and two coats of plastic emulsion paint of approved make & shade is to be applied.

f) However, Server Room, BMS Room, Electrical Room, and Battery Room shall be painted with 2 coats of fire-retardant painting.

1.6 Furniture (Workstations)

a) **Pre-laminated Particle Board:** Pre-laminated particle board shall be of interior grade confirming to IS 12823. The contractor shall ensure to use pre-laminated particle board in single piece (without joint) for a size/requirement.

b) **Laminate:** The Laminate shall be of 0.8-1.0 mm thickness of approved shade and colour on main /exposed /visible faces and 0.6mm thickness (balancing laminate) on other faces as approved.

c) **Powder Coating:** All CRCA/ Aluminium members shall be powder coated in approved shade as per best standard practice/ process to the thickness of 50-55 micron unless mentioned otherwise and approved. All steel & aluminium parts shall be pre-treated for 7 stages anti-rust treatment as per manufacturer's specifications.

d) **Edge Banding/ Lipping:** The PVC edge banding shall be of best quality as approved by Engineer in charge and shall be hot pressed to the edges at factory as per the standard methodology. The thickness of the edge banding shall be 2 mm on all the exposed/ front edges and 0.8 mm on all the unexposed/ rear/ concealed / inner edges.

e) **Floor Levelers:** The rate quoted by the bidder shall be deemed to be inclusive of the providing and fixing of floor levelers and or leg caps of approved quality in which ever furniture required.

f) **Flip Top Box:** The flip top box to be provided on tabletops shall be of approved quality and design and of suitable size to accommodate the required number of

switches and sockets of electrical/ voice/ data. The rate quoted by the bidder shall be deemed to be inclusive of the same.

g) Variation in dimensions (other than thickness) of the furniture like height of workstation, size of loose furniture, storages, height of table top, storage units etc.) up to +/- 25mm may be acceptable at the time of approval of shop drawings/ layouts, depending upon site conditions, standard product of the manufacturer and decision of Engineer in charge. No extra shall be payable to the contractor on this account. However, it shall be contractor's obligation to match the, standard dimensions as required.

1.7 Other Furniture

White magnetic boards of size 600 x 900 mm with corners chrome plated of Alkosign display system shall be provided for the BMS Room.

Providing and fixing of closed shoe rack with seating in corridor as approved by Engineer in-charge as per catalogue of preferred makes. The shoe rack shall accommodate at least 12 pairs of shoes.

1.8 Pest Control

The contractor shall carry out pest control measures for walls, partitions and other civil works executed by them as per the specifications outlined by Bureau of Indian Standards or other bodies.

The pest control shall be done for all external walls, ceilings, furniture and civil works using suitable chemical emulsions as per specifications of BIS and industry standard practices.

Anti-termite treatment under existing cavity floors shall be done using suitable chemical emulsion.

1.9 Miscellaneous Works

a) Providing & fixing glow signage on both sides of the door shutters marking PUSH / PULL along with other signage marking different work areas and emergency exit signs in the Data Centre.

b) Removing of existing partition walls, false ceiling, plumbing works, removal of tiles, Cutting & Chipping of existing floors and disposing of debris. The walls/partitions shall be dismantled with prior approval of IIT Bombay without affecting the structure of the building and with minimal disturbance to the existing offices in the building. The debris shall be collected, transported and disposed out of the campus by the contractor at their own cost and risk as per the time and schedule approved by IIT Bombay Committee.

c) A ramp shall be constructed near the Server Room main door for the access floor level difference from true floor level using 2-hour fire rated materials.

d) Civil works for panels, earthing and other required electrical installation as per local regulatory requirements and site conditions.

e) Any other civil works required to complete the works in the Data Centre shall be in the scope of the bidder.

2. Electrical Design Guidelines

a) Electrical design shall meet TIER III Guidelines of the Uptime Institute and TIA942 standards except DG sets

b) Redundancy and concurrent maintainability are must for all the capacity components (such as TRANSFORMER, UPS, DG, HT & LT Panels, etc.) and distribution components (Cabling, Switch gears, etc.). Bidder to submit detailed SLD in technical bid for technical evaluation and qualification.

c) Automatic Transfer Switch (ATS) of appropriate rating shall be used for each of the IRCUs (if not built in) as indicated in the Electrical SLD.

d) All LT cables shall be tested quality and acceptance tests/routine tests shall be indicated.

e) All metering instruments used in the LT panels shall be microprocessor based digital type with RS485 interface with Modbus protocol support.

f) Data Centre grounding and protection shall be in accordance with the relevant IEEE, TIA and BIS standards and shall be in compliance with local electrical codes.

g) The contractor shall submit the design document along with engineering drawings and soft copy for review by IIT Bombay. Only after due approval by IIT Bombay, the contract shall carry out the construction.

2.1.1 Data Centre LT Panels

2.1.2 Scope

Design, manufacture, assembly & testing at the manufacturer's works, supply, delivery, erection and commissioning of indoor type 415 / 230 Volts LT switchboards as per the scheme specified in the SLD.

2.1.3 Standards

The equipment covered by this specification shall, unless otherwise specified be in accordance with relevant IEC/IS specification. The degree of protection shall not be less than IP-52 mentioned in IEC-144 / IS-5.

2.1.4 Design Criteria

I. Dedicated distribution panels are required for UPS, Precision Cooling, Comfort Cooling, Lighting, Safety and security system and other facilities in the Data Centre.

II. Each distribution panel inside the Data Centre shall have incomers of appropriate ratings.

III. Redundant and concurrent maintainability shall be provided for UPS, Precision Cooling and Safety and Security systems LT panels as per Tier III.

IV. UPS and PAC Panels and PDUs distributing power to racks should have inbuilt TVSS of appropriate rating with response time <0.5 nanosec, all mode protection (L-L. L-N, L-G, N-G), UL Approved, and EMI/RFI attenuation of 45 dB typical.

V. There shall be at least one or 20% of the installed circuit breakers (whichever is maximum) as spare to be provided for each rating.

2.1.5 Construction

I. The switchboards shall be of multi-cubicle/compartmental or multi box factory-built air-insulated type, fully enclosed with doors for access to the interior. 2.00 mm thick steel sheet shall be used for the fabrication of the panels.

II. The complete panels shall not be more than 1800 mm high with the channel base and the depth shall be preferably within 750 mm wide measured from rear to front faces. The working height shall be minimum 450 mm to maximum 1650 mm. The width of the panel will depend upon the no. of circuits to be accommodated. The design shall be such as to permit extension at site on either end.

III. The panels shall be designed to facilitate cable entry from the top through entry holes of removable plates provided at the top of the cubicle.

IV. Sufficient clearance to be provided around the circuit breakers for maintenance purposes.

V. The switchboard shall be vermin proof and suitable for use in tropical climate. All ventilating louvers and holes shall be covered with fine wire mesh from inside. A suitable rust resisting primer paint shall be applied on the panel after the same is polished and the primer shall be evenly sprayed. The colour of the exterior of the panel shall be of same colour as that of the main control & relay panel. The colour of the interior panel should be as to provide a colour contrasting background for the wiring inside the cubicle.

VI. The switchboards shall be mounted on channel and shall be complete with channel bottom plates, grouting bolts, earthing bolts, washers, cable glands, etc.

VII. Single and three phase switches as well as the fuse terminals provided on the panel shall be of best quality and easy in operation.

2.1.6 Space Heaters

I. The AC switch board shall be provided with thermostat-controlled space heaters through hand operated switch.

II. TVSS and space heaters to be provided for all the critical panels like MLT, LTP & UPS O/G panels.

2.1.7 Bus bars

I. Bus bars shall be aluminium, suitably sized for the specified continuous current rating mentioned in the SLD and short circuit current rating of 50 KA (rms) for 3 sec.

II. Necessary precaution shall be taken to avoid bimetallic action if aluminium conductors are to be connected to copper bus.

III. Means shall be provided for identifying various phases of bus bars by red, yellow and blue print.

IV. Bus support shall be of arc resistant, non-tracking, low absorption type insulators of high impact strength to withstand normal and fault condition stresses.

2.1.8 Circuit breakers

- AC Air Circuit Breakers or MCCBs shall be fully draw out type, housed in separate compartments having a continuous current carrying capacity, breaking capacity as per approved scheme. The circuit breakers shall be provided with trip coil and closing coil operated from suitable control voltage to be arranged by bidder. Spring operated mechanism shall be provided for breaker closing. The breaker shall be

provided with trip free, automatically operated mechanism & push button to trip the breaker as well as to close the breaker electrically.

- The breaker shall be provided with two over current and one earth fault IDMT electronic type relay.
- The circuit breaker shall be provided with auxiliary contacts for Close / Open and trip circuit healthy indicating lamp. Two sets of spare auxiliary contacts of each open and close position shall be provided.
- The door of the circuit breaker compartment shall be interlocked so that (1) the door cannot be opened while the breaker is in closed position and (2) when the door is open the breaker cannot be closed. However, facility, to defeat this interlock shall be provided for testing purposes. The circuit breaker shall have three defined position namely (a) Service (b) Test and (c) Isolated. The circuit breaker can be closed in test position.

2.1.9 Miniature circuit breakers

- The MCBs shall be triple pole / double pole, air brake types capable of safely breaking the fault current of the associated feeder. The MCB shall have a quick make, quicker break mechanism completes with position indicator.
- All MCCBs shall be microprocessor based.
- The MCBs shall comply with the relevant IS Standard.
- The audio alarm for tripping of AC circuit breaker or blowing of fuse shall be made with facility of canceling the alarm. Individual lamp indication shall be provided in the AC switchboard and the same will continue to glow till the fault is rectified.

2.1.10   Indicating lamps of control switches

Indicating lamps shall be LED type provided with coloured dust protecting type lens. Lamps shall be of very low wattage consumption and heat generated due to continuous burning shall not deteriorate lamp cover.

2.1.11   Internal wiring

Internal wiring of the AC switchboard shall be done by means of stranded copper conductor, PVC insulated and sheathed cable conforming to IS: 1554 (Part-I). Minimum size of the wiring shall be such as to allow only 5% drop of voltage at the remote end of the longest outgoing feeder from the AC panel board, 2.5% drop in case of starting of motor of the remote end. Multi-way terminal blocks of copper stud moulded construction complete with screws, nuts, washers, etc. shall be provided for terminating the internal wiring and outgoing cables. Control terminals shall be clamp type. Screw type terminals with screw directly impinging on conductor shall not be supplied.

Each wire shall be identified at both ends and shall be properly tagged & ferruled in compliance with approved drawings. Wires shall not be spliced or taped between terminal points.

Wires shall be neatly bunched and adequately supported as to prevent sagging, strain and termination and proper dressing to be done.

All spare contacts of the equipment shall be wired up to the terminal block. At least 10% spare terminals shall be provided in each cubicle. There shall be sufficient space between

the terminals for easy connection of the leads. More than two connections in a stud shall be avoided. Lock nut with washer shall be provided in each stud.

2.1.12   Grounding

Copper/aluminium strip of 50mm thick for ground bus rated to carry maximum fault current shall be provided along the entire length of the distribution board. Ground bus comprising of Aluminum conductors, as alternative shall not be acceptable.

Each casing of the equipment provided in the board shall be connected directly to the ground bus in accordance with I.E. rules. The ground bus shall be brought out to two terminals at the two ends of the switchboard for connection with the station earthing system.

2.1.13   Tropical finish

All electrical equipment, accessories and insulation of wiring shall have fungus protection involving special treatment on insulation and metal against fungus, insect & corrosion.
Insulation
The insulation at any point in the distribution board shall be of at 1.1 KV grade.

2.1.14   Cable glands

All feeders shall be provided with suitable dust tight screwed brass cable glands conforming to the relevant IS Standard. Gland shall project above the gland plate. Terminating cables shall be armored and the armour rods shall be connected to earth bar.

2.1.15   Digital Multi-Function Meter

One KWH meters of 3-phase, 4 wire type shall be flush mounted on the incoming breaker compartments, all circuits of the meters shall be capable of withstanding 20% overload for a period of at least 8 hours. Phase selector switch shall be provided for Ammeter and Voltmeter. The selector switch of voltmeter shall be such that it can select phase to phase and phase to neutral voltage.

2.1.16   Relays & Contractors

Two over current relays and one earth fault relay shall be provided in each of the incoming breaker. The relays shall be IDMT type. The relays shall be suitable for operation with a temperature range of 0°C to 50°C. The contacts of the relay shall be silvered. When open, the contacts shall withstand a voltage of 115% of the normal circuit voltage. The relays shall not deteriorate in performance due to ageing of any constituent material.
The over current relay shall have a setting from 50% to 200% and that of earth fault relay from 20% to 80% of the rated secondary current of the C.T. The operating voltage of the trip & closing coil shall be 220 V DC +/– 10%. Contactors, if used shall be of same voltage rating.

2.1.17   Current transformer of the breaker

Current transformer used for incoming L.T. Switchgear shall be air cooled of accuracy class of 5P and 1 for protection and metering respectively. VA burden & CT ratio will be

such as to suit the requirement. The insulation level of the C.T. shall be suitable for 1.1 KV grade service.

2.1.18   Packing and Dispatch

All equipment shall have to be dispatched suitably and securely packed in wooden crates, suitable for handling during transit by rail and / or road.

Panels shall be tested at Factory and Test Certificates shall be submitted.

The switchboard wiring should withstand a test of 3 kV power frequency voltage for one minute. Other tests shall be carried out as per relevant IEC/IS specification. Three (3) copies of such test reports are to be submitted to Purchaser for approval before the switchboard is actually dispatched.

The Contractor shall give at least 14 (fourteen) days advance notice of the date when the test will be carried out.

Softcopies of test report to be submitted before conduting test

2.1.19   Cables

- All cables shall be 1.1 KV grade fire retardant, XLPE armored aluminum conductor cables and copper conductor cables as mentioned in the SLD confirming to IS 1554 of suitable sizes.

- All cables used in the Data Centre shall be Fire Retardant, Low Smoke Zero Halogen (LSZH) type.

- Cables shall be laid on cable trays with proper tie and clamping as per specifications.

- Cables should be tagged with name plate near end terminals and at an interval of 4 Mts.

- Entry of the cables shall be through suitable and appropriate cable sockets and glands.

- The size and number of cores of all the cables shall be determined as per scheme requirement. The size of cables shall be supported by cable-sizing calculation.

- While cabling, cable joints should not be there.

   Cable shall be standard product of reputed manufacturer and shall conform to relevant Indian standards.

3. DG Sets

3.1.1 Diesel Generator Sets

Three numbers of 625 kVA Prime Power Diesel Generator Sets with rated output of 415V, 3 phase, 50Hz, 0.8 lagging power factor and having acoustic enclosure shall be provided as per the detailed technical specifications mentioned below.

Diesel Generator set comprising of diesel engine with radiator cooling and with all standard features coupled to alternator with Class H insulation and VPI epoxy impregnated winding, coupled together and mounted on a rigid base frame and comprising of following accessories like:

- Integral fuel tank of min 990 liters.

- Batteries: 2 numbers of 12 Volts / 160Ah

- Electronic control panel

- Acoustic Enclosure suitable for outdoor applications.

- Modbus interface (RS485) for status monitoring in BMS

Reference Standards

Diesel Engine Power	: ISO 3046-1
Speed Governor	: ISO 3046-4
Generator	: IS 4722 / IS 13364
Permissible limits of Noise level of Rotating Machines	: IS 12065
Diesel Fuel	: IS 1460
Hot dip-Galvanizing steel	: IS 2629
Codes of fire safety	: IS 3034
Battery & Charging	: IS 7372
Degree of Protection of generator	: IP 23 as per IS 4691
Degree of Protection of Control panel	: IP 41 as per IS 2147
Control Panel	: IS 8623 Part I

Description	Units	Rating
Prime Rated output	kVA	625
Engine Cooling		Liquid cooled (EG complete 50:50)
Aspiration		Turbo charged, change air cooled
Cylinder arrangement		As per OEM
Bore and stroke	MM	As per OEM
Compression ratio	Ratio	14.3: 1
Rated speed	RPM	1500
Minimum continuous load	%	20
Engine KW at rated RPM	Kw (HP)	As per OEM
Fuel stop power as per ISO-3046	Kw (HP)	As per OEM

Note:

1. Pollution Control Board Certificate should be provided for the installed DG Sets.

2. Existing one number of 625kVA Powerica make DG set must be integrated with 2 numbers of proposed Synchronization panels along with 3 numbers of proposed 625kVA DG sets.

a. Engine

Engine shall have the following accessories:
- Air Inlet System
- Cooling System for engine cooling

- Exhaust System
- Fuel System
- Lubrication System
- Flywheel & Flywheel Housing
- Charging System for batteries
- Control System
- Instrumentation for metering
- Engine and alternator protection system

b. Base Frame and Coupling

Diesel engine and alternator are coupled together with closed coupling and placed on robust, sturdy iron base frame specially designed to absorb vibrations for the smooth operation of the D.G. set. Spring mounted Anti-vibration mounting shall be supplied.

c. Alternator

Alternator shall have the following specifications:

Make	: Stamford/equivalent
Output	: 625 kVA
No: of Phase	: 3
Power factor	: 0.8 lag
Reference Altitude	: 1000 meters above MSL
No: of poles	: 4 poles
Insulation Class	: H
Voltage Regulation	: +/- 2%
Enclosure	: IP23
Rotor	: Dynamically balanced
Waveform distortion/total harmonic distorting	: No load <1.5% Non distorting balanced linear load <5%
Maximum unbalanced load across phases	: $\leq 25\%$
Telephonic Harmonic factor	: <3%

d. Fuel Tank

Minimum 990 liters capacity integral fuel tank made up of standard quality and thickness as per OEM recommendation tested for leak and pressure and supplied with filling point, breather, and level indicator with graduation, outlet valve, drain plug, lifting hooks and provision for return fuel.

e. Battery

2 numbers of 12V batteries along with terminated lead connectors including inter connection cables will be supplied. Suitable MS battery stand with proper earthing will be provided.

The power supply shall be provided to battery charging from redundant circuits and shall be concurrently maintainable.

f. Acoustic Enclosure

Acoustic enclosure shall meet the stringent norms laid by Ministry of Environment and Forests (MoEF) / Central Pollution Control Board (CPCB) and meeting the noise barrier of 75 dB @ 1-meter distance from the enclosure at free field conditions. The Enclosure shall be fabricated to have optimum serviceability. The air inlet louvers shall be specially designed such that the system operates at rated load even at 50°C ambient temperature. All the five sides shall be powder coated for superior finish and long-lasting life. Stainless steel hardware in addition to IS 8183 specification material shall be used to achieve better noise insulation resulting in the best sound attenuation. The enclosure shall be containerized type housing the Engine, Alternator, Fuel Tank, and Batteries.

g. Exhaust Piping

- The exhaust piping shall be fabricated with suitable thickness of MS pipes. Vendor shall confirm the adequacy and submit the calculation for approval before delivery.

- Height of the exhaust pipe shall be as per OEM recommendation

- A weather cowl shall be provided at the top.

- The pipe shall be painted after fabrication with heat resistant paint as per OEM standard

- The exhaust piping and the silencers shall be insulated using 50mm thick mineral wool all along the length. The insulation shall be cladded with 24-G SWG aluminium sheet. (temp to be mentioned)

- All lifting tools and tackles used for the erection shall have valid safety certification

3.1.2 Synchronizing panel

- Supplying, erecting, testing and commissioning of automatic synchronizing panel with pre-programmed microprocessor-based controller for parallel operation of four diesel generating set on common busbar system. The diesel generators are from different manufacturer and different capacity, three phase, 415 volts, 50Hz. The synchronizing panel should be with all standard features such as load management system, operation of DG sets as per load condition based on connected load, safety protection for engine, alternator etc.

- The panel must be cubicle type, base frame mounting of 14/16Guage CRCA Sheet with hinged doors and Single Front operation. The Panel is fabricated on CNC machines and Powder coated to 80 – 120 microns thickness after a 11-tank pre-treatment and cleaning process. The control panel portion should have facility for operation of the genset – starting, stopping, metering and protection. The power panel portion should include the power switchgear.

3.1.3 Synchronizing panel operation

- There is one existing Cummins DG of rating 625kVA. In this tender scope, 3 numbers of 625kVA DG sets shall be supplied. The panel should have 4 numbers of DG incomers of 1000A, 3P ACB along with suitable neutral contactor and a common busbar system of adequate capacity comprising of Aluminium busbar. On failure of Electricity Board supply, any one DG should start automatically and supply the load. Upon increasing the load, other three DG sets should start sequentially and synchronize with the Main bus system. The DG sets should run until the Electricity Board supply resumes back. When load reduces, the DGs should stop automatically one by one. Hence the DGs should start automatically, synchronize and power up the load in absence of Electricity Board supply and total number of running DGs should be as per the load condition at any given time.

3.1.4 CONSTRUCTION

Description of components	Specifications
Frame	2.0 mm CRCA sheet.
Door	1.5 mm CRCA sheet.
Rear door	1.5 mm CRCA sheet
3.1.5 Partition	1.5 mm CRCA sheet
3.1.6 Gland plate	2 mm GI (without paint)

3.1.7 SWITCH BOARDS

a. The switchboard shall be cubicle type, compartmentalized, free standing floor mounting type, Indoor, IP-42 or Outdoor, IP-55 type with form 2b construction.

b. Base frame shall be of 75mm x 40mm ISMC channel.

c. Incoming & Outgoing entry shall be from bottom or top of the panel as per approved drawing.

d. Undrilled gland plate to be provided for all Incoming & Outgoing cables.

3.1.8 PAINTING

a. Sheet metal work must be given cold surface treatment in an eleven-tank process to inhibit

b. corrosion.

c. The panel shall be finished in powder coated light grey shade of ral - 7035 structure finish for both exterior & interior

3.1.9 BUSBAR SYSTEM

a. Busbars shall be electrolytic grade aluminium busbars.

b. Busbars sizes: as required

c.   Busbars supports: SMC / DMC.

d.   Busbars clearance: minimum 25 mm between phase to phase & phase to neutral 19mm.

e.   Heat shrinkable color sleeves shall be provided for busbars for identification only.

3.1.10 WIRING

a.   All internal wiring shall be carried out with multistrand copper conductor, pvc insulated, 1100/650v grade shall be color coded the size being: -

b.   AC control: - 1.0 sq., mm.

c.   DC control: - 0.75, 1.0, 2.5,4.0 sq., mm.

d.   CT's 2.5 sq., mm.

e.   Earth   : - 2.5 sq., mm.

f.   Ferrules should be provided at both the ends of control wires. tube type ferrule shall be used. (tube of white color & inscription of black colour)

3.1.11 EARTHING

a.   Earth busbar shall be provided inside the panel throughout the length & appropriate dia hole shall be provided on the busbar to connect external earth bus or cable.

b.   All hinged doors shall be connected to the main frame by flexible copper wire for earth continuity.

c.   CT common point will be connected to earthing busbar / bolt.

3.1.12 LABELS

Anodized engraved label having white characters on black background with white description inscribed legibly shall be provided for all components.

3.1.13 GENERAL

a.   Danger name plate shall be provided on busbar chamber compartment.

b.   Suitable eye bolt / lifting arrangement shall be provided.

3.1.14 Standards

The equipment covered by this specification shall, unless otherwise specified be in accordance with relevant IEC/IS specification. The degree of protection shall not be less than IP-52 mentioned in IEC-144 / IS-5.

4. Uninterrupted Power Supply (UPS)

4.1.1 400kVA Monolithic UPS

The bidder shall offer 400kVA True online double conversion monolithic parallel Architecture UPS with 3 phase input and 3 phase output. Each UPS System shall have 15 minutes battery backup on full load.

UPS AC Input
- Voltage Range: 350V to 440V
- Frequency Range: 40~60Hz
- Power Factor: Input power factor shall be ≥ 0.99 without any optional filter at rated UPS full output load.
- Current Distortion: Less than<3% at full rated UPS output load at input Voltage THDv<2%

UPS AC Output
- Three-phase, 3-wire plus & Ground. (4 wire)
- Load Rating: 100% continuous load rating for any combination of linear and non-linear loads.
- Output frequency ranges from 50/60Hz
- Output voltage stability: +/-1%
- Overload capacity
  - 150% for 1min
  - 125% for 10mins
- Harmonic distortion (voltage)
  - <2% at 100% linear load
  - <5% at 100% non-linear load
- Output voltage stability
  - Static load - +/-1% static
  - Dynamic load+/-3% static
- Overall efficiency
  - Voltage Frequency Independent mode (VFI) – 96% (according to EN 62040-3 definition)
  - ECO mode – up to 99% (according to EN 62040-3 definition)

General conditions
- Operating temperature: 0°C to 40
-
- Seismic zone III

Technical specification of 400KVA monolithic UPS system

S. No.	Specification	Requirement
1.	Capacity (in KVA / KW)	400 kVA/400 kW 3-Phases Input / 3-Phase Output.
2.	Technology and Capability	a) True Online configuration double conversion UPS. b) ECO mode c) Voltage Frequency Independent
3.	Temperature (design ambient)	0 to 40°C
4.	Relative Humidity	0- 95% (Non condensing)
5.	IP Class	IP20
6.	Acoustic Noise measured at 1 m distance	<75db at full load
7.	Input facility -Phases / Wires	3-Phase & Ground (R, Y, B -Phases & Ground)
8.	Nominal Input Voltage	380V to 450V.
9.	Nominal Input Frequency	50-60Hz
10.	Input Frequency Range	50Hz (± 5%)
11.	Input Power Factor	0.99 on Full load
12.	Input Current Harmonic Distortion (THDi)	<3% on Full Load
13.	Input Protection	a) Input to Rectifier b) Input to Bypass c) Manual Bypass (In-built)
14.	Over voltage/under voltage	Yes
15.	Input Frequency variation protection	Yes
16.	Rectifier	IGBT Rectifier
17.	Surge protection	Yes
18.	Phase sequence change	The UPS should have protection at Input side for phase sequence change
19.	Nominal Output Voltage	380/400/415Vac (Three Phase Three-wire)
20.	Output Voltage Regulation	+/- 1%
21.	Nominal Output Frequency	50/60 Hz
22.	Output Frequency Regulation	+/-0.1%
23.	Output Wave Form	Pure sine wave
24.	Output Voltage Distortion (THDv)	≤ 3% (For 100% Linear / Resistive Load) ≤ 5% (For 100% Non-Linear)
25.	Unbalanced load on phases	100% unbalanced load should be allowed
26.	Voltage symmetry with 100% Unbalanced Load	+/- 1%
27.	Output Protection	Yes
28.	Output short circuit Protection.	Yes

29.	Over-temperature protection.	Yes
30.	Overall Efficiency	> 95 %
31.	Output N-E voltage	≤ 1.0 Volt
32.	Transfer Time (Mode of operation)	Nil from Mains mode to Battery Mode Nil from Battery Mode to Mains mode
33.	Automatic & Bi-directional static by-pass (In-built)	Should be provided to take care of uninterrupted transfer of load from Inverter to bypass (under overload / fault conditions) & automatic retransfer from bypass to inverter (on removal of overload / fault conditions)
34.	Inverter Overload capacity (Mains Mode & Battery Mode)	125% for 10 minutes 150% for 60 seconds
35.	Display	Standard LED/LCD panel displaying the UPS status, voltage, current, frequency, date, time, etc.
	Battery	
36.	Backup Required	15 minutes on full load
37.	Battery Type	LMO/NCM Li Ion battery

450kVA Isolation Transformer	
Configuration	Three Phase, Delta/Star
Insulation	Class – H
K-Factor	K1
Voltage Adjustment	±2.5% by selecting Taps on Primary
Voltage Regulation	2-4% for 100% change in current
Transformer Input/output MCCB	Must be provided

4.1.2 60kVA Monolithic UPS

The bidder shall offer 60kVA true online double conversion monolithic parallel architecture UPS with 3 phase input and 3 phase output. UPS System shall have 15 minutes battery backup on full load.

UPS AC Input
- Voltage Range: 400V to 430V
- Power Factor: Input power factor shall be ≥ 0.98 without any optional filter at rated UPS full output load.
- Current Distortion: Less than≤3% at full rated UPS output load

UPS AC Output
- Three-phase, 3-wire plus ground.
- Load Rating: 100% continuous load rating for any combination of linear and non-linear loads.
- Output frequency ranges from 50/60Hz
- Output voltage stability   +/-1%

- Overload capacity
    - 150% for 1min
    - 125% for 10mins
- Overall efficiency   ≥96%

General conditions
- Operating temperature: 0° C to 40
-
- Seismic zone III

Technical specification of 60KVA monolithic UPS system

S. No.	Specification	Requirement
1.	Capacity (in KVA / KW)	3-Phases Input / 3-Phase Output.
2.	Temperature (design ambient)	0 to 40°C
3.	Relative Humidity	0- 95% (Non condensing)
4.	IP Class	IP20
5.	Acoustic Noise measured at 1 m distance	<66db at full load
6.	Input facility -Phases / Wires	3-Phase / 4-Wire & Ground
7.	Nominal Input Voltage	400V to 430V.
8.	Nominal Input Frequency	50-60Hz
9.	Input Frequency Range	50Hz (± 5%)
10.	Input Power Factor	0.98 on Full load
11.	Input Current Harmonic Distortion (THDi)	<3% on Full Load
12.	Input Protection	Input to Rectifier Input to Bypass Manual Bypass (In-built)
13.	Over voltage/under voltage	Yes
14.	Input Frequency variation protection	Yes
15.	Rectifier	IGBT Rectifier
16.	Surge protection	Yes
17.	Phase sequence change	The UPS should have protection at Input side for phase sequence change
18.	Nominal Output Voltage	380/400/415Vac (Three Phase Four-wire)
19.	THDv	
20.	Output Voltage Regulation	+/- 1%
21.	Nominal Output Frequency	50/60 Hz
22.	Output Frequency Regulation	+/-0.1%
23.	Output Wave Form	Pure sine wave
24.	Unbalanced load on phases	100% unbalanced load should be allowed
25.	Output Protection	Yes
26.	Output short circuit Protection.	Yes

27.	Over-temperature protection.	Yes
28.	Overall Efficiency	Efficiency : 96 %
29.	Output N-E voltage	≤ 1.0 Volt
30.	Transfer Time (Mode of operation)	Nil from Mains mode to Battery Mode Nil from Battery Mode to Mains mode
31.	Automatic & Bi-directional static by-pass (In-built)	Should be provided to take care of uninterrupted transfer of load from Inverter to bypass (under overload / fault conditions) & automatic retransfer from bypass to inverter (on removal of overload / fault conditions)
32.	Inverter Overload capacity (Mains Mode & Battery Mode)	125% for 10 minutes 150% for 60 seconds
33.	Display	Standard LED/LCD panel displaying the UPS status, voltage, current, frequency, date, time, etc.
	Battery	
34.	Backup Required	15 minutes on rated load
35.	Battery Type	LMO/NCM Li ion battery

4.1.3 10kVA Monolithic UPS

Bidder should supply UPS systems capable of delivering continuous output power of 10KVA at 0.8 output power factor.

10 kVA UPS system for critical load shall be with N+N concurrently maintainable configuration working in parallel mode. This UPS system shall provide power supply to BMS, Safety and Security Systems, work stations and emergency lighting system. 15 minutes battery backup on full load per UPS is required.

Technical Specifications for the 10kVA UPS are as follows:

S. No.	Description	Specifications
1.	UPS Capacity	10 kVA
2.	Technology	True Online Double Conversion UPS
	Input Parameters	
3.	Nominal Input Voltage	380 V 3 Phase, 4 wire
4.	Permissible Input Voltage Range	300 Vac (-15%) to 418 Vac (+10%) in three phases
5.	Nominal Input Frequency	50 Hz
6.	Input Frequency Variation	+/- 5%
7.	Power factor at rated load	>0.95 on full load
8.	Distortion	< 5% for nonlinear load
	Intermediate DC Circuit Parameters	
9.	Rectifier	IGBT Rectifier
	Output Parameters	
10.	Output Power	10 KVA/8KW
11.	Output Power Factor	0.8
12.	Nominal Output Voltage	Three Phase 380Vac, Single Phase 220Vac
13.	Output Voltage Distortion	≤5%
14.	Distortion Factor (a) Linear Load (b) Non-Linear Load	<3% in Linear Load, <5% on Non-Linear Load
15.	Nominal Output Frequency	50 Hz
16.	Overload Capacity	105%- 125% - 5 mins 125%-150% - 1 min
17.	Efficiency at 100% load	> 93%
	Mechanical Parameters	
18.	Protection Grade	IP 20
19.	height x width x depth in mm	Specify
	Communication	
20.	Interface Type	Modbus
	Environmental Parameters	

21.	Operating Temperature Range	0-40 °C
22.	Relative Humidity	5-95% without condensing
23.	Maximum Attitude with Full Rating	< 1000 Meters
24.	Acoustic Noise with Rated Load At 1 m distance	< 65 dB
25.	Display	Standard LED/LCD panel displaying the UPS status, voltage, current, frequency, date, time, etc.
	Battery	
26.	Battery Backup	15 minutes Battery Backup at 10kVA Load for each UPS
27.	Type of batteries	VRLA/SMF batteries

5. Server Room Power Distribution

The Server Room power distribution shall consist of Bus bar trunking of appropriate sizing from the UPS Outgoing Panels (in the UPS Room) to Server Room UPS Power Distribution Panels. And Cabling from Server Room UPS Power Distribution Panels to PDUs in the IT Racks as per the Electrical SLD.

The power distribution shall be redundant and concurrently maintainable meeting Uptime Institute Tier III guidelines.

5.1.1 Cabling between Server Room Power Distribution Panels and Rack

- Supply, installation and commissioning of cabling of suitable rating for UPS power distribution to the racks using 32A/63A mobile industrial sockets as per the Electrical SLD.
- The cables used should be of FRLS type and should be dressed properly in the tray of suitable size and loading capacity.
- For each HPC Cluster, appropriate power circuit breakers of 320A/250A to be provided at Server Room Power Distribution Panel as per the Electrical SLD.

5.1.2 Power distribution for HVAC Systems

- Each of the Precision AC system should be dual powered from two different distribution panels. In case of dual power supply options not available, a static transfer switch of appropriate rating shall be used.
- The electrical grounding and protection for HVAC equipment shall be done as per applicable Industry standards and best practices.
- Power cables for the in-row cooling units shall be taken under the false floor.

6. Lighting

6.1.1 SCOPE

- Design, supply, delivery, erection, and commissioning of lighting system for all rooms of Data Centre.
- This also includes supply, erection and commissioning of all associated parts and accessories required for construction, operation and maintenance of complete system comprising of lighting fixtures complete with lamps, supports and accessories, exhaust fans, lighting panels, galvanized rigid steel conduits, lighting wires, G.I. earth wire, receptacles, switchboards, switches, junction boxes, pull out boxes complete with accessories, power cables, conduits, and allied accessories for such lighting system.
- There shall be provision for emergency lighting system in strategic. so that the operating personnel can safely find their way even during emergency of a total AC failure. These lights will be normally 'OFF' and will be switched 'ON' automatically when under voltage or total AC failure occurs in the main AC system.

6.1.2 STANDARDS

- The equipment's and materials to be furnished under this specification shall be designed, manufactured and tested in accordance with the latest revision of relevant Indian Standards, IS: 3646.
- The electrical installations shall meet the requirement of Indian Electricity Act - 2003.

6.1.3 Lighting

Lighting system includes supply, erection and commissioning of all associated parts and accessories required for construction, operation and maintenance of complete system comprising of lighting fixtures complete with lamps, supports and accessories, exhaust fans, lighting panels, galvanized rigid steel conduits, lighting wires, G.I. earth wire, receptacles, switchboards, switches, junction boxes, pull out boxes complete with accessories, power cables, conduits, and allied accessories for such lighting system.

The electrical installations shall meet the requirement of Indian Electricity Act - 2003.

The following illumination level has to be maintained at 1000mm height from finished floor level for each area:

- Server Room: 500 Lux

- All other rooms and outdoor area of the Data Centre: 300 Lux

a. Lighting Fixture

- The lighting fixtures shall be designed for use in 230 ± 10% V, 50Hz, AC system.
- The emergency lighting fixtures shall be designed for use in 220 V ± 10% AC System (or other suitable level DC system).
- All equipment and accessories shall be suitable for continuous operation.
- All lighting fixtures complete with lamps/LEDs, tubes and accessories shall be within the scope of the bidder.
- Light fittings shall be so arranged that the required lux values specified are maintained uniformly, with supply of required fixtures and supports.

b. Lamps

- Luminaries will be selected to suit architectural, functional and aesthetic requirement.
- Energy efficient LED lighting using 600mm x 600mm fixtures shall be used at all locations in the Data Centre.
- Reflector, if used, shall be made out of high purity aluminum scientifically designed for high optical performance.
- The distribution of fittings over the three-phase supply shall be such that any particular area is not completely void of supply in case of failure in any phase.
- All accessories and fittings shall be within the scope of supply of the bidder.

c. Receptacle with plug

All receptacles shall be of flush mounting type complete with individual plug and switches. The receptacle shall be 5A/15A/230V, 2-Pole, 3-Pin type with 3rd pin grounded and suitable for indoor and outdoor installation.

d. Switch and switchboard

- All switchboard/boxes shall be fabricated from 14 SWG sheet steel and shall be hot dip galvanized.
- All switchboards shall have adequate space to accommodate all accessories and wires.
- All switches shall have quick make and quick break mechanism. Small duty switches shall be piano type with service marking on the switches.

e. Lighting cables

- All lighting cables shall be 1.1 KV graded PVC insulated with stranded copper conductor. Multicore cables shall have extruded PVC inner sheath and overall extruded PVC outer sheath. Entry of the cables shall be through suitable and appropriate cable sockets and glands.
- Final casing wiring / cable routing shall be done based on fixture location and other site conditions.
- The size and number of cores of all the cables shall be determined as per scheme requirement. The size of cables shall be supported by cable-sizing calculation.
- All cables used in the Data Centre shall be Fire Retardant, Low Smoke, Zero Halogen (LSZH) type.
- Cable shall be standard product of reputed manufacturer and shall conform to relevant Indian Standards.

f. Junction box

The Junction Box shall be of 14 SWG sheet steel with hot dip galvanized and have screwed cover. The junction boxes shall be square/rectangular type. Each junction box shall have the following marking with indelible ink:
- Circuit numbers on the top.
- Circuit numbers with ferrule (inside).
- Danger sign in case of 415 V junction box.

g. Terminals

- Multi-way terminal block of approved make 1100V grade and of approved type complete with screws, nuts, washers and marking strip shall be furnished for termination of incoming and outgoing wires. Each terminal shall be used for only one termination.
- 20% spare terminal blocks shall be provided for future use.

h. Grounding

All lighting panels/distribution boards, junction boxes, switchboard, fixtures, etc. shall be grounded in compliance with the provision of IE Rules.

7. Cable Trays and ducting

7.1.1 Cabling for Rack

- Supply, installation and commissioning of underfloor cabling of suitable rating for UPS power distribution in the Server Room.
- Each Server/Network Rack shall be powered from two different UPS sources. The redundant cabling shall be distributed in such a manner to ensure concurrent maintainability.
- Cables shall be terminated in a power distribution unit on one side. Other side shall have a mobile industrial socket of 63A, 1Φ/3Φ as per rack density requirements as indicated in the 'Electrical SLD for the Data Centre'.
- Plugs for all the mobile industrial sockets are also to be provided.

  The cables used should be of FRLS type and should be dressed properly in cable tray of suitable size and loading capacity.

7.1.2 Cable Trays and ducting

- All electrical cabling inside the Data Centre area shall be done using corrosion resistant metal cable trays of appropriate size and weight carrying capacity.
- The cable trays sizing shall be done such that there shall be at least 25% spare capacity for future use
- All cable trays shall be earthed as per standards. Earthing continuity shall be provided at cable tray joints.
- The fixing of underground and overhead cable trays shall be as per industry best practices and shall be approved by IIT Bombay HPC Committee.
- The bidder shall submit the proposed design, layout drawings and BOQ of cable ducting.

8. Data Centre Earthing

8.1.1 SCOPE

The scope of work is inclusive of but not limited to the following:

i)   Design and engineering of earthing system and supply, delivery, installation, testing and successful commissioning as per the drawings and BOQ.
ii) Beside connections of different risers below and above ground up to equipment's and different structures and other important installations are also within the scope of bidder.
iii) Special treatment in Earth pit other than charcoal and salt shall be adopted to ensure good earthing.
iv) Besides electrical installations, Earthing System for RF earthing for UPS and the earthing of servers are also included in this scope. Reference earthing for false flooring pedestals are also included with this scope of work.

8.1.2 Data Centre Earthing Standards

Proper grounding of Data Centre equipment, often called network grounding or the data Centre grounding infrastructure, is defined by TIA/EIA-942 Telecommunications Infrastructure Standard for Data Centres, and goes beyond the requirements of the National Electrical Code (NEC) to protect equipment and improve system reliability. The bidder shall follow both TIA and NEC; however, whenever NEC does not cover any aspect or there is difference between the two, TIA/EIA-942 would prevail.

IEEE Std. 1100-2005 (IEEE recommended Practice of Powering Grounding) shall also be acceptable. Earthing schematic shall be submitted along with electrical SLD with details of conductors.

i.   Design criteria

The two goals of the grounding system are (1) to equalize electrical potentials and (2) to create a low resistance path to ground to ensure equipment safety and personnel safety. It should facilitate proper operation of protection system during earth fault in the system. Five basic principles shall be used when designing a grounding system to accomplish these goals:

As the grounding system is no more reliable than its weakest link, only high-quality components shall be used and trained professionals must make all connections.

The grounding system shall be visually verifiable so as to be able to visually inspect degradation of any component of the grounding system, from the equipment to the rack, to the common bonding network (CBN), to the earth. The system shall be accessible during moves, adds, and changes, ensuring long-term system reliability and scalability.

The grounding system shall be adequately sized to prevent premature equipment failure that contributes to increased operating costs.

The grounding system shall make each rack to bond directly to the CBN, thereby directing current away from sensitive electronics.

All metallic components in the Data Centre e.g., equipment, racks, cabinets, ladder racks, enclosures, and cable trays shall be bonded to the grounding system to ensure all conductive materials at the same electrical potential to minimize current flow.

j. Installation Criteria

The bidder shall, however, be liable for proper quantification for the work.

The design shall ensure that the ground resistance shall be within the limit. The composite of all ground electrodes connected together must have an impedance of less than 1 ohms to ground. If this impedance exceeds 1 ohm, then additional chemically assisted grounding electrode must be added to reduce this value to below 1 ohm.

Safe earthing electrode of suitable diameter with 3-meter length pipe-in-pipe technology with electrolyte backfill compound shall be used. The number of earth pits shown mentioned in the earthing drawing are minimum quantity required. Based on the soil resistivity additional electrodes shall be used.

Copper flats of appropriate sizing shall be used for connecting to the earth pits and also for interconnection of the earth pits.

Standby Generator or UPS system are considered to be separately derived systems (by the definition in NEC Article 100.I) and, therefore, must be separately grounded in accordance with NEC Article 250-30.

Methods for attaining low impedance to ground for data processing grounding electrode may include:
- An array of grounding electrodes spaced at least 12 ft apart
- A buried ground loop with multiple ground rods
- Chemically enhanced grounding electrodes

Once the grounding electrode has been established (location, low impedance, minimum length, configuration, etc.), all electrical distribution components associated with the data Centre should be connected to a central ground bus. This ground bus is an insulated, isolated ground bus and is intended for a signal reference ground—not an equipment, safety ground. It will be connected to the isolated ground bus in the UPS, the PDUs, the branch circuit panels, and the isolated ground conductors going to the individual server racks. This bus will be completely isolated within the data Centre room from the green-insulated or bare, safety-grounding conductor that is connected to the conduit, boxes, panel board cabinets, server rack frames, UPS enclosures, generator frames, and the like. It is critical to the data Centre grounding system's integrity that there are no connections between these two systems within the data Centre and, in fact, no connections anywhere—with the exception of a single bonding jumper specifically located to minimize the interactions between the electrical distribution system and the data Centre ground system.

Thus by providing two separate low-impedance grounding electrodes (one for the main electrical service and one for the sensitive electronic system), and connecting them with the smallest bonding conductor permitted by the NEC (i.e., the conductor with the highest impedance), a reliable, low-noise, low-impedance, virtually isolated, signal reference ground for electronic systems.

Apart from the two types of grounding system mentioned above one more type of earthing, named Signal Reference earthing, needs to be implemented with braided copper wire tied with

false floor pedestal. It will eventually create a mesh system the level of which will be in between power and data cable trays.

Because most racks and cabinets are made of painted components that are bolted together, there remains uncertainty about electrical continuity from one rack component to the next. In the Data Centre, rack and cabinet continuity is important for safety; electrostatic discharge (ESD) protection; and the proper grounding of switches, servers, and power strips. Continuity may not exist if the installer fails to scrape paint between sections of rack or use specially designed paint-piercing hardware.

To avoid loosening of grounding connectors over time, permanent copper compression lugs shall be used instead of setscrews to fasten conductor.

Failing to create an electrical bond between the structural components of racks and cabinets can trap currents within sections of them, resulting in potential safety hazards, failure of ESD protection, and ungrounded equipment. So, components such as hardware and jumper cables are to be tested for their ability to create electrical bonds and carry current.

k. Test

All tests as required for successful commissioning of the system shall be carried out by the contractor at site in presence of IIT Bombay representative/Consultant.

9. HVAC System

Air cooled water chillers are proposed for the Data Centre. Air Conditioning system shall be designed for the total heat load of 840kW. Three numbers of 120Tr are proposed in N+1 configuration (2 working and 1 standby).

Cooling Load Summary

S.no:	Description	Cooling load in Tr	Unit Proposed	Redundancy Configuration
			Cooling Load Summary Sheet	
1	Server Room	102.00	12 x 12.0 TR CW InRow Cooling Unit	4 Nos (3W+1S) per Bay
2	Proposed HPC Room	72.00	As per HPC Cluster OEM recommendation	As per HPC Cluster OEM recommendation
3	Existing HPC Room	40.00	As per HPC Cluster OEM recommendation	As per HPC Cluster OEM recommendation
4	UPS Room	10.00	2 x 10.0 TR PAHU Units	2 Nos (1W+1S)
5	Battery Room	2.00	2 x 2.0 TR Hi Wall FCU	2 Nos (1W+1S)
6	BMS Room	2.00	2 x 2.0 TR Hi Wall FCU	2 Nos (1W+1S)
7	IT Manager Room	2.00	2 x 2.0 TR Hi Wall FCU	2 Nos (1W+1S)
Total cooling load		**230.00**		

Specifications of Air-Cooled Water Chillers:
1. Capacity: Min 420KW actual capacity at below conditions.
2. Chilled water in/out temp: 14 / 9 ^{0}C
3. Ambient temp: 41.4 ^{0}C
4. 120TR @ design conditions

5. Chiller should be suitable for given scheme of variable primary flow.

Air-Cooled Water Chiller

Air-Cooled Chiller, factory assembled, factory charged, factory run tested of various capacities. Chiller should consist of accessible Screw type compressors, condenser coils, electronic expansion device, refrigerant direct expansion shell & tube heat exchanger, R134a refrigerant, Quick Restart Feature, steel base frame for mounting the above components, refrigeration piping, fittings, valves, refrigerant and oil, controls and ancillaries.

Sound pressure levels for the units shall not exceed 63 dBA at 10 meters from the unit. In built acoustic enclosure has to be provided for all the 3 chiller compressors as per the site conditions.

Noise level should be complied with Maharashtra Pollution Control Board, if client wanted SI has to get the certification from Maharashtra Pollution Control Board (MPCB).

Structure
The structure and the frame of the unit shall, in order to ensure resistance to corrosion, shall be produced entirely in galvanized steel. The painting should be resistance to saline humidity; therefore, the units can be installed in even the most testing of atmospheric conditions.
All external fastenings are in stainless steel. The closing mechanism on the casing gives ≥IP54 protection.
The access panels to the unit have to be equipped with handles and fast screws.

Compressor
The units shall be consisting of two double screw compact compressors. These compressors should be supplied by the market's leading manufacturers.
To attenuate the transmission of vibrations, and therefore reduce noise levels and possible faults, each compressor shall be fitted on rubber anti-vibration supports and inbuilt acoustic enclosure to be provided for all the compressors.
Electrical motor shall be 2-pole, semi-hermetic, squirrel-cage induction type and cooled by suction gas. The compressor shall be direct electrical driven, without gear transmission between the screw and the electrical motor. Refrigerant system differential pressure shall provide oil injection on all moving compressor parts to correctly lubricate them.
The motor should have built-in electronic protection with temperature sensors located directly in the windings.

9.1.1 QUICK RESTART FEATURE:

Unit controls should be designed such that during power failure and restart, chiller should be able to provide full load capacity (100% loading) within **180 secs.**

Cooling circuit

The unit shall be equipped with double refrigerant circuit designed for R134A refrigerant in copper tubing including filter dryer, liquid sight glass, Microprocessor controlled electronic expansion valve with external equalisation, high- and low-pressure switches and high-pressure transducers

9.1.2 INTEGRATED CHILLER PLANT MANAGER

Chiller has inbuilt/external plant manager feature which can control operation of multiple chiller on Configurations like sequencing, scheduling, load sharing between chillers etc will be controlled by chillers. onboard primary variable flow pumps (should be offered within chiller frame) shall be controlled by chiller plant manager which is a part of chiller controller. This will avoid need of any 3rd party chiller plant manager.

Microprocessor control panel indicating following:
Suction and Discharge pressures.
Oil pressure.
Chilled water inlet / outlet temperature.
Condenser water inlet / outlet temperature.
System voltage.
Current drawn by each compressor.
The complete framework shall be mounted on anti-vibration spring isolators.
Note: In particular the unit shall be provided with two compressors with two independent circuits. The unit can thus count on two partial cooling steps at any time, guaranteeing a modular cooling capacity. It also provides redundancy i.e., if one circuit fails, the chiller plant should run on 50% capacity.

Chilled Water Evaporator
The evaporator should be a high efficiency shell & tube single passage evaporator. This type of "single passage" evaporator allows for:
- Maintaining the flow of water horizontally,
- Guaranteeing a uniform temperature of the volume of water even in partial load conditions or when one of the circuits is not operating.
- The flow of refrigerant to be straight, facilitating the drag of oil inside the tubes.
- The thermal exchange to always occur "against the current" so ensuring maximum possible efficiency.
- The heat exchanger shall be insulated with UV-resistant material.
- Water side pressure drop of evaporator shall not exceed 50 **kPa** at actual conditions

Air Cooled Condenser with EC fans
The condenser should be generously proportioned in order to function at high ambient temperatures. It shall be composed of:

- coil/s equipped with aluminium fins and mechanically expanded copper tubing in order to obtain optimum metallic contact for maximum exchange efficiency.

- axial fans, statically and dynamically balanced and made from composite materials for high efficiency and low acoustic impact with internal and external safety protection grilles.

Fan speed shall be driven by a modulating condensation control system based on the condensation pressure.

Condenser fan shall be EC (electronically commutated) axial type to have better efficiency.

Electrical Panel: -

The electrical panel shall be housed on the chiller package structure and shall include starters for the compressor motors. The panel should be ≥ IP54 protection degree, shall be done in compliance with EC standard and it shall be provided mainly with

- ≥IP54 protection grade
- Lockable general cut-off switch
- Electric bars distribution
- Acquisition of the absorbed current
- Phase sequence control, minimum and maximum power supply
- Maximum internal temperature control
- Thermo-magnetic protection for the fans and auxiliaries, fused on the compressors
- Remote control switches for the compressors
- Auxiliary transformer at 24V and 230V

Microprocessor control system

The microprocessor control shall be integrated with the local user terminal where the regulation software is housed. This control shall include:

- local control terminal with LCD display with signal lights
- local user terminal with external accessibility
- outlet chilled water temperature regulation by means of an exclusive PID algorithm
- electronic expansion valve managed by the control system
- advanced control of cooling capacity by automatic set-point sensitivity regulation
- refrigerant charge monitoring
- monitoring of the absorbed current and checking of eventual malfunctions
- advanced anti-freeze protection on evaporator
- integrated LAN card for local network connection of a group of chillers
- integrated clock card
- breakdown Loss of Chilled water flow
- Phase loss, phase reversal, phase imbalance and under and over voltage protection
- Microprocessor control system in addition shall allow:
  - management of double set-point from remote control
  - limiting of absorbed current on pre-set value or external signal
  - "High Speed Restart" procedure to reach total cooling capacity within 3 minutes.
  - Free-contact for general alarm and 2 for addressable alarms
  - Remote ON-OFF switch

- o Auto Sequencing of Chillers.
- o Ability to interface with Modbus protocol directly on RS485 serial cards

Refrigerant Circuit

Sufficient valves shall be included to allow a compressor to be removed for service and to allow the refrigerant to be pumped in to and contained in the condenser. The unit shall be equipped with a liquid line shut off valve, filter drier, liquid line sight glass, solenoid valve and insulation where required to prevent condensation forming.

Controls & Interlocking

Control Panel shall be housed on the chiller package structure and shall include starters for the compressor motors. The panel shall have a Temperature controller to control the leaving chilled water temperature at the required set point. The panel shall have IP ≥55 protection for outdoor operation and shall have following minimum features of safety

- Discharge and suction pressure indication for each compressor.

- High discharge and low evaporator pressure cut out.

- Anti-freeze protection for chilled water.

- Loss of Chilled water flow.

- Phase loss, phase reversal, phase imbalance and under and over voltage protection.

- Motor protection for each compressor motor.

HIGH TEMPERATURE OPERATION:

On Evaporator side: Chiller should be capable of delivering the high chilled water temperature up to 20^0C which will provide higher EER.

On condenser side: Chiller should be able to operate up to 50^0C without tripping

ONBOARD INVERTER DRIVEN PUMPS:

Chiller frame should include inverter driven pump after the evaporator to supply the chilled water to plant at desired temperature & head pressure.

Pump shall be operated from chiller microprocessor panel itself without any need of external controller.

Pump should be connected with UPS power supply.

9.1.3 DUAL POWER ATS:

ATS shall designed to accept two power sources for each chiller. ATS has two power source input termed as Source A and Source B. Source A is the preferred source and Source B is emergency source.

TESTING

The units shall be factory tested and supplied complete with oil and refrigerant Infront of client and consultant

Computer Software generated technical data sheet should be attached with the offer. If required, the same needs to be demonstrated during the time of final approval.

Four sets of test report shall be submitted as hard copies and same to be shared as softcopies.

Chilled Water In Row Cooling Units

A. CABINET CONSTRUCTION

The exterior panels shall be 18-gauge steel foam insulation. Insulation shall comply with UL94 HB. Front and rear exterior panels shall be 18-gauge perforated steel with 80% open free area, and equipped with a keyed lock to provide a means of securing access to the internal components of the unit. The frame shall be constructed of 16 gauge formed steel welded for maximum strength. All units shall provide maintenance from the front and rear, allowing units to be placed within a row of racks. All exterior panels and frame shall be powder coated for durability and attractive finish.

Units shall include castors and leveling feet to allow ease of installation in the row and provide a means to level the equipment with adjacent IT racks

B. VARIABLE SPEED EVAPORATOR FAN ASSEMBLY

The unit shall be configured for draw-through air pattern to provide uniform air flow over the entire face of the coil. The unit is equipped with variable speed, electrically commutated, 400 mm backward incline fans complete with Inlet Volute. Each fan assembly should be designed to provide total CFM with standard filter is min 6000 CFM. Fans shall be variable speed capable of modulating from 30-100%. Each fan assembly shall consist of integral fan finger guards.

C. MAIN DISCONNECT SWITCH

Unit shall be provided with Thermal-Magnetic circuit breakers with interrupt capacity ratings per UL/IEC listed. Voltage: 380-415V 50Hz

D. AUTOMATIC TRANSFER SWITCH

The units shall be equipped with an automatic transfer switch (ATS). The ATS shall automatically switch from a main power supply to a secondary power supply in the event of a power outage or power supply failure, without changing equipment operation. The ATS shall monitor the main power supply so that when the power is restored to the primary source it will automatically switch from the secondary source back to the main power source.

E. MAIN DISCONNECT SWITCH

Unit shall be provided with Thermal-Magnetic circuit breakers with interrupt capacity ratings per UL/IEC listed Voltage: 380-415V 50Hz. Units shall include main disconnect switches located on the E-panel in order to individually disconnect primary/secondary power inputs.

F. MICROPROCESSOR CONTROLLER

The master display shall allow monitoring and configuration of the cooling unit through a touch screen control. Functions include status reporting, set-up, and temperature set points. LEDs report the operational status of the connected air conditioning unit. The microprocessor controller shall allow the user to navigate between menus, select items, and input alpha numeric information. The microprocessor controller shall activate a visible and audible alarm

in the occurrence of the events listed in the Technical Specifications Manual. The microprocessor controller shall log and display all available events. Each alarm log shall contain a time/date stamp. Controller shall display the run time hours for major components.

Unit should able to display below details: -

i)   Unit capacity

ii)   Unit airflow

iii)   Unit water flow rate

iv)   Supply air temperature

v)   Return air temperature & RH

vi)   Rack inlet temperature

vii)   Group capacity

viii)   Water leak detection alarm

G. NETWORK MANAGEMENT CARD

The unit shall include a network management card to provide management through a computer network through TCP/IP. Management through the network should include the ability to change set points as well as view and clear alarms. Modbus TCP/IP and RTU: Units shall support Modbus TCP/IP and RTU.

H. COOLING COIL

The cooling coil shall use aluminum fin OD copper tube coils. Fin shall be a minimum of 0.0055 in thick. Tube wall shall be a minimum of 0.016 in thick. Coil tube sheets shall be a minimum 18-gauge G90 galvanized steel. The coil shall be rated for a maximum pressure of min 2500 kPa. Coil headers are equipped with drip plates in the bottom to route the condensate accumulating on the header tubes to the condensation pan. The coil is configured in a counterflow arrangement to optimize heat transfer efficiency. The coil should be hydrophilic blue fin coating.

I. 2 WAY MODULATING VALVE

The valve shall be microprocessor controlled to automatically direct the proper amount of chilled water in the cooling coil to maintain desired conditions. A shut-off valve located in the bypass line may be manually adjusted for 2-way flow if so desired. Three-way control valve shall be rated for 300 WOG with brass body and stainless-steel ball. Actuator shall be direct connected rotary floating point style actuator with potentiometer feedback, and should be capable of being replaced without disconnecting piping from the valve. Ability for manual operation is also provided.

J. CONDENSATE PAN WITH CONDENSATE PUMP

The unit shall consist of a primary and secondary drain pan. The secondary drain pan shall be piped to the primary pan for removal of condensate. The primary drain pan shall include a condensate pump and dual floats for control and overflow protection.

The factory-installed condensate pump is piped internally to the condensate pan. It is capable of pumping min 20 l/h liquid a maximum distance of 20 m, which may include a maximum

lift of 3.0 m. Dual floats are included with the unit. One float is used for condensate pump control, the other to generate condensate pan overflow alarms.

K. FILTERS

The standard filters shall be 30% efficient per ASHRAE Standard 52.1, UL Class 2 (MERV 8 per ASHRAE 52.2). Filters shall be EN779 G4 efficient. The 96 mm (3.75 in) deep, pleated filters shall be replaceable from the rear of the unit. The optional filter shall be 85% efficient per ASHRAE Standard 52.1 (MERV 13 per ASHRAE 52.2, EN779 F7).

L. HUMIDIFIER

Humidifier shall be able to modulate capacity. The humidifier shall be self-contained, steam generating type, factory piped and wired, with disposable cylinder and automatic solid-state control circuit. Humidifier canisters shall be replaceable. The humidifier controller shall communicate directly to the microprocessor controller and provide complete status and control at the operator interface. Humidifier shall control flush cycling and conductivity via automated controls. Humidifier shall be capable of producing steam as per OEM design

M. ELECTRIC REHEAT

Reheat elements shall be low watt density, wired for three-phase, loaded equally on all three phases and shall be electrically and thermally protected by both automatic and manual reset cutouts. Reheat capacity shall be 9 kW. Reheat coils shall be stainless steel, fin tubular construction. Heater casing shall be 20-gauge G90 galvanized steel. Heater shall be provided with self-engaging electrical connectors upon installation. Heaters with manually connected conductors are not acceptable.

N. TEMPERATURE AND HUMIDITY SENSOR

   i. Internal Temperature Sensors: Thermistor temperature sensors shall be mounted behind the front and rear doors to provide control inputs based on supply and return air temperature. Sensor accuracy shall be within ± 1 °C accuracy.

   ii. Internal Humidity Sensors: Humidity sensors shall be mounted behind both the front and rear doors and shall provide control input based on humidity in supply air. Humidifier sensor shall be ± 2% RH accuracy full scale.

   iii. Remote Temperature Sensors.

   Three remote rack inlet temperature sensors shall be shipped with the unit for placement in the field to provide control input based on rack inlet temperature.

   iv. Water Temperature Sensors: Internal supply and return chilled water temperature sensors shall be installed into sealed wells. Wells are filled with thermal conducting heat transfer grease to provide accurate temperature sensors.

O. FLOW METER

The flow meter shall be factory piped inside the unit and connected to microprocessor controls to provide water flow rate through the unit. The microprocessor controller shall also use this information to provide total unit capacity out of the unit while in operation. The flow meter shall be a glass filled nylon construction vortex-sensing meter.

P. SELECTABLE TOP OR BOTTOM PIPING

Pipe connections for field connection from either the top or bottom of the unit. Unit connections shall be made internal to the unit. The unit shall include two pipe adapters Pipe adapters shall ship loose with the unit for field installation where applicable.

Q. CABLE WATER DETECTOR

Leak detection sensing cable can be shipped loose with the unit. If water or other conductive liquids contact the cable anywhere along its length, the main controller visually and audibly annunciates the leak.

9.1.4 Aisle Containment

i.   The aisle containment shall be constructed between two symmetrical rows of racks in cold Aisle.

ii. The cold aisle containment shall be modular to enable to add the racks.

iii. All the components used in the aisle containment shall be 120 minutes fire rated.

iv. Entry and exit doors of the cold aisle should be of double leaf and have swing type mechanism.

v.   Each door should have CRCA frame with fire rated glass of 4 mm thick.

vi. Frame of the door should have 4 vertical MS Columns of rectangular section with thickness of 1.5mm.

vii. Four columns should be grouted to real floor or can be fixed to the base frame of rack.

viii. Doors must have a steel picture frame fabricated in 1.2mm thick CRCA sheet as per "IS 513 Grade D" standards.

ix. Glass doors should be mounted on the frame to provide 120° door opening.

x.   PU Foam Gasket shall be used across the metal edges of the door to prevent any leakage on cold air.

xi. Doors should have automatic door closers.

xii. Polyamide cable brushes should be fitted at the bottom of doors to avoid leakage of hot air when doors are closed.

xiii. Powder coating for door frames and support frames shall comply with ROHS requirement to avoid hazardous substance contamination in the Data Centre. Pre-treatment nano ceramic process shall be followed.

xiv. Powder coating thickness shall be 80-100 microns.

Top Panels

i.   Top of the cold aisle shall be covered with either fire rated Glass or Polycarbonate panels.

ii. Top panels shall be fixed in CRCA frame as per "IS 513 Grade D" with thickness of 1.2 mm.

iii. Glass/polycarbonate in the top panels shall be of 4 mm thick.

iv. Top panel must be toolless installation to offer quick access to area above the contained aisle during the maintenance activity.

v. Top Panel must have opening for Smoke Sensor/ Suppression System wherever necessary.

9.1.5 Comfort Air Conditioning System

Comfort air-conditioning systems shall maintain room temperature of 25°C with the outside ambient temperature of 41.4° C.

System Description and Design Considerations

Chilled water PAC units and Hi wall fan coil units will be used for conventional air conditioning systems for the required rooms in the Data Centre.

S. No.	Room Description	Cooling Capacity Requirement	Redundancy	Type of Unit
1.	UPS and Electrical Panel Room	10.0 TR	N+N redundancy	2 x 10.0 TR PAC units
2.	Battery Room	2.0TR	N+N redundancy	2 x 2.0 TR Hi Wall Mount FCU Unit
3.	BMS Room	2.0TR	N+N redundancy	2 x 2.0TR Hi Wall Moun FCU Unit
4.	IT Manager Room	2.0TR	N+N redundancy	2 x 2.0 TR Hi Wall Mount FCU Unit
5.	Server Room	3.0TR	N	5 x 3.0 TR Floor Mount FCU Unit

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i. The system shall be designed for maintaining room temperature of 25°C and ambient temperature of 41.4° C.

ii. The bidder shall submit the design drawings and layouts along with the bid.

SPECIFICATIONS OF 10.0 TR PAHU UNITS

PAHU UNIT FOR UPS AND ELECTRICAL PANEL ROOM

UPS and Electrical Panel Room shall be provided with Precision Air Handlers. The design of the air conditioning and ventilation System shall take into account temperature and heat

dissipated by all equipment's installed. Air conditioning Systems will operate to supply the necessary cooling while one of the units are in stand-by mode. On failure of the operating unit, the stand-by units will automatically start by means of auto change over control. All Precision Units for UPS and Electrical Panel Room shall be bottom discharge type with EC Fan. There shall be provision for remote alarm in case of any equipment failure. The Building conditioning and ventilation Systems shall be monitored and controlled by a microprocessor-based control System.

Top discharge Chilled Water Type Units with EC Fan- Motors (Electronically Commutated):

2.1. Scope

Scope of this section comprises the supply, installation, testing and commissioning of precision air conditioning Systems. The units shall be provided with chilled water coil along with 2-way valve control. A built in ATS shall be provided within unit for dual power supply. All units shall be provided with Modbus/ BACnet over IP for connectivity with building management system.

2.2. Selection basis

Units for shall be selected based on 32-degree centigrade air inlet & chilled water with supply and return of 9/14-degree C.

2.3. Cabinet Construction

1) The frame and panels shall be constructed of heavy gauge corrosion resistant sheet steel and have modular construction with railing and hinged doors

2) The cabinet shall be powder coated and have a textured finish

3) The cabinet shall be provided with double skin panels with inner panel of minimum thickness of 0.8mm and outer panel of thickness of 1.0mm

4) Insulation thickness in all the panels should be 19 mm thick glass wool or equivalent insulation

2.4. Evaporator Coil

Evaporator coil shall be constructed of rifled bore copper tubes and louvered aluminum fins, with the aluminum/ GI frame. The coil should be straight/ slant coil configuration and drip tray should be fabricated from heavy gauge steel with powder coating to avoid corrosion. The drip trays must be double angled for condensate flow and easily removable for cleaning. The cooling coil shall be of suitable rows deep and designed for high sensible cooling. The distance between the fins should not be less than 1.8 mm and the face velocity shall not be more than 2.75 m/sec. The coil must be internally partitioned with minimum 6 rows. 2.5. Fan and Motor: ELECTRONICALLY COMMUTATED DRIVES Fans: Unit must be provided with direct drive backward curved fans each running with DC drive electronically communicated fans for discharge of cold air in the false floor. The fans should be aligned and balance statically and dynamically. The fan speed must be controlled based on the room return air Temperatures and also must have automatic speed control without manual intervention.

The fans can be one /two/ three no's as per the manufacturer's standard. Units with latest innovative EC fan technology with "COMPOSITE "Blade material will be preferred. Units shall be factory balanced in accordance with Section 15071, mechanical, sound and vibration control. Only direct drive fans to be provided in offered units and centrifugal fans with belt drive is strictly not acceptable. Noise Level: 70 dB from 1 Meter of unit in free filed conditions.

2.6. Accessibility:

Service Area

1) The unit shall be accessed from front, which will be enabling to access all the main components of the machine from the front for installation purposes and routine servicing.

2) The unit shall be serviceable from the front with a maximum service space required of 1m

2.9. De-Humidification

De-humidification to be achieved.

2.10. Filtration

Filtration level should be of 90% at 10 microns. Filter should be of HDPE media & washable type. Filters with combustible / dry disposable media are strictly not accepted.

2.11. Electrical Panel

Control cabinet to be provided with Type 2 enclosure, with grounding lug, combination magnetic starters with overload relays, circuit breakers and cover interlock, and fusible control circuit transformer. The electric panel provided for the unit must be equipped with main incoming power isolation switch or IMCCB of suitable rating with microprocessor control, additionally the unit must be provided with under voltage / over voltage / phase reversal / single phasing protection, all three phase motors must be operated only via 24V coil voltage contactors and MPCB's, additionally step down transformer must be provided for power supply to the unit controller. The electrical panel must also be providing with relay block for common alarm.

2.12. Micro Processor Controller

Each air conditioners should have single microprocessor with following controls: Control Type The controls shall be a microprocessor programmable logic controller. The controls shall have separate indication of operating modes (cooling, heating, humidifying and dehumidifying), alarm conditions (temperature high, loss of sensor, compressor HP & LP, wet floor, no air flow and low humidifier water). The display and indication shall be visible on the front without removing any external panels. Local and remote alarms will be triggered if an alarm condition is reached. Each unit must be provided with large screen GRAPHICAL DISPLAY and additionally the controller must have feature of DUAL SET POINT programming.

1) The control should have an auto-restart feature which will return the unit to normal operation resumption of mains power.

2) Automatic load / time and alarm sequencing function to be performed by the unit.

3) Microprocessor must have output point for ON/OFF of motorized damper and must be suitable to be integrated with fire point for unit shut off incase receiving signal from fire panel or fire detectors.

4) The unit controller must have option of {DUAL SET} point for energy saving i.e. customer must have the option to set two independent set points for the unit based on operational requirements and energy saving concepts.

2.13. Display

In normal operating mode the screen should display unit number, temperature and relative humidity set points and actual, operating status. The unit must have a large screen LCD display on controller with user friendly menus and minimum two-level password protections. RS485 interface port for BMS compatibility with Modbus RTU protocol is required.

2.14. Alarms:

Following alarms should be available:

1) Temperature high / Loss of sensor

2) Wet floor

3) No air flows

4) Temperature high / low

2.15. Safety Protections:

The unit shall also incorporate the following protections:

1) Single phasing preventers

2) Reverse phasing

3) Phase unbalancing

4) Phase failure

5) Overload tripping (MPCB) of all components

6) Wet floor sensor

7) Over Voltage and Under Voltage protection Safety Interlocks: Operation of heaters & humidifiers shall be possible only when blower fan is in operation. Interlocking should be with alarms or indications for the above conditions

2.16. Sequencing

The sequencing should be feature of the PAC units. The units shall be designed to work for equal no of run hours also in case of fault the stand by unit should start.

2.17. Microprocessor Controls

Following information shall be displayed on the units:

1) Room temperature and humidity

2) Supply fan working status

3) Current date and time

4) Electric heaters working status

5) Manual / Auto unit status

6) Temperature set point

7) Working hours of main component i.e. fan, heater

8) Unit working hours

9) Modes of operation (cooling, heating)

10) The last 10 intervened alarms or faults

The Microprocessor shall perform the following functions

1.1. Password for unit calibration values modification

1.2. Automatic reset of program

1.3. Cooling capacity control

1.4. Date & time of last 10 intervened alarms

1.5. Start / Stop status storage by switch

1.6. Bypass arrangements in case of microprocessor failure for any emergency conditions

FAN COIL UNITS

Fan coil units are used for the Server Room, Battery Room, BMS room and IT Manager Room.

1.1   SCOPE

The scope of this section comprises the supply, erection, testing and commissioning of Fan Coil Units conforming to these specifications and in accordance with the requirements of the Drawings and Bill of Quantities.

1.2   TYPE

The Fan Coil Unit shall be Hi Wall type, 220~240VAC/1ph/50Hz, it shall be blow through type complete with one or more centrifugal forward curved fan blower, fan motor, multirow copper heat exchanger, casing, filter, insulated main drain pan & thermostat with intelligent control.

1.3   CAPACITY

The air moving and coil capacities shall be as shown on Drawings and indicated in bill of Quantities.

1.4   CASING

Casing shall be made of High-Quality Galvanized Steel with Zinc coating, completely covered by high quality thermal insulation, thickness of casing shall be 1mm.

1.5   COIL

It shall be constructed with seamless copper tubes mechanically expanded into corrugated aluminium fins for minimum thermal contact resistance and permanent primary to secondary surface bond. Coil shall be 2/3-Rows evaporator coil constructed with copper tubes and header.

1.6   FANS

Fan blower shall be forward curved centrifugal type with direct driven impeller which is dynamically and statically well balanced. Impeller and its casing shall be made of galvanized steel.

1.7   FAN MOTOR

Fan motor shall be energy efficient brushless DC type, electronically communicated by controller (thermostat). It shall have option of step-less fan speed selection to adjust airflow on site as per site requirement. It shall have option to adjust external static pressure on site between 0Pa to 60Pa as per requirement on site using simple setting.

1.8   THERMOSTAT / CONTROLLER

Thermostats shall be proportional type, with power supply of 220~240VAC / 1ph / 50Hz, for thermostat, output power of 24VAC for modulating actuator and output control signal of 0-10V DC to modulate actuator.

Thermostat shall have intelligent ΔT manager to maintain set ΔT of chilled water. It shall be able to monitor outlet chilled water temperature and inlet chilled water temperature and maintain set ΔT by modulating flow of water. It shall have option to change set ΔT of water if required.

It shall have following mode of operations cool, heat, dy and fan. It shall have selection of fan speed from high, medium, low and auto that can be adjusted from options of stepless fan speed as per requirement on site. When, fan speed set to auto thermostat shall modulate the fan speed depending on return air temperature and set temperature.

It shall be BMS compatible with open Modbus protocol. It shall have option to be controlled by wireless remote control. It shall have occupancy contact and economy contact mode. It shall to set daily timer and shall be automatic resettable during power failure, manual reset shall not be required when power resumes.

1.9   FILTER

It shall be fabricated of synthetic nylon filter; washable type and it shall have high efficiency of class Merv4 or G2 filter.

1.10   VALVE PACKAGE ASSEMBLY

Each fan coil unit shall be supplied with factory fitted and tested complete valve package assembly comprising of an isolating ball valve at outlet, an isolating ball valve with Y-strainer at inlet, a pressure independent balancing and control valve with motoric modulating actuator at outlet, chilled water line and necessary copper fittings and brass connections.

Pressure independent balancing valve shall be combination of balancing valve and control valve with modulation actuator. PICV shall be able to limit the maximum set flow rate at different load, it shall be able to limit the maximum set flow at differential pressure up to 6 bars. Balancing should be done by valve and not actuator. PIBCV shall have 51 settings of flow range for valve size. PICV shall have maximum operating pressure of 25 bars.

Motoric modulating actuator shall accept control signal of 0-10VDC from thermostat. Power supply shall be 24VAC. It shall have maximum close off pressure of not less than 6 bars. Running time for motoric modulating actuator to close completely from completely open shall be less than 120 sec.

1.11   MAINTAINANCE

Fan deck and cooling coil shall be easily removable from FCU without lowering down of the entire FCU without and without disturbing the other installations. Filter shall be easy to remove and washable type. Motoric modulating actuator shall have manual override feature.

1.12   COMPATIBILITY WITH BUILDING MANAGEMENT SYSTEM

Each individual fan coil units shall have Modbus protocol to communicate with BMS. BMS shall be able to read/write mode, read/write fan speed, read/write set temperature, monitor room temperature, monitor inlet and outlet chilled water temperature, read/write set differential temperature of outlet and inlet chilled water, read/write rpm of fan motor of the fan coil unit. Each thermostat of individual fan coil unit shall be Modbus compatible and shall not require any additional gateway in case of Modbus protocol.

1.13   PERFORMANCE DATA

Fan coil units shall be selected for the lowest operating noise. Fan coil unit performance rating and power consumption data shall be clearly indicated and submitted by the Contractor and verified at the time of testing and commissioning of the installation.

1.14   TESTING

Cooling capacity of various fan coil unit models shall be computed from dry and wet bulb temperatures of air entering and leaving the coil measured by accurately calibrated thermometer. Flow measurements shall be measured by anemometer. Power consumption shall be computed from measurements of incoming voltage and input current. Computed ratings shall conform to the specified capacities and quoted ratings.

10. SAFETY AND SECURITY SYSTEMS

10.1.1 FIRE ALARM SYSTEM

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. GUI Based software shall be provided along with the system for integration with BMS and monitoring of the Fire Alarm System.

Fire Alarm Control Panel shall contain Liquid Crystal Display unit of at least 4" display area to present vital information to operators concerning a fire situation, fire progression, and evacuation details.

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 systems 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 display unit 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 trouble condition is detected and reported by one of the systems 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 display unit shall indicate all information associated with the trouble 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 (trouble notification appliances and/or relays) shall be activated.

- When a supervisory condition is detected and reported by one of the systems 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 display unit 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 systems 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 display unit 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 systems 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 display unit 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.

a. Operator Control

Acknowledge Switch

- 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.

- Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.

Signal Silence Switch
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.

Drill Switch
Depression of the Drill switch shall activate all programmed notification appliance circuits. The drill function shall latch until the panel is silenced or reset.

System Reset Switch

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.

Lamp Test

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.

Scroll Display Keys

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.

Print Screen

Depression of the PRINT SCREEN switch shall send the information currently displayed on the 640-character display to the printer.

h. System Capacity and General Operation

- The control panel shall be capable of expansion via up to 4 SLC modules. Each module shall support a maximum of 250 addressable devices for a maximum system capacity of 1000 points. The system shall be capable of 1000 annunciation points per system regardless of the number of addressable devices.

- The Fire Alarm Control Panel shall include a full featured operator interface control and annunciation panel that shall include a liquid crystal display, individual, color coded system status LEDs, and a QWERTY style 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.

- 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.

- The FACP shall be able to provide the following software and hardware features:

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.

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.

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.

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.

The system shall support a detector response time to meet world annunciation requirements of less than 4 seconds.

Device Blink Control: Means shall be provided to turn off detector/module LED strobes for special areas.

NFPA 72 Smoke Detector Sensitivity Test: The system shall provide an automatic smoke detector test function that meets the requirements of NFPA 72.

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.

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.

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.

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.

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.

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.

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.

Two Wire Detection: The system shall support standard two wire detection devices specifically all models of System Sensor devices

Block Acknowledge: The system shall support a block Acknowledge for Trouble Conditions

Sensitivity Adjust: The system shall provide Automatic Detector Sensitivity Adjust based on Occupancy schedules including a Holiday list of up to 15 days.

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.

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.

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, pre alarms, disabled points and activated points, all installed points filtered by SLC points, logic zones, annunciators, releasing zones, special zones, and trouble zones.

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 fire alarm type code shall activate an output with a fire alarm type code.

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.

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.

Custom Graphics: When fitted with an LCD display, the panel shall permit uploading of a custom bit-mapped graphic to the display screen.

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.

Tracking/Latching Duct (ion and photo): The system shall support both tracking and latching duct detectors either ion or photo types.

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.

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.

Security Monitor Points: The system shall provide means to monitor any point as a type security.

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.

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.

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.

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.

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.

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.

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.

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. 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.

i.   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.

j. 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 backlit alphanumeric Liquid Crystal Display (LCD) of at least 4"- 6" screen size. 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 an alphanumeric 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 display screen of the FACP.

k. Loop (Signaling Line Circuit) Control Module

- The Loop Control Module shall monitor and control a minimum of 250 intelligent addressable devices. This includes 125 intelligent detectors (Photoelectric, or Thermal) and 125 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 shielded 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.

- The system to have redundant loops in case of emergency
- Each DC & Novec location will be handled by a dedicated single loop.

l. 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.

m. Power Supply

- The Addressable Main Power Supply shall operate on 120/240 VAC, 50/60 Hz, and shall provide all necessary power for the FACP.
- 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.
- The supply shall be capable of charging batteries ranging in capacity from 7-200 amp-hours within a 48-hour period.
- The Addressable Main Power Supply shall provide a very low frequency sweep earth detect circuit, capable of detecting earth faults.
- The Addressable Main Power Supply shall be power-limited per UL864 requirements.

n. System Circuit Supervision

- 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.
- Transponders that lose communication with the CPU shall sound an audible trouble and light an LED indicating loss of communications.
- Sprinkler system valves, standpipe control valves, PIV, and main gate valves shall be supervised for off-normal position.

- 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).

o. Field Wiring Terminal Blocks

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.

p. Controls with associated LED Indicators:

- Speaker Switches/Indicators
  - ✓ The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
  - ✓ The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.
- Emergency Two-Way Telephone Control Switches/Indicators
  - ✓ The emergency telephone circuit control panel shall include visual indication of active and trouble status for each telephone circuit in the system.
  - ✓ The telephone circuit control panel shall include switches to manually activate or deactivate each telephone circuit in the system.

q. Remote Transmissions:

- Provide local energy or polarity reversal or trip circuits as required.
- 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.
- Provide capability and equipment for transmission of zone alarm and trouble signals to remote operator's terminals, system printers and annunciators.
- Transmitters shall be compatible with the systems and equipment they are connected to such as timing, operation and other required features.

r. 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.

s. Field Programming

- The system shall be programmable, configurable and expandable in the field without the need for special tools, laptop computers, or another electronic interface equipment. There shall be no firmware changes required to field modify the system time, point information, equations, or annunciator programming/ information.
- It shall be possible to program through the standard FACP keyboard all system functions.
- All field defined programs shall be stored in non-volatile memory.

- 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.

- 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.

- 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 a 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.

t. Specific System Operations

- 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.

- 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 0 to 60 seconds and each detector shall be able to be selected for verification during the field programming of the system or any time 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.

u. System Point Operations:

- Any addressable device in the system shall have the capability to be enabled or disabled through the system keypad or video terminal.

- System output points shall be capable of being turned on or off from the system keypad or the video terminal.

- 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:
  - ✓ Device Status.
  - ✓ Device Type.
  - ✓ Custom Device Label.

- ✓ Software Zone Label.
- ✓ Device Zone Assignments.
- ✓ Analog Detector Sensitivity.
- ✓ All Program Parameters.

- System Status Reports: Upon command from an operator of the system, a status report will be generated and printed, listing all system statuses:

- System History Recording and Reporting: The fire alarm control panel shall contain a history buffer that will be capable of storing up to 1000 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.

- The history buffer shall use non-volatile memory. Systems which use volatile memory for history storage are not acceptable.

- 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.

- 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.

- 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.

10.1.2 FIRE SUPPRESSION SYSTEMS

a. General

The bidder shall supply, install, test and put into operation NOVEC 1230 based fire suppression system for the following rooms:

- Server Room

- Proposed HPC Room

- UPS and Electrical Panel Room

- Battery Room

The fire suppression system shall include and not be limited to gas release control panel, PESO 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 2001 standards and installed in compliance with all applicable requirements of the local codes and standards.

The system design should be based on the specifications contained herein, NFPA 2001 and in accordance with the requirements specified in the design manual of the clean agent. The bidder shall confirm compliance to the above along with their bid.

The system shall be properly filled and supplied by an approved OEM (Original Equipment Manufacturer)

The key components of the system, namely, valves and its accessories, actuators, flexible discharge and connection hoses, check valves, pressure switch, and nozzles shall be FM/UL listed. The NOVEC 1230 gas shall:

- Comply with NFPA 2001 standard
- Have the approval from US EPA (Environmental Protection Agency) for use as a total flooding fire extinguishing for the protection of occupied space:
- Be 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

The gas release panel shall be capable for integration to Fire Alarm System.

b. 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 42 bar/25bar as per the relevant standards at 21°C, the agent is a liquid in the container.

The designer shall consider simultaneous total flooding of all voids within the protected volume. The system shall be designed in accordance with the OEM's Design Manual.

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 4.5%. 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 the 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 4.5% and the average pressure at each nozzle to be not less than 6.034 Bar.

The agent discharge time shall not exceed 10 seconds and not less than 5 seconds.

The design concentration shall follow at minimum NFPA 2001 for under floor, room and ceiling space.

The bidder should carry out the piping Isometric design and validate the same with a hydraulic flow calculation generated by using the agent's design software. 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.

c. System Components

Cylinders
Each cylinder shall be seamless steel type manufactured from billets and tested in accordance with IS 7285 / BS 5045 standard and approved by PESO.
The cylinder/valve assembly shall have suitable metallic protection for the valve enabling transportation of the filled cylinders safely.
The cylinders shall be super-pressurized with dry Nitrogen to 42 bar/25bar as per the relevant standards. The cylinder shall be capable of withstanding any temperature between -30° C and 70° C.

All cylinders shall be distinctly and permanently marked with the quantity of agent contained, the empty cylinder weight, the pressurization pressure and the zones they are protecting.

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 assembly 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 shall 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.

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 and locally manufactured actuators shall not be used.

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

The 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.

Refilling and Maintenance

In case of any leakage or accidental discharge of the agent, it should be possible to re-fill the cylinders from a valid PESO approved OEM filling station in India itself. The contractor should indicate the source of re-filling and the time that will be taken for re-filling and replacement.

Piping and Fittings

All piping shall be ASTM A-106, Grade-B, Schedule 40 seamless pipes and all fitting shall be of ASTM A-105.

Documentation

The bidder should prepare & submit along with the bid documents, the piping isometric drawing and support the same with a UL listed hydraulic flow calculation generated using the agent's design software. The calculations shall validate the fill density assumed by the bidder. The bidder shall submit copies of datasheets of hardware used in the system. The bidder shall also submit copy of PESO approval letter for the cylinder proposed to be used.

The bidder shall also submit calculations to evidence the quantity of agent considered for the system.

The successful vendor must submit, along with the supply invoice, a certificate of authenticity for the agent, duly checked and vetted by the OEM.

VESDA SYSTEM

a. General

The bidder shall supply and install the VESDA system for the Server Room, Electrical Room and Battery Room.

b. Design Requirements

- Shall consist of a highly sensitive smoke detector, aspirator, and filter.
- It shall have a display featuring LEDs and a Reset/Isolate button. The system shall be configured by a Programmer that is either portable or PC based.
- The system shall allow programming of:
  - ✓ up to three smoke threshold alarm levels;
  - ✓ time delays;
  - ✓ faults in airflow, detector, power and filter as well as an indication of the urgency of the fault;
- Three relay outputs for remote indication of alarm and fault.
- It shall consist of an air sampling pipe network to transport air to the detection system, supported by calculations from a computer-based design modelling tool.
- Interface to the Building Management system shall be provided.
- Performance Requirements
- Shall be tested and approved to cover up to 500 Sq.m
- Shall be approved to provide very early smoke detection and provide up to three output levels corresponding to Alert (optional), Pre-Alarm and Fire. These levels shall be programmable and able to be set at sensitivities ranging from 0.005 – 20% obsc/m.
- Shall report any fault on the unit using the fault relay or via VSM.
- Shall be self-monitoring for filter contamination.
- Shall incorporate a flow sensor in the pipe inlet port and provide staged airflow faults.

c. Detector Assembly

- The Detector, Filter, Aspirator and Relay Outputs shall be housed in an enclosure and shall be arranged in such a way that air is drawn from the fire risk and a sample passed through the Dual Stage Filter and Detector by the Aspirator.
- The Detector shall be LASER-based type and shall have an obscuration sensitivity range of 0.005 – 20% obs/m.

- The Detector shall have up to three independent field programmable smoke alarm thresholds across its sensitivity range with adjustable time delays for each threshold between 0-60 seconds.
- The Detector shall also incorporate the facility to transmit a fault either via VESDA net or relay.
- The detector shall have a single pipe inlet which must contain a flow sensor. Both Minor and Urgent flow faults for both high and low shall be reported.
- The filter must be a two-stage disposable filter cartridge. The first stage shall be capable of filtering particles in excess of 20 microns from the air sample. The second stage shall be ultra- fine, removing more than 99% of contaminant particles of 0.3microns or larger, to provide a clean air barrier around the detector's optics to prevent contamination and increase service life.
- The aspirator shall be a purpose-designed rotary vane air pump. It shall be capable of supporting a single pipe run of 50m, or two or three pipe runs, with a transport time of less than 60 seconds or as appropriate codes dictate.
- The Assembly must contain relays for alarm and fault conditions. The relays shall be software programmable (latching or non-latching). The relays must be rated at 2 AMP at 30 VDC. Remote relays shall be offered as an option and either configured to replicate those on the detector or programmed differently.
- The assembly shall have built-in event and smoke logging. It shall store smoke levels, alarm conditions, operator actions and faults. The date and time of each even shall be recorded. Each detector (zone) shall be capable of storing up to 12,000 events.

d. Displays

- The detector will be provided with LED indicators only.
- Each Detector shall provide the following features at a minimum:
- Independent high intensity alarm indicators for Pre-Alarm and Fire (Alert indicated by the Pre-Alarm LED flashing) corresponding to the alarm thresholds of the detector
  - ✓ Fault indicator
  - ✓ OK indicator
  - ✓ Isolate indicator
- A single button supporting the following features:
- Reset – (a single push of the button) Unlatches all latched alarm conditions on the assigned VLC zone.
- Isolate – (push and hold) Isolates the individual VLC zone (inhibits Alarm and Fault relays and initiates the Fault relay).

e. Programmers

Programming of VESDA controller shall be performed using a Windows® application running on a PC.
Each Programmer shall support the following features at a minimum:
- Programming of any device on the VESDA net system.
- Viewing of the status of any device in the system.
- Adjustment of the alarm thresholds of a nominated detector.

- Initiation of Auto Learn™, to automatically configure the detector's alarm threshold settings to suit the current environment.
- Multi-level password control.
- Programmable latching or non-latching relay operation.
- Programmable high and low flow settings for airflow supervision.
- Programmable maintenance intervals.
- Facilities for referencing with time dilution compensation. (VN only)
- Testing of relays assigned to a specific zone to aid commissioning.

f. Device Networking Requirements

The devices in the smoke detection system shall be capable of communicating with each other via twisted pair RS485 cable. The network shall be able to support up to 250 devices (detectors, displays and programmers), of which at least 100 detectors can be supported.
The unit shall be capable of being configured in a fault tolerant loop for both short circuit and open circuit.
PC based configuration tools shall be available to configure and manage the network of detectors.

g. Digital Communication Port

Should comply to EIA RS485 Protocol.

h. Application

Detection Alarm Levels
The laser based aspirating detection system shall have up to three (3) independently programmable alarm thresholds. The three alarm levels may be used as follows:
Alarm Level 1 (Alert)   : Activate a visual and audible alarm in the fire risk area.
NOTE:The alarm level functions as listed are possible scenarios. Consideration should be given to the best utilization of these facilities for each application and the requirements of local authorities.
Initial Detection Alarm Settings
Initial settings for the alarm levels shall be determined by the requirements of the fire zone.
 Default settings of the unit shall be:
- Alarm Level 1 (Alert)   : not configured
                                 : (0.08% Obs/m if configured)
- Alarm Level 2 (Pre-Alarm)   : 0.14% Obs/m
- Alarm Level 3 (Fire)   : 0.2% Obs/m
- Alarm Delay Thresholds
Alarm delay threshold shall be programmable for the following:
- Alarm Level 1 (Alert)
- Alarm Level 2 (Pre-Alarm)
- Alarm Level 3 (Fire)

i.   Fault Alarms

The Detector Fault relay shall be connected to the appropriate alarm zone on the Fire Alarm Control Panel in such a way that a Detector Fault would register a fault condition on the FACP. The fault relay shall also be connected to the appropriate control system.
(Check local Codes, Standards or Regulations to determine whether compliance with this set-up is required).

j.   Power Supply and Batteries

The system shall be powered from a regulated supply of nominally 24V DC. The battery charger and battery shall comply with the relevant Codes, Standards or Regulations.

k.   Sampling Pipe Design

Sampling Pipe
- The sampling pipe shall be smooth bore with an internal diameter between 15-25mm. Normally, pipe with an outside diameter of 25mm and internal diameter of 21mm should be used.
- The pipe material should be suitable for the environment in which it is installed, or should be the material as required by the specifying body.
- All joints in the sampling pipe must be air tight and made by using solvent cement, except at entry to the detector.
- The pipe shall be identified as Aspirating Smoke Detector Pipe (or similar wording) along its entire length at regular intervals not exceeding the manufacturer's recommendation or that of local codes and standards.
- All pipes should be supported at not less than 1.5m or that of the local codes or standards.
- The far end of each trunk or branch pipe shall be fitted with an end cap and drilled with a hole appropriately sized to achieve the performance as specified and as calculated by the system design.

Sampling Holes
- Sampling holes of 2mm, or otherwise appropriately sized holes, shall not be separated by more than the maximum distance allowable for conventional point detectors as specified in the local code or standard. Intervals may vary according to calculations. For AS1670 the maximum allowable distance is 10m. For BFPSA the maximum allowable distance is 10m. For NFPA the maximum allowable distance is 30 ft.
- Each sampling point shall be identified in accordance with Codes or Standards.
- Consideration shall be given to the manufacturer's recommendations and standards in relation to the number of Sampling Points and the distance of the Sampling Points from the ceiling or roof structure and forced ventilation systems.

Installation
- The contractor shall install the system in accordance with the manufacturer's System Design Manual.
- The Capillary Sampling Network

- Where false ceilings/aisle containment are installed, the sampling pipe shall be installed above the ceiling, and Capillary Sampling Points shall be installed on the ceiling and connected by means of a capillary tube.
- The minimum internal diameter of the Capillary tube shall be 5mm, the maximum length of the Capillary tube shall be 2m unless the manufacturer in consultation with the engineer have specified otherwise.
- The Capillary tube shall terminate at a Ceiling Sampling Point specifically designed and approved by the manufacturer. The performance characteristics of the Sampling Points shall be taken into account during the system design.

10.1.3 ACCESS CONTROL SYSTEM

a. Specifications of Biometric Device

S. No.	Features	Minimum Required Parameters
1.	Transmission Frequency	13.56 MHz
2.	Technology	I Class
3.	Security	64-bit authentication keys. The data flow between card & Reader should be encrypted
4.	Graphical Display	LCD display
5.	Function	Should be configured as a Reader – Enroller, Enroller Only & Reader Only (All three are mandatory)
6.	Enrollment of fingerprint templates I Class Smart Cards	Yes
7.	Read Range	Minimum 3.5"
8.	Operating Voltage	10 – 12V DC
9.	Operation	Indoor use
10.	Housing	Polycarbonate
11.	Fingerprint Sensor	Optical
12.	Sensor Resolution	500 dpi
13.	Timing	Fingerprint Capture: Less than 2 Sec
14.		Verification of captured finger: Less than 1 Sec
15.	False Acceptance Rate	Less than 0.01%
16.	False Rejection Rate	Less than 0.01%
17.	Fingerprint Enrollment Software	Yes
18.	Technology Compliance	I Class 15693 & 14443B
19.	Certifications	UL
20.	Operating Temperature	0° C to 50° C

21.	Operating Humidity	10% to 90% relative humidity (Non-Condensing)

b. Specifications of Access Controller

S.o.	Features	Minimum Required Parameters
1.	Reader Inputs	Four
2.	Universal Inputs	Six
3.	Tamper Input	One
4.	Digital Lock Inputs	Two
5.	Processor	50 MHz with 128 MB RAM and 32 MB lash
6.	Processor for Reader Inputs	Yes (Dedicated Processor for each eader)
7.	Communication	10/100 Ethernet Port
8.	Memory	Minimum 4,00,000 personnel Records
9.	Area Lockdown Support	Yes
10.	Real Time Clock	Yes
11.	Encryption	128-bit
12.	SNMP Network Management support	Yes
13.	Visual Indicator	Yes
14.	Mounting	Wall / Ceiling Mount
15.	Battery Backup	5 hours
16.	Technology Compatibility	Wiegand
17.	Card Reader Power	5V DC & 12V DC (Jumper Selectable)
18.	Wiring Distance	150 meters (Wiegand)
19.	Indicator LED	Yes
20.	Push Button Switches	Yes (For clearing the memory & Resetting the IP Address)
21.	Offline Mode Operation	Yes (In the event of Network failure)
22.	Enclosure	Yes
23.	Certifications	UL
24.	Operating Temperature	0 °C to 45 °C
25.	Operating Humidity	10% to 90% relative humidity (Non-Condensing)

c. Specifications of Access Control Software

S. No.	Minimum Required Parameters
1.	Compatibility with any Windows Operating System
2.	Compatibility with MYSQL / SQL / ORACLE
3.	Support for TCP/IP communication
4.	Provision for Alarm Monitoring for Battery, Mains Supply, Door Opened too Long, Door Forced Opened, Unauthorized Swipe & Controller Tampering
5.	Support for unlimited number of Card Database & Transactions
6.	Specify Card Activation & Expiry Date
7.	Support for Biometric, Pin & Smart Card Applications
8.	Management of Dual Access Levels to a single card
9.	Remote Locking & Unlocking of Doors
10.	Remote management of Controllers
11.	Customization of Door User time for every card holder
12.	One Client License
13.	Two Stages of Alarm Management (Acknowledgement on Receipt & closure on Investigation)
14.	Management of Minimum 100 Readers
15.	Access Privileges on the basis of Time & Date
16.	Creation of holiday schedules to cover maintenance and Vacations / Holidays
17.	Setting of Time / Date from Client Workstation
18.	Permission to activate any control output for a specific event such as alarm
19.	Programmable Shunt time to control the door opening time
20.	Area Control by using Hard Anti Pass back, Soft Anti Pass back, Timed Anti Pass back, Occupancy Limit, Multi man principle, Area Lock down, Threat level conditioning
21.	Alarm Management
22.	Camera Integration & Image Comparison
23.	Automatic User Log off
24.	Cardholder Management & Enrollment
25.	Creation & Maintenance of User Database
26.	Assignment of Access Privileges

d. Specifications of Workstation for Access Control System

S. No.	Features	Minimum Required Parameters
1.	Processor	Intel Core i7, min 3 GHz
2.	RAM	8 GB DDR, 1333 MHz
3.	Hard Disk	1 TB SATA
4.	Expansion Ports	4 USB 3.0, 1 Line-in, 1 Line-out, 1 Microphone, 1 LAN, 1 VGA

5.	Keyboard & Mouse	Yes, Wireless
6.	Ethernet Port	10/100/1000 Base-T Network Interface
7.	Chipset	Intel
8.	Included Software	Windows 10 Operating System
		McAfee Anti-Virus valid for 3 years
		Recovery CD Creator
		Hard Drive based application recovery for reinstallation of appliances & drivers
		Hard Drive based system recovery with option to keep user data files intact
		Microsoft Internet Explorer
		Microsoft Windows Live applications
9.	Screen	21" LED monitor

10.1.4 IP BASED CCTV SURVEILLANCE SYSTEM

The IP based Closed Camera surveillance system shall use state of the art technology and shall comply to UL standards.

IP based Cameras and IP Digital Video Management System provider should be from the same OEM.

All the cameras proposed shall be Power Over Ethernet (PoE) with option for 24V ac input.

The system shall support open architecture and shall not have any proprietary equipment`s to ensure future compatibility with third party systems.

The scope shall include supply, installation, testing, commissioning and maintenance of the IP based CCTV system proposed.

Scope shall include supply, installation, testing and commissioning of cameras, managed network switches, network video recorders/severs, Digital Video Management Software (DVMS) software, workstations, monitors, racks, console cables, UPS, etc. The specifications for these components shall be as mentioned below.

The location of the Cameras shall be such that no blank spots are observed in the Server Room Area. All the doors of the Data Centre shall be monitored. Cameras shall be provided for all the rooms and corridors in the Data Centre. All the external equipment`s pertaining to Data Centre shall be under CCTV Surveillance.

Minimum number of cameras requirements is:

Camera Type	Quantity
Indoor Dome	23
Outdoor PTZ	2

The above mentioned are minimum requirements the bidder is required to offer. If additional cameras are required to ensure there are no blank spots, the bidder has to incorporate them as well.

Specifications for IP Based Varifocal Lens Dome camera with IR illumination (for Server Room & other Critical Areas)

S. No.	Description
1	1/3" Progressive High Definition CMOS Sensor
2	Wide dynamic range
3	Minimum Illumination: Color 0.1 lux and B/W 0.03 lux, 0 lux with IR illuminator ON.
4	3mm - 9mm varifocal, Auto Iris lens
5	Adjustable Horizontal coverage between 40° to 110°
6	Manual pan/tilt adjustment up to 350°/+-90°
7	Automatic Gain Control, Back Light Compression, White balance: On/Off
8	3D Noise reduction: On/Off
9	IR Cut filter
10	Tamper Detection: On/Off
11	Compression: Dual stream, H.264
12	Resolution: 1980 x 1080 @ 25FPS and up to 720 x 576 @ 12FPS on stream 1 and stream 2 respectively at the same time
13	Bandwidth: configurable - 64Kbps to 8Mbps
14	Built-in Multi-zone motion detection
15	Protocols: Unicast, Multicast, RTP, TCP, UDP, HTTP, IGMP, ICMP, DHCP, DNS
16	10/100 Base-T Auto sensing, Half/Full Duplex (RJ45)
17	S/N Ratio: ± 50db
18	IR Sensitivity: 700 to 1100nm
19	Built in Micro SD card slot to support up to 32GB storage for local recording
20	Power: 802.3af PoE and 12VDC/24VAC auto sensing
21	Vandal resistant clear bubble surface mount enclosure.
22	Operating Temp: 0° C to 50° C
23	Humidity: 90% (Non-condensing)
24	UL, CE and FCC certified
25	ONVIF Compliance

Outdoor High Definition PTZ Dome camera (for DG Sets and Chillers area)

S. No.	Description
1	1/3" CCD/CMOS Progressive Sensor
2	Minimum Illumination: Color 0.3 lux & B/W 0.1 lux
3	Wide Dynamic Range support
4	Auto iris, Auto focus, Motorized 4.7mm-94mm or better zoom lens
5	Automatic Gain Control, BLC, White balance: Automatic
6	Compression: Dual stream, H.264
7	Resolution and performance: 1920x1080 @ 25FPS on Stream 1 and 1280 x 720 @ 15FPS Stream 2 simultaneously
8	Bandwidth: 64Kbps to 8Mbps
9	Built-in Multi-zone motion detection
10	Privacy Mask Zones: Required
11	Unicast, Multicast, RTP, TCP, UDP, HTTP, IGMP, ICMP, DHCP etc. as per system requirement
12	10/100 Base-T Auto sensing, Half/Full Duplex (RJ45)
13	S/N Ratio: >50db
14	Endless 360° pan and -5° to +95° tilt movement
15	Manual Pan/tilt speed up to 90 deg per second and preset speed up to 300 deg per second
16	256 preset positions and 4 tour patterns
17	External audio Input and output: Required
18	2 potential free alarm inputs, 1 Relay out
19	Power input: 802.3at PoE+ and 24VAC
20	Vandal resistant dome enclosure, IP66 rated, Built in heater and blower, wall mount. Enclosure should be of same make as that of camera
21	Operating Temp: -10° C to 50°C
22	Mount: Wall or pole or pendant
23	Humidity: 90% (Non-condensing)
24	CE and FCC

Indicative locations of the cameras are as per the attached drawings NT-IITB-HPC+BYOH - CCTV-LAYOUT. However, bidder has to determine the exact number of cameras required and finalize the locations for fixing the cameras based on the site conditions.

Network Video Recorder / Server supporting 32 video streams

- The Network video recorder / sever shall support a maximum of 32 video inputs per network video recorder / server.
- Multiple NVRs shall be configured in N+1 configuration for redundancy. Synchronized Failover directory feature should be provided with the offered system to avoid the single point of failure.

The total NVR shall have a internal hard disc capacity of up to 2 TB or 30 days of video storage (whichever is maximum) at 1280x1080 resolution, 25 frames per second for the installed cameras with provision for 25% additional cameras in RAID configuration. When the number of cameras increases further, the storage should be upgradeable in modular fashion.

- The NVR shall support central archive storage of a SAN or NAS storage solution in case of extended storage. Offered software shall provide automatic scheduled backup facility so that selected cameras, selected time video shall be backed up on central storage at specified time.

- The NVR / server shall be able to record individual camera with selectable frame rate

- The NVR / server shall support remote administration, monitoring and management of video, audio and data.

- The NVR shall support health and event monitoring of the system.

- The NVR shall support logical camera grouping.
- The NVR / server should support H.264, MPEG4 & MJPEG formats
- The network video recorder shall be able to record videos in CIF (352x288), VGA (640x480) 4CIF/D1 CIF resolutions (720x576), HD 720 (1280x720) & HD 1080 (1920x1080).

- NVR hardware shall be off-the-shelf server hardware of suitable specifications from HP/IBM/Dell/Cisco.
- Necessary operating system and the system software licenses required shall be included.

Digital Video Management System (DVMS) software features
- The software shall manage and support video from IP cameras and encoders through the Ethernet.

- Remote administration, monitoring and management of video and audio, shall be possible through the software.

- The DVMS software shall be able to display a minimum of 16 videos on the screen. It shall be possible to get the following information.
- Host name
- IP address
- Serial number
- Software version
- Trap destination
- Model number
- System name
- Number of hard drives on system
- Hard drive serial numbers
- Hard drive temperatures
- Misc. hard drive status'
- Number of system cameras

• Camera names
• Camera input numbers
• Camera status (recording, no signal, scene loss)
• Number of days of video storage on disk
• Licensed product name
• Product ID
• Camera list change
• Service changes
• System restart
• Hard drive event
• System shutdown
• Alarm events
• Video deleted sooner than expected
• Windows events

- The DVMS software shall allow users to monitor and manage any IP devices through a single digital video surveillance application.

- The DMS shall support open architecture platform expands the capabilities of legacy devices and maximizes investments in current and future security technology.

- The DVMS shall support third-party applications, video analytics and data transaction information.

10.1.5 RODENT REPELLENT SYSTEM

a. General 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 audible 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.

b. Scope

- The system proposed is to protect all the equipment, 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 10000 sft area per controller & shall be able to connect minimum 20 transducers per controller. Each transducer shall be capable of covering minimum 400 sft of area.
- Transducers can be tested periodically by means of a test switch provided on the Main console.
- Applicable Standard
- The OEM shall have an IDEMI and CFTRI certification for its products.

c. System Components

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 400 sft. for room void application, for ceiling void & floor void applications.

No looping is permitted while connecting the satellites to the main controller. Every satellite connected to the controller shall have a dedicated connection with the controller.

Controller

The controller shall support 20 Transducers and shall come with a pair of stands and brackets. The controller shall be installed in BMS room and the transducers in the problematic areas i.e. above and below false ceiling and below false flooring.

Controller Features:

- 10000 square feet of area coverage per Controller.
- Shall drive up to 20 Transducers with minimum 400sft coverage each.
- LCD display with on-board controls are required for changing the following parameters:
- Wave Speed: It can have a maximum value of 130 and a minimum value of 60 frequency sweeps per minute. The incremental size is 5.
- Wave Density: It can have a maximum value of 100 and a minimum value of 80 divisions within a frequency band. The incremental size is 10.
- 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: 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 up to 1.2 kms to protected area (BMS Room).
- 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.
- GUI Software Compatibility having the following Features:
    - Facility to configure controller parameters for all controllers in one go (broadcast) or for an individual controller.
    - 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.
    - 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.
    - PCB snapshot of the controller for faulty transducer drivers.
    - Configurable control of the image quality of the PCB snapshot, thereby enabling the customer to manage the computer memory effectively.
    - Admin Level password for report generation and scheduling.
    - Service Level password for parameter configuration of all / individual controllers.
    - Test facility to check if the signal is being transmitted to the transducer from the drivers on the PCB.
    - 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.
    - Configurable ping acknowledgement / return time. This would be the time for which CRMS software would wait for the Controller to respond before it confirms the status of the controller as 'Online' or 'Offline'.
    - Test Facility to test all controllers in a sequential mode or in an individual mode.
- RS/ EIA 485 to RS/EIA 232C converter to transfer the controller data to the serial port of your computer.

10.1.6 WATER LEAKAGE DETECTION SYSTEM

a. General

The Bidder shall be responsible to supply, deliver, install, test, commission and maintain of a proven technology and industry standard solution for a water detection system in Server room. The complete system shall include electronic alarm panel, sensing cable, 4x20 alphanumeric display, and auxiliary equipment, as indicated on the design drawings. The system shall

simultaneously detect the presence of water at any point along the cable's length and switch the module's leak alarm relays.

The sensing cable shall be of such construction by using Non-conductive polymers in the leak detection cable's construction. The Sensing Cable shall be an abrasion resistant polymer cores to increases the strength of the cable. Pressure on the sensing cable shall not create a false alarm.

Sensor Cable shall be provided with pre-connectorized sensing cable components.

b. **Alarm Panel**

- The alarm panel shall be capable of monitoring up to (30 meters) of sensing cable.
- The alarm Panel shall have LEDs indicating "power" (green), "alarm" (red), and "continuity" (yellow). The system shall sound an audible alarm upon sensing a leak. The unit can then continue to monitor and will re-alarm if there are any major changes. Once the alarm condition has been cleared, the panel is reset with a single keystroke. The Panel shall have 4x20 alpha numeric display with adjustable contrast.
- Basic Features of the alarm panel
- In addition to detecting leaks, the system shall warn of fault conditions and indicates when service is required.
- An event history log allows leaks (and other events) to be tracked.
- Both the events history log and any user settings are held in non -volatile memory. Event log shall store 50 date and time stamped alarm.
- The alarm module will be powered by 230 VAC. The panel shall have a pair of contacts open on an alarm, and a pair of contacts close on an alarm. These contacts shall be used to actuate other alarms and shall be capable of switching 10 amps at 230V AC.
- In additions, the panel shall be provided with RS-485 series port for connection to Building Management System & shall have slave Modbus RTU protocol.
- The module enclosure shall be NEMA 1, constructed of 18- gauge steel and shall be powder coated.

c. **Sensing Cable**

The water sensing cable shall detect the presence of water and other conductive fluids. The sensing technology shall be very low current AC signal and not DC signal to avoid corrosion when subject to wetness for long period.

d. **Accessories**

A Complete system accessory (leader cable, end terminations, etc.) shall be provided by the system manufacturer.

e. **Performance**

Leak Size Required to Alarm: Maximum wetted length of cable required to produce an alarm with tap water shall be no greater the 1 centimeter. Sensitivity shall be adjustable at panel module.

Continuous Coverage: The system shall provide continuous, distributed coverage of the area to be protected. System shall have not less than 4 physical zones.

Supervision: The system shall be continuously monitored for continuity. The loss of continuity in any of the wires shall energies the continuity LED and set the alarm.

Cleaning: If required, cleaning the cable without removing it shall be possible using a damp cloth.

Drying: The cable shall dry and reset at the panel within 15 seconds of removal from free water. No shaking, wiping, air-drying, or other mechanical action shall be required to dry the cable.

The alarm panel shall have a voltage free-contact (N.O./N.C) for external interfacing.

10.1.7 Public Address System

The PA system is required for

a. Making public announcement from the BMS Room. Clear and crisp announcement should reach to the entire Facility area.

b. Microphones should be provided to make announcements / respond to announcement from the designated location within the Facility to play light music if required.

The Voice Alarm Controller is the heart of the voice alarm system. It is the basis of the Voice Alarm System, and should have the essential functionality for compliance with the EN 60849 and 54-16 standards, including full system supervision, loudspeaker line impedance supervision, a supervised emergency microphone on the front panel and a supervised message manager.

A 240 W amplifier provides the power for the emergency call channel and BGM. Additional Amplifiers can be added to provide two-channel operation. All amplifiers should be supervised. The audio output uses standard analog audio 100 V line switching for full compatibility with the family of public address equipment and EVAC-compliant loudspeakers.

The powerful 240 W output section has six transformers isolated 100 V constant-voltage outputs for driving 100 V loudspeakers in six separate zones. The 100 V-technique reduces line losses on longer distances and provides easy parallel connection of multiple loudspeakers. All zones may be individually selected from the front panel, and the BGM output level in each zone can be individually set in six steps.

Six configurable volume-override output contacts are available for overriding local volume controls during priority calls. Both four-wire and three-wire schemes are supported. An LED meter monitors the output.

The controller should support up to 12 zones. Up to 255 messages can be stored in the internal 16 MB flash ROM, without a need for battery backup. Each message can have any length within the total available capacity. Messages and configurations are uploaded from a PC via USB into the memory, after which the unit operates without a PC connection.

The unit has 12 contact trigger inputs for business and emergency (EMG) calls. Each can be configured for a message consisting of a sequence of up to eight wav files. In this way some wav files may be used in various combinations with other messages, optimizing flexibility and the amount of storage space used .The Controller should also have two RS232 ports of which one should be reserved for product development and the other can be used to integrate to a third party digital device supporting RS232 protocol and can be used as a soft trigger input, in that way the number of trigger inputs (both emergency and business trigger inputs) can be increased to minimum of 150. Multiple messages can be merged to form one integrated message. The controller should have dip switches to adjust the system settings. The controller should have impedance calibration button for matching to the speaker impedance. The controller should have the VOX activation feature. A zone selection, together with this sequence can be configured for each trigger input.

Technical Specifications are as follows:

     a. Voltage: 230 V AC, 50/60 Hz

     b. Max Power consumption: 6W

     c. Distortion: <1% at rated output power

     d. Memory capacity: 16 MB

     e. Operating temperature: -10 ºC to +55 ºC

     f. Storage temperature: -40 ºC to +70 ºC

The Voice Alarm Router has a set of relays for zone-switching the power amplifier output(s) to different loudspeaker groups. The Voice Alarm Router is an expansion unit that can add six zones as well as 12 input and eight output contacts to the Voice Alarm System. It can use the built-in amplifier on the Voice Alarm Controller, and provides inputs and outputs for one or two amplifiers in a multi-amplifier one or two-channel system. It provides dual channel operation for calls and BGM simultaneously to a maximum of six different zones, using two amplifiers. Additionally, single channel operation is possible with only one amplifier. An overload protected 24 VDC output provides power for driving external relays, making an external power supply unnecessary. The Product shall be certified according to EN 60065, EN 54-16 / EN 60849.

Technical Specifications are as follows:

     a. Supply voltage: 230/115 V AC, 50/60 Hz

     b. Max Power consumption: 50 VA

     c. Operating Temp: -10 ºC to +55 ºC

     d. Storage Temp: -40 ºC to +70 ºC

Stylish six-zone call station for the Voice Alarm System. Six zone selection keys, all-call key and momentary. Push to Talk-key for calls. Selectable gain, speech filter, limiter, and output level for improved intelligibility. LED indications for zone selection, fault, and emergency state. Call station extension provides seven additional zone and zone group keys. Up to eight keypads can be added with each keypad adding seven zone or zone-group keys. This call station features selectable gain, a selectable speech filter, and a limiter for improved

intelligibility. The call station has a balanced line level output, making it possible to position it up to 1000 meters from the controller, using CAT-5 extension cables. With shielded cable, the call station can also be used in an EMC level 5 (heavy industry) environment.

The Call station shall be certified according to EN 60065 and Emergency according to EN 54-16 / EN 60849.

Technical Specifications are as follows:

   a. Voltage range: 24 VDC

   b. Current consumption: <30 mA

   c. Output impedance: 200 ohms

The keypad is an extension to the Voice Alarm Call Station that adds seven additional zone-select keys with LED indications for zone selection. It has the same stable metal base as the call station. In addition to tabletop use, the special design allows it to be neatly flush-mounted in desktops.

The keypad shall be compliant to EN 54-16 and EN 60849.

Technical Specifications are as follows:

   a. Power Supply: 24 VDC supplied by call station.

   b. Current consumption: <15 mA.

   c. Operating temperature: -10 ºC to +45 ºC

   d. Storage temperature: -40 ºC to +70 ºC

   a. **Wall Mount speaker**

A wall-mounting loudspeaker is available for general application. These full range loudspeakers are suitable for both speech and music reproduction. The speaker assembly consists of a single piece, 6 W loudspeaker and frame with a 100 V matching transformer mounted on the back.

Technical Specifications are as follows:

   a. Max Power: 9W

   b. Rated power: 6 W

b. Power Amplifiers

The main function of the power amplifier is the amplification of audio signals for the loudspeakers. It shall be possible to select the output voltage between 100V, 70V or 50V by changing jumpers. The system has two balanced inputs with priority control, each with a loop-through facility.

The amplifier has 70V and 100V outputs for constant voltage loudspeaker systems, and a low impedance output for 8 ohm or 4-ohm loudspeaker loads

Technical Specifications are as follows:

   i. Power supply: 230 V AC

   ii. Line impedance: 4 ohm/ 8 ohm

10.1.8 BUILDING MANAGEMENT SYSTEM

a. SYSTEM DESCRIPTION & INPUT OUTPUT SUMMARY

The system will consist of a flat, open architecture that utilizes high-speed communication protocol between all controlled and controlling devices.
The following will be monitored by the Building Management System:

- Access Control System
- Fire Alarm System
- Fire Suppression System
- Temperature and Humidity monitoring for Server Rooms, UPS Rooms and Battery Room
- Hydrogen Gas Detection for the Battery Room
- Water Leak Detection System
- VESDA System
- Rodent Repellent System
- Main LT panels incoming power parameters
- UPS System parameters
- PAC System parameters
- DG Set parameters
- DG Sets fuel levels

Microprocessor based Direct Digital Distributed Controllers (DDC) shall interface with sensors, actuators and control systems to carry out followings functions:

- Individual input/output point scanning, processing and control.
- Centralized operation of the plant (remote control).
- Dynamic graphic details of the Data Centre.
- Energy Management through optimization of all connected electrical and mechanical plants.
- Alarm Detection and early recognition of faults.
- Time, event and holiday scheduling as well as temporary scheduling.
- Prevention of unauthorized or unwanted access.
- Communication interfaces and control.

The control system shall be designed such that mechanical equipment will be able to operate under stand-alone control. In general, the operation of any controllers on the network shall not rely on any other controller for its functional operation. System controllers that require a master computer will not be considered. Function specific modules may be used to supplement the functionality resident in each controller. As such, in the event of a network communication failure or the loss of any other controller on the communication network, the control system shall continue to independently operate under local control of the resident program stored in nonvolatile memory as detailed herein. In such a case, each individual controller shall continue to perform basic functions until a network connection can be restored.

The number of controllers for central plant room equipment shall be decided by the contractor. Overall, the system shall be provided with 15% spare capacity, with spare of at least 15% points on each controller.

There shall be one control station located in BMS Room. The computer shall be sized to cover the graphic display memory and planning information. The display shall be in the form of dynamic colour graphics and text format with menu driven pop-up windows and help facility.

b. Reference Standards

Control system components shall be new and in conformance with the following applicable standards for products specified:

- ANSI/EIA 709.1 (Lon Talk Protocol)
- Lon Mark Certified (Version 3.1 Guidelines)
- BACnet/IP
- Modbus
- UL 916 (Energy Management Equipment)
- OPC

c. Products

Utilize standard components for all assemblies. Custom hardware, operating system, and utility software are not acceptable.

All products (PCU's, TDCU's and ID's) shall contain Lon Works/ BACnet/ Modbus networking elements to allow ease of integration of devices from multiple vendors.

All materials, equipment and software shall be standard components, regularly manufactured for this and other systems and custom designed for this project. All systems and components shall be thoroughly tested.

i. Central Stations Hardware

- The Control stations shall comprise of Personal Computer (PC) providing high-level operator interface with the system. The terminals shall be capable of providing the operator with the facility for remote system interrogation, control, and retrieval / storage of logged data, annunciation of alarms and reports, analysis of recorded data and the formatting of management reports.
- The control station shall consist of the following minimum configuration with all of them suitable for the power supply voltage of 230 V AC ± 10%, 50 Hz + 3%.
- PC with Core i7 Processor, 8GB RAM, 1TB hard disk, keyboard and optical mouse
- 21" LCD display
- Suitable dot matrix printer for printing of Alarms
- Windows 10 Operating System and other required software shall be included.

ii. Central Station Software

- As a minimum, the menu driven command and operating software shall permit the operator to perform the following tasks.
- Configure the network.

- Create control sequences.
- Graphical interface to systems.
- Provide additional third-party software to permit the operator to manage hard drive files such as access, delete, copy, modify, etc. The package shall be object oriented and permit the user to manage directories upon boot-up. The file management software shall organize directories and sub-directories using files, file folder objects.
- On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext.
- Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator. The system supervisor shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operator's access for viewing and/or changing each system application, full screen editor, and object. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password. All system security data shall be stored in an encrypted format.
- System Diagnostics. The system shall automatically monitor the operation of all HVAC control workstations, printers, modems, network connections, and nodes. The failure of these devices shall be annunciated to the operator.
- Reports and Logs. Provide a reporting package that allows the operator to select, modify, or create reports. Each report shall be definable as to data content, format, interval, and date. Report data shall be archived on the hard disk for historical reporting. Provide the ability for the operator to obtain real time logs of designated lists of objects. Reports and logs shall be stored on the PC hard disk in a format that is readily accessible by other standard software applications including spreadsheets and word processing. Reports and logs shall be readily printed to the system printer. Data shall be transferable to other software packages so as to create custom reports.
- Web Browser Access: The DDC system shall provide total integration of the facility infrastructure systems with user access to all system data, either locally over a secure Intranet within the building or by remote access by a standard Web Browser over the Internet.

iii. Graphical Object-Oriented Programming Software

- The system shall include a graphical object-oriented programming function which shall be used to create all control sequences utilized in Programmable Nodes (PN). The graphical object-oriented programming function shall provide programming elements to be connected together to create a logic diagram. The graphical object-oriented programming function shall include elements for mathematical, logical, timing, setpoint, display and input/output functions to create logic diagrams that represent sequences of operation for PNs.
- Program elements shall be able to be combined into a custom template that can then be used as a standard function.

- Program checkout and debug tools shall include display of real-time and/or simulated system variables and inter-object data on the programming screens. The user shall be able to assign fixed or variable values to inputs during the dynamic debugging of the control sequence.
- The graphical programming tools shall provide the ability to print I/O lists, lists of standard network variables and lists of all parameters to be viewed by the HMI.
- The programming software shall reside on each POT (Portable Operator Terminal) and OW-server for programming and/or configuring each model of PN on the project. The applications shall be downloaded and executed at the appropriate nodes. The software shall allow for updated applications via the network from the OW.
- DDC programs are to be provided to meet the control strategies as called for in the sequence of operation sections of these specifications. Each PN shall have availability of a full library of DDC algorithms, intrinsic control operators, arithmetic, trigonometric, logic, Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and relational operators for implementation of control sequences. 2-position, floating, standard i/o and counter inputs, time-based data, curve fit function, psychometric functions, integration.
- All DDC setpoints, gains, and time constants associated with DDC programs shall be available to the operator for display and modification via the POT, DDU or OW interface.
- Library of Applications: A library of control, application, and graphic objects shall be provided to enable the creation of applications and user interface screens. Provide the capability to cut & paste objects and libraries into applications for a node/system. Applications are to be created by selecting the desired control objects from the library, dragging or pasting them on the screen, and linking them together, using a built-in graphical connection tool. Completed applications may be stored in the library for future use. Graphical User Interface screens shall be created in the same fashion. Data for the user displays is obtained by graphically linking the user display objects to the application objects to provide "real-time" data updates. Any real-time data value or object property may be connected to display its current value on a user display. Systems requiring separate software tools or processes to create applications and user interface display shall not be acceptable.
- Provide integral trend-logging presentation in the programming screen.
- Print capability, with page break reference tags to allow down to 8 ½"x 11" size paper
- Off-line simulations (step function, continuous run function, simulation of external inputs)
- Dynamic presentation of logic in on-line state (all intermediate values)
- Text to logic screens
- Memory monitoring
- Power cycle restart function
- Run-time capability
- Calculator objects, including if-then-else, log, ln, exponential and trigonometric functions.

- Recognize standard network variable type data (nvi) and create network variables to put on the network (nvo)

iv.   Programming Objects

- Provide the capability to copy objects from the supplied libraries, or from a user-defined library to the user's application. Objects shall be linked by a graphical linking scheme by dragging a link from one object to another. Object links will support one-to-one, many-to-one, or one-to-many relationships. Linked objects shall maintain their connections to other objects, regardless of where they are positioned on the page and shall show link identification for links to objects on other pages for easy identification.

- Configuration of each object will be done through the object's property sheet using fill-in the blank fields, list boxes, and selection buttons. Use of custom programming, scripting language, or a manufacturer-specific procedural language for configuration will not be accepted.

- The software shall provide the ability to view the logic in a monitor mode. When on-line, the monitor mode shall provide the ability to view the logic in real time for easy diagnosis of the logic execution. When off-line (debug), the monitor mode shall allow the user to set values to inputs and monitor the logic for diagnosing execution before it is applied to the system (step function and run mode, integral trend logging).

- The system shall support object duplication within the Owner's database. An application, once configured, can be copied and pasted for easy re-use and duplication. All links, other than to the hardware, shall be maintained during duplication.

v.   Object Libraries

- A standard library of object function blocks shall be included for development and setup of application logic, user interface displays, system services, and communication networks.

- The function blocks in this library shall be capable of being copied and pasted into the user's database and shall be organized according to their function. In addition, the user shall have the capability to group objects created in their application and store the new instances of these objects in a user-defined library.

- Start-Stop Time Optimization Object. Provide a start-stop time optimization object to provide the capability of starting equipment just early enough to bring space conditions to desired conditions by the scheduled occupancy time. Also, allow equipment to be stopped before the scheduled un-occupancy time just far enough ahead to take advantage of the building's "flywheel" effect for energy savings. Provide automatic tuning of all start / stop time object properties based on the previous day's performance.

- Application Specific Node Configuration Software Tools: Provide application specific node configuration software tools that will permit the individual network nodes to be configured and commissioned with appropriate parameters. This software will reside on the POT. Functionality shall include:
  - ✓ Recognize all Standard Configuration Parameters (SCPTs)
  - ✓ Provide capability for setting all Standard Configuration Parameters (SCPTs)

✓ Translation capability for user defined configuration parameters
✓ Monitoring capability for nvo's from the nodes
✓ Ability to set the values for nvi's to the nodes

vi.   Network Management

Network Management Software for Windows network management software tool shall be used to assign domain, subnet, and node addresses to nodes; configure all routers and repeaters; define network data connections between LanWorks®/BACnet Device/Modbus Device network variables, known as "binding;" and record binding data into node addressing tables, and create a database of all addressing and binding information for all nodes on the network.

Network management shall include the following services: browse all network variables on nodes; Attach, Detach, Manage, Add, Remove, and Replace nodes; plus, transmission error off-line, on-line reporting.

The network management database shall be resident in the operator workstation server, ensuring that anyone with proper user name/password authorization has access to the network management database at all times.

The software shall have Client/server capability to allow multiple users ability to manipulate the database simultaneously.

vii.   Human-Machine Interface - Operator Workstation Software (OWS)

The HMI shall be a client/server architecture to allow multiple client access to an Ethernet connected server. The workstation shall operate also as a stand-alone workstation/server.

The software shall enable an operator to interact with various devices including network nodes (LanWorks/Modbus/BACnet), recorders, input/output (I/O) systems, intelligent transmitters, and other field devices.

It shall provide the following functions:
✓ Calendar.
✓ Scheduling.
✓ Trending.
✓ Alarm monitoring and routing.
✓ Time synchronization.
✓ Time zone handling
✓ Integration of controller data
✓ Object linking and embedding for process control (OPC) for connectivity to third party OPC compliant software/devices
✓ Color graphic display
✓ On-line plots
✓ Use Microsoft NT security
✓ System documentation generation
✓ Dynamic data exchange (DDE)
✓ Dispatch of a single time schedule to all programmable nodes

System Configuration: At a minimum, the HMI shall permit the operator to perform the following tasks, with proper password access:

- ✓ Create, delete, upload, or modify control strategies.
- ✓ Add/delete objects to the system.
- ✓ Tune control loops through the adjustment of control loop parameters.
- ✓ Enable or disable systems
- ✓ Generate text file reports to a networked printer.
- ✓ Select points to be alarmable and define the alarm state.
- ✓ Configure alarms to be sent to Microsoft windows mail client
- ✓ Select points to be trended over a period of time and initiate the recording of values automatically.
- ✓ Provide different levels of security to every object in the HMI database
- ✓ Modify and create users with passwords and access levels and also be able to use currently logged on users and passwords

viii. Event Alarm Notification and Actions

- The HMI software shall provide alarm recognition, storage, routing, management, and analysis.
- The HMI software shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up, telephone connection, or wide-area network.
- Alarm generation shall be selectable for annunciation type and acknowledgement requirements including, but not limited to:
  - ✓ To alarm.
  - ✓ Return to normal.
  - ✓ To fault.
- Provide for the creation of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, fire, etc.
- Provide timed (schedule) routing of alarms by class, object, group, or node.
- Provide alarm generation from "runtime" and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
- Control equipment and network failures shall be treated as alarms and annunciated.
- Alarms shall be annunciated in the following manners as defined by the user:
- Screen message text.
- Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:
  - ✓ Day of week.
  - ✓ Time of day.
  - ✓ Recipient.
  - ✓ Short Message Service (SMS)
  - ✓ Auto answer (at OWS) and auto dial (from node)
  - ✓ Graphic with flashing alarm object(s).
  - ✓ Printed message, routed directly to a dedicated alarm printer.
  - ✓ Audio messages.

- The following shall be recorded by the OWS HMI software for each alarm (at a minimum):
  - ✓ Time and date.
  - ✓ Location (building, floor, zone, office number, etc.).
  - ✓ Equipment (air handler #, accessway, etc.).
  - ✓ Acknowledge time, date, and user who issued acknowledgement.
  - ✓ Number of occurrences
- Alarm actions may be initiated by user defined programmable objects created for that purpose.
- Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
- A log of all alarms shall be maintained by the OWS HMI and shall be available for review by the user.
- Attach a graphic screen, text notes, and/or plant status report, to each alarm, as defined by user.
- Repeat/nuisance alarms must have feature to be disabled, and a feature for monitoring disabled alarms.
- The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. An alarm notification window will supersede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms.
- The dedicated alarm window shall provide user selectable colors for each different priority of alarm.

ix.   Data Collection and Storage Requirements

- The OWS HMI shall have the ability to collect data for any property of any object and store this data for future use.
- The data collection shall be performed by objects, resident in the node, and if desired OWS, shall have, at a minimum, the following configurable properties:
- For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
- For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
- For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
- Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.
- All log data shall be stored in a database in the OWS HIM and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
- Systems that cannot provide log data in HTML formats at a minimum shall not be acceptable.

- The OW shall have the ability to archive its log data either locally (to itself), or remotely to a OWS server. Provide the ability to configure the following archiving properties, at a minimum:
  - ✓ Archive on time of day.
  - ✓ Archive on user-defined number of data stores in the log (buffer size).
  - ✓ Archive when log has reached its user-defined capacity of data stores.
  - ✓ Provide ability to clear logs once archived.

x. Audit Log

- Provide and maintain an Audit Log that tracks all activities performed on the OWS HMI. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached its user-defined buffer size. Provide the ability to archive the log locally to OWS HMI or to a server. For each log entry, provide the following data:
  - ✓ Time and date.
  - ✓ User ID.
  - ✓ Change or activity: i.e., change setpoint, add or delete objects, commands, etc.
  - ✓ Database Backup and Storage
- The OW shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
- Shall have the ability to automatically complete full or partial backups; and have the ability to full or partial restore. Partial is defined as only items that have changed in the database.
- Copies of the current database and, at the most recently saved database shall be stored in the OW. The age of the most recently saved database is dependent on the user-defined database save interval.
- Graphical Real-Time Displays. The HMI, shall at a minimum, support the following graphical features and functions:
- Graphic screens shall be developed using any drawing package capable of generating and importing a GIF, BMP, DWG, DXF, or JPG file format. In addition to, or in lieu of a graphic background, the HMI shall support the use of scanned pictures.
- Graphic screens shall contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML, or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
- Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.
- Commands to start and stop binary objects shall be done by clicking the selected object and selecting the appropriate command from the pop-up menu. Data entry may be typed or mouse entered.
- Adjustments to analog objects, such as set points, shall be done by clicking the selected object and entering value or using a graphical slider to adjust the value.
- The OWS shall be able to support multiple graphic objects at the same time. If tiled, then each graphical object shall be fully scalable or aspect locked.

- Trend Displays (variable versus time) - A trend display shall show the values of points plotted versus time similar to a strip chart recorder. Eight tags shall be trended per trend. The HMI software shall provide real-time and historical trending (for data which had been logged). This may be achieved by either color graphic page display or an Microsoft excel based display.
- Real-Time Trends - shall contain real-time data without consuming hard disk space.
- Historical Trends Logs - A historical trend log display presents data stored on the computer's hard disk.
- X-Y Plots (variable versus variable) - An x-y plot shall dynamically represent the real-time or historical relationship one variable plotted against another variable.
- Automatic Generation - All trends and plots shall be self-generated and not require any programming by the user.
- The HMI software shall provide dialog boxes and menu picks for configuring trends and plots.
- Any analog or binary data may be trended or plotted.
- The software shall store pre-configured presentation of trends to facilitate operator call-up of trend log displays. It shall be possible to call up a trend log with pre-assigned data.
- Graphics Builder - The HMI software shall provide a graphics builder.
- Display Documentation - The graphics builder shall provide show, simulate, review, and document animation functions to allow the user to identify, diagnose, change, and document animation points on each display.
- A library of vendor-supplied objects will be included. These objects, widgets, and symbols must be continuously scalable. These items shall be editable by the user.
- A library of animated graphic objects shall be included.
- Animation - The Graphics Builder will animate process graphics with real-time data from field devices.
- Multi-State Color Animation shall be provided to change a graphic object's color from a palette of colors.
- Alarm Color - Color animation for normal, alarm, and alarm acknowledged states for both analog and binary point tags shall be provided. The user shall define the foreground and background colors for each state.
- Alarm Blink – Objects and text data shall blink based on alarm state and acknowledged state.
- Text and Numeric Animation - The software shall display the numeric value of an analog point, text of a text point, and the descriptors of a binary point. Display Linking - The software shall provide a display linking function. Clicking the object associated with the link changes the display to a new user-defined display.
- Pickable/Non-Pickable - The software shall enable active points to be selected with the mouse and accessed. It shall be possible to make a point non-pickable: the dynamic information shall be displayed, but the operator will not be able to access a detail display, change the value, etc. based on security settings of the software.
- Ability to open external executable files from button click
- Ability to open HTML web pages from button click

- Ability to view Microsoft Excel files from button click
- On-Line Help. Provide a context sensitive help system to assist the operator in operation and editing of the system. Help screens shall be available for all applications and shall provide the relevant data for that particular screen.
- Security. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data.
- System security shall be selectable for each operator.
- The system administrator shall have the ability to set passwords and security levels for all other operators.
- Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
- Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected.
- All system security data shall be stored in an encrypted format.
- Each object in the HMI database must be able to have a security policy applied to it.
- System Diagnostics. The system shall automatically monitor the operation of network connections and controllers. The failure of any device shall be annunciated to the operator.
- DDE Server - The HMI software shall be able to communicate and exchange data with any Third-Party DDE compliant application.
- MICROSOFT REPORT GENERATION – The HMI software shall be able to seamlessly interact with Microsoft Office Products, including Excel, with no additional programming.

a. DIRECT DIGITAL CONTROLLER (DDC) HARDWARE REQUIREMENT:

- DDC controllers shall be capable of fully "stand- alone" operation i.e. in the event of loss of communication with other DDC's or Control Station, they shall be able to function on their own. The controllers shall be LanWorks/BACnet/Modbus based products.
- The controllers shall consist of minimum single 32-bit microprocessors for reliable throughput, based with EEPROM based Operating System.
- The memory available to the controller board as working space for storage of the Operating system software and data files shall be decided on the basis of number of points being controlled by them.
- The controllers shall be UL listed and conforming to CE (Euro norms).
- Controllers requiring nickel-cadmium/lithium battery to support the full operation of the RAM, shall have battery back-up up to 12 hours in the event of a localized mains failure. The battery shall not be required to supply power to actuators, valves, dampers etc.
  - ✓ In addition to the above battery reserve a further battery shall be provided to retain the RAM for a minimum of 2 days, after the expiration of the standard battery.
  - ✓ A low battery alarm shall be provided with each Controller and with an indication at the Control Station.
  - ✓ In case the memory is stored on EEPROM, the battery backup will not be required.

- The Controllers shall have proportional control, Proportional plus Integral (PI) Control, Proportional plus Integral plus Derivative (PID) Control, Two Position Control and Time Proportioning Control and algorithms etc., all in its memory and all available for use by the user, i.e. all the control modes shall be software selectable at any time and in any combination. The analog output of Proportional Control, PI Control, and PID Control shall continuously be updated and output by the program shall be provided. Between cycles the analog output shall retain its last value. Enhanced integral action in lieu of Derivative function shall not be acceptable.

- The controllers shall have a resident real time for providing time of day, day of week, date, month and year. These shall be capable of being synchronized with other clocks in the network.

- Back-up power shall support the clock. Upon power restoration all clocks shall be automatically synchronized.

- The microprocessor based DDC's shall be provided with power supply, A/D and D/A converters, memory, and capacity to accommodate a maximum of 18 input/output (I/O) hardware points (with or without an expansion board). DDC's with a lower capacity of points shall preferably be provided at the locations with relatively less input/output points.

- If the controllers provided by the contractor have the configurable plug in function cards, then the following minimum specifications shall have to be met:
  - ✓ In addition to the basic outstation, a minimum of two slots shall be provided for the insertion of plug-in function cards.
  - ✓ The cards shall provide for analog or digital, input or output, hardwired connections to the installed plant.
  - ✓ The quantity and combination of these cards shall be determined by the requirements of the plant in that location with the concurrence of the Owner/ Consultant.

- The DDC's shall have 15% spare capacity (digital/analog input/output) to give flexibility for future expansion.

- All DDC controllers shall be capable of handling voltage, milli-ampere, resistance or open and closed contacts inputs in any mix, if required.

- Analog inputs/outputs of the following minimum types shall be supported:
  - ✓ 4-20 mA.
  - ✓ 0-10 volts.
  - ✓ Resistance Signals (either PTC or NTC)
    (PT 100, PT 1000, PT 3000, Balco 500, NI 1000)

Digital input/output types to be supported shall be, but not limited to the following:
  - ✓ Normally-open contacts.
  - ✓ Normally-closed contacts.

Modulating outputs shall be true proportional outputs and not floating control type.

- Controller's packaging shall be such that complete installation and check out of field wiring can be done prior to the installation of electronic boards.

- All board terminations shall be made via plug-in connectors to facilitate trouble-shooting, repair and replacement. Soldering of connections shall not be permitted.

- Controllers shall preferably be equipped with diagnostic LED indicators with at least indication for Power up Test OK, and Bus Error. All LEDs shall be visible without opening the panel door.

- It shall be possible for the controllers to accept regulated uninterrupted power supply to maintain full operation of the controller functions (control, logging, monitoring and communications) in the event of a localized mains failure.

- Controllers requiring fan cooling are not acceptable.

- There shall be the facility for accessing controller data information locally, via a portable plug-in keypad display which can be common to all controllers and normally removed to prevent unauthorized tampering. Alternatively, each controller shall have a keypad and display integral with its casing for local interrogation and adjustment. In either case, access to the system thus provided shall be restricted by passwords in the same way as at the main operator terminal.

- In case the Portable Operator Terminals (POT) is required to program the controllers, sockets shall be provided for same. Attachment of POT shall not interrupt or disable normal panel operation or bus connection in any way.

- The controllers shall be housed in vandal proof boxes to protect them from tampering by any unauthorized personnel. All DDC controllers used in plant room spaces and external application shall be housed IP66/IP54 rating enclosures.

- It shall be possible to add new controllers to the system without taking any part of the system off-line.

b. DIRECT DIGITAL CONTROLLERS CAPABILITIES:

- The Controllers shall have a self-analysis feature and shall transmit any malfunction messages to the Control Station. For any failed chip the diagnostic tests, printout shall include identification of each and every chip on the board with the chip number/location and whether the chip "Passed" or "Failed" the diagnostic test. This is a desired requirement as it would facilitate trouble-shooting and ensure the shortest possible down time of any failed controller. Controllers without such safety feature shall be provided with custom software diagnostic resident in the EEPROM. The Bidder shall confirm in writing that all controllers are provided with this diagnostic requirement.

- Operating system (O.S.) software for controllers shall be EPROM resident. Controllers shall have resident in its memory and available to the programs, a relevant library of algorithms, intrinsic control operators, arithmetic, logic and relational operators for implementation of control sequences.

- In the event of failure of communication between the controllers and/or Control Station terminal, alarms, reports and logs shall be stored at the controllers and transmitted to the terminal on restoration of communication.

- In the event of memory loss of a Controller, or the expiration of back-up power, on start-up of the unit the necessary data-base shall be downloaded automatically and without operator instruction. Controllers requiring a manual intervention for the re-boot of software are not desired.

- Where information is required to be transmitted between controllers for the sharing of data such as outside air temperature, it shall be possible for global points to be allocated

such that information may be transmitted either on change of incremental value or at specific time intervals.

- Controllers must be able to perform the following energy management functions as a minimum.
  - ✓ Time & Event programs
  - ✓ Holiday Scheduling
  - ✓ Maximum and Distributed power demand
  - ✓ Optimum start and stop program
  - ✓ Night purge
  - ✓ Load reset
  - ✓ Zero energy band
  - ✓ Duty cycle
  - ✓ Enthalpy analysis and control
  - ✓ Run Time Totalization
  - ✓ Sequencing and Optimization
  - ✓ Exception scheduling

- Detailed description of software features and operating sequence of all available energy management software shall be submitted with the tender for evaluation by the Consultant.

- The DDC Controllers shall have Adaptive Control capability whereby the control software measures response time and adjusts control parameters accordingly to provide optimum control. The software shall allow self-tuning of the variable control loops (all or any of P, P+I, P+I+D) of the AHU's and chiller system so as to provide the most efficient and optimized controls at different load conditions. The energy management programs shall update their parameters based on past experience and current operating conditions.

- Alarm Lockout shall be provided to prevent nuisance alarms. On the initial start up of air handler and other mechanical equipment a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating an alarm comparison logic. Bidders shall indicate their proposed system alarm handling capability & features.

- Run time shall be accumulated based on the status of a digital input point. It shall be possible to total either ON time or OFF time. Run time counts shall be resident in non-volatile memory.

- It shall be possible to accommodate Holiday and other planned exceptions to the normal time programs. Exception schedules shall be operator programmable up to one year in advance.

- Distributed power demand program shall be based on a sliding window instantaneous demand trend algorithm. The DDC interfaced to the demand meter shall calculate the demand, forecast the demand trend, compare it to the established demand limits, and initiate load shedding or re-establishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last.

c. DATA COMMUNICATION

The communication between controllers shall be via a dedicated communication network as per LanWorks/BACnet/Modbus recommended standards. Controllers microprocessor failures

shall not cause loss of communication of the remainder of any network. All networks shall support global application programs, without the presence of a host PC.

Each controller shall have equal rights for data transfer and shall report in its predetermined time slot. There shall be no separate device designated as the communication's master. Those systems using dependent controllers shall be pointed out by the contractor and a dual redundant transmission media with automatic switching and reporting in the event of line faults will have to be provided.

The communication network shall be such that:

- Every DDC must be capable of communicating with all DDCs.

- Network connected devices with no messages to transmit shall indicate "No failure" message each cycle. Lack of this message after successive retries shall constitute a communication or device failure

d. ELECTRIC AND ELECTRONIC CONTROLS RELATED EQUIPMENT

General Requirements

All controls shall be capable of operating in ambient conditions varying between 0 to 55 °C and 90% R.H. non-condensing.

All Control devices shall have a 20mm conduit knockout. Alternatively, they shall be supplied with adaptors for 20 mm conduit.

Ancillary Items

When items of equipment are installed in the situations listed below, the BAS contractor shall include the following ancillary items:

(i)   Weather Protection

All devices required to be weatherproofed are detailed in the Schedule of Quantities. IP ratings for the equipment are mentioned in the respective section.

(ii)   Pipe work Immersion

Corrosion resisting pockets of a length suitable for the complete active length of the device, screwed ½" (13 mm) or ¾" (20 mm) NPT suitable for the temperature, pressure and medium.

(iii)   Duct Mounting (Metal or Builders Work)

Mounting flanges, clamping bushes, couplings, locknuts, gaskets, brackets, sealing glands and any special fittings necessitated by the device.

Additional features

(i)   Concealed Adjustment: All two position switching devices shall have concealed adjustment unless detailed otherwise in the Schedule of Quantities.

(ii) Operating Voltage: All two position switching devices shall operate on 230V a.c and all accessible live parts shall be shrouded. An earth terminal shall be provided.

e. TEMPERATURE SENSOR

Temperature sensors for space, pipes and ducts, shall be of the Resistance Temperature Detector (RTD) type or thermistor. These shall be two wire type and shall conform to the following specifications:

The temperature sensors may be of any of the following types:

- PT 100, PT 1000, PT 3000
- NI 100, NI 1000
- Balco 500.
- Thermistor
- NTC1800

f. HUMIDITY SENSOR

Space and duct humidity sensors shall be of capacitance type with an effective sensing range of 10% to 90% RH. Accuracy shall be + 3% or better. Duct mounted humidity sensors shall be provided with a sampling chamber. Wall mounted sensors shall be provided with a housing. The sensor housing shall plug into the base so that the same can be easily removed without disturbing the wiring connections. The sensors shall not be mounted near any heat source such as windows, electrical appliances, etc.

g. 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.

h. 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

i. THERMOSTAT

Thermostat shall be snap acting fixed differential type thermostat for air-conditioning application for actuating the two way valve at each fan coil unit with HI-MED-LO fan switch and system setting OFF-FAN-COOL. Switching off must break fan circuit. Thermostat shall be provided with necessary relays to operate valve of cooling coil.

j. ELECTRONIC METERING

Electronic metering shall be provided on the main LT panel at incoming and outgoing feeders. These meters shall be installed in the LT panel by the Electrical contractor. The electrical

contractor shall also provide necessary CT, PT and 220 V power input for the meters. All further control wiring and networking of the meters shall be in scope of BAS contractor.

The specifications for the electronic meters to be supplied by BAS contractor is as follows:

Type: Static Power Meter of Class 1.0 accuracy.

Instantaneous Measurements:

- V (1-n), V (1-1) & 1 per ph& avg. V & I unbalance

- PF per ph& total, frequency

- Power &Bi-directional energy (active, apparent, reactive)

- Peak & Predictive Demand (I, W, VA, VAR totals)

- V & I harmonics (Individual & Total)

- Time of use (internal calendar, multiple daily tariff, energy & demand accumulators).

Features:

- Event Triggered

- Sequence of event

- Panel mountable

- Internal battery backup

- Transducer less connection via standard CT / PT

Display: Local LCD display panel user formattable display with scrollable screens.

Software interface shall be ensured by contractor for the electronic meters. Systems requiring transducers for duplicating the data shall not be accepted.

All the instantaneous measurements shall be displayed on the control stations and the data shall be logged. It shall be possible to access minimum / maximum logging of any parameter with alarm annunciation for unusual measurements. The system shall also accept user defined "Set-Point" limit of any parameter.

k. ENCLOSURES FOR CONTROLLERS AND ELECTRICAL PANELS

All the controllers shall be housed in Lockable Vandal proof boxes which shall either be floor mounted or wall mounted. These shall be free standing, totally enclosed, dust and vermin proof and suitable for tropical climatic conditions.

The panel shall be metal enclosed 14 SWG CRCA sheet steel cubicle with gaskets between all adjacent units and beneath all covers to render the joints dust proof. All doors and covers shall be hinged and latched and shall be folded and braced as necessary to provide a rigid support. Joints of any kind in sheet metal shall be seam welded with welding slag grounded off and welding pits wiped smooth with plumber metal.

Note: All panel enclosures used in plant room spaces and external to building shall be suitable for outdoor application (IP 54 protection) and UL listed.

l. CONDUITS AND WIRING

Prior to laying and fixing of conduits, the contractor shall carefully examine the drawings indicating the layout, satisfy himself about the sufficiency of number and sizes of conduits, sizes and location of conduits and other relevant details. Any modifications suggested by the Contractor shall be approved by IIT Bombay before the actual laying of conduits is commenced.

m. CONDUITS / TRUNKER

Conduits and accessories shall conform to relevant Indian Standards. PVC conduits of required diameter shall be used as called for in the schedule of quantities. Joints between conduits and accessories shall be securely made, with help of adhesive.
The conduits shall be delivered to the site of construction in original bundles and each length of conduit shall bear the label of the manufacturer.

n. CONNECTIONS

All jointing methods shall be subject to the approval of the Architect/Engineer. Separate conduits shall run for all power wiring.
The threads and sockets shall be free from grease and oil. Connections between conduit and controller metal boxes shall be by means of brass hexagon smooth bore bush, fixed inside the box and connected through a coupler to the conduit. The joints in conduits shall be smooth to avoid damage to insulation of conductors while pulling them through the conduits.

o. BENDS IN CONDUIT

Where necessary, bends or diversions may be achieved by means of bends and/or circular inspection boxes with adequate and suitable inlet and outlet screwed joints. In case of recessed system each junction box shall be provided with a cover properly secured and flush with a finished wall surface. No bends shall have radius less than 2½ times the outside diameter of the conduit.

p. SIGNAL CABLING & COMMUNICATION CABLING

The signal cable shall be of the following specifications:

a.	Wire	:	Annealed Tinned Copper
b.	Size	:	1.5 sq. mm, 7 strands
c.	No. of conductors	:	Two (One pair)
d.	Shielding	:	Aluminum polyester shield.
e.	Jacket	:	Chrome PVC
f.	Nominal DCR	:	17.6 ohm/km for conductor
			57.0 ohm/km for shield
g.	Nominal OD	:	8.5 mm
h.	Nominal capacitance	:	130 pF/m between conductors

at 1 KHz 180 pF/m between one conductor and other conductors connected to shield.

i.	Color	:	Black and Red

q. COMMUNICATION CABLE

The communication cable shall be of the following specifications:

a.	Wire	:	Annealed Tinned Copper
b.	Size	:	Minimum 24 AWG stranded
c.	No. of conductors	:	One pair (2 conductor)
d.	Shielding	:	Aluminum polyester shield.
e.	Jacket	:	Chrome PVC
f.	Nominal DCR	:	78.7 ohm/km for conductor
			55.8 ohm/km for shield
g.	Nominal OD	:	5.64 mm
h.	Nominal capacitance	:	131 pF/m between conductors at 1 KHz 243 pF/m
			between one conductor and other conductors connected to shield.
i.	Color	:	Black and Red, Black and White

11. Racks

1   Cabinet shall be constructed in Steel of IS 513 D. Rated for 1000 Kgs equipment loads. Cabinet shall be 42U, 19" 600(w)x1200(d) for server racks and 42U, 19" 800(w)x1200(d) for network racks.

Cabinet shall have form factor of not more than 1.05 when compared between overall height to usable height.

It shall be possible for the Cabinet to be completely knock downable.

Three pairs of depth support channels shall be fixed between the front and the rear frame for additional rigidity to the frame.

The Cabinet shall have bottom cover split in two sections and shall be of 18 gauge. These bottom covers shall have 45° angled end for aesthetic looks. The height of the bottom cover shall not exceed 50mm. The rear Bottom Cover shall have provision for cable entry. Cable brush shall be provided in the rear Bottom Cover. The Top cover shall be fixed from inside of the cabinet. The rear side of the top cover shall have provision for cable entry. Cable brush shall be provided in the rear top cover.

2   Side panels shall be fixed from inside thereby not providing access to open the side panels from outside. Side panel shall be locked without key from inside, preferable with use of latches. Rack shall be provided with a dual side panel on each side for easy of handling. Side covers shall be in two sections in 18 Gauge. These covers shall be hooked from the top and locked at bottom from inside of the rack.

3   Cabinet shall have provision for mounting PDU which are recessed towards the side panel to offer clear path for accessing the 19" Mounting angle. Rack shall be provided with full height Frames positioned along the edges of the cabinet and outside of the active 19" space so as to provide clear

access to the rear of installed equipment and not to impede the flow of warm exhaust air towards the cabinet rear door

4   Completely recess able 19" equipment mounting angles shall be in 14 Gauge with notches at regular interval for mounting of equipment such as High-end Servers, Telecom equipment, etc. as per Industry standards to be provided. It should be possible to install any standard equipment with varying depth in the Cabinet without the use of any additional accessories.

5   The Cabinet shall be designed for structure cabling.
The cabinet will have ease of routing the cable into the cabinet or taking out of the cabinet without any down time. In other words, the cabinet can be positioned in place once the cabling is completed. Bottom rear side of the rack shall be provided with cable entry cutout with cable brushes.

6   Front and Rear doors shall be made in Steel and with hexagonal perforation. The perforated area of the front door shall cover 100% of the active equipment area of the cabinet. The Door shall be with three-point locking mechanism and shall be designed for tool-less installation for ease of handling and installation on site. Option of Installing Split door shall also be available. The front and rear doors will close between the top and Bottom Cover

7   Rack shall be providing with base frame to eliminate point loads

8   Rack shall be provided with proper earthing arrangement in both front and rear with use of an earthing sqid.

9   Network racks shall have provision of adding an Integrated cabling frame (200 mm width) with overall depth matching the depth of the main rack so that the rack can be converted for handling dense cabling in front & rear for networking.

11.1.1 Specifications

S. No.	Parameter	Tender Specifications
1.	Type	19" 42U racks mounted on the floor
		Floor Standing Server Rack - 42U with Heavy Duty Extruded Aluminum Frame for rigidity. Top cover with FHU provision. Top & Bottom cover with cable entry gland plates. Heavy Duty Top and Bottom frame of MS. Two pairs of 19" mounting angles with 'U' marking. Depth support channels - 3 pairs with an overall weight carrying Capacity of 1000Kgs.
		Each network/server rack will be supplied with 5 numbers of 1U blanking panels, 5 numbers of 2U blanking panels and 2 numbers of 4U blanking panels
		Stationery Shelf (2 sets per Rack)
		All racks must be lockable on front and rear side with unique key for each rack
		Racks should have Rear Cable Management channels, Roof and base cable access
		Cabinet shall have form factor of not more than 1.05 when compared between overall height to usable height.

2.	Size	Server Rack: 42U x 600mm x 1200mm Network Rack: 42U x 800mm x 1200mm
3.	Wire Managers	Two vertical and four horizontals
4.	Power Distribution Units	2 per rack
		Intelligent Power Distribution Unit - Vertically Mounted, 32AMPs with 25 Power Outputs. (16 Power outs of IEC 320 C13 Sockets & 8 power outs of IEC 320 c19 sockets p5 Power outs of 5/15 Amp Sockets), Electronically controlled circuits for Surge & Spike protection, LED readout for the total current being drawn from the channel, 32AMPS MCB, 5 KV AC isolated input to Ground & Output to Ground
5.	Doors	The racks must have steel (solid / grill / mesh) front / rear doors and side panels. Racks should NOT have glass doors / panels.
		Front and Back doors should be perforated with at least 63% or higher perforations.
		Both the front and rear doors should be designed with quick release hinges allowing for quick and easy detachment without the use of tools.
6.	Metal	Aluminum extruded profile
7.	Side Panel	Detachable side panels (set of 2 per Rack)
8.	Earthing	Rack shall be provided with proper earthing arrangement in both front and rear with use of an earthing sqid.

12. Network Cabling

A. Data outlets will be provided on the worktables in IT Manager Room, BMS Room and for CCTV and other BMS integration purposes.

A.   Copper Cabling Solution

S. No.	Description
	Channel Performance
1.	Channel Performance The Category 6A/ Class EA UTP SCS shall comply with the following standards a) ISO/IEC 11801:2010 b) EN 50173 Part 1 through Part 5:2010 and 2011 c) ANSI/TIA-568-C d) IEC 60603-7-4 e) IEEE 802.3 applications as outlined in section 2 f) Local/National Codes and Regulations
2.	The Category 6 Class EA UTP system should support the following IEEE Ethernet applications a) 802.3e - 1BASE5 b) 802.3i - 10BASE-T c) 802.3u - 100BASE-TX, 100BASE-T4 d) 802.3y - 100BASE-T2

S. No.	Description
	e) 802.3z - 1000BASE-X f) 8023ab - 1000BASE-T g) 802.af - Power Over Ethernet (15.4W) h) 802.3at - Power Over Ethernet Enhancements (25.5W) i) 802.3az - Energy Efficient Ethernet
3.	Additionally, the Category 6 Class EA UTP SCS shall be capable of supporting the following Fiber Channel Applications Standards, per Technical Committee 11 of INCITS: a) 1GFC-BASE-T b) 2GFC-BASE-T c) 4GFC-BASE-T
4.	The proposed Category 6A UTP SCS, when configured as a worst-case 100-meter channel shall provide performance headroom over limits specified by Cat6A
5.	NEXT (Near End Cross Talk): Minimum 3 dB above the standards; Should support a minimum of 4 connector Channel with a minimum 3 dB guaranteed NEXT
6.	Insertion Loss: < 3%
7.	Return Loss: <1.0db
8.	The SCS must consist of individual components provided by the same manufacturer. "Mix and Match" products are not allowed as there is no guarantee that the overall channel will meet Category 6A Channel requirements if constructed with components from different vendors.
9.	The Category 6A cable and Category 6A channel components shall be manufactured by a single manufacturer. The manufacturer shall warrant the Category 6A channel cable, components, and applications for a period of 20 years.
10.	The 20-year warranty shall be a transferable warranty and has component replacement policy in case of manufacturing defect
11.	The SCS must be tested by an ISP 17025 accredited 3rd Party test facility to EIA/TIA 568C, ISO/IEC 11801 Amendment 1 and for the channel testing must be provided as part of the bid response.
12.	The Category 6A system should support channels that are shorter than 15 meters for 2, 3, 4 connector channels without any minimum length requirements.
	Horizontal Cable
13.	The Cable should meet ANSI/TIA 568C.2 Category 6A Specifications
14.	The cable should consist of Eight 23 AWG copper conductors. Copper Clad Aluminum or any other combinations are not allowed
15.	The Cable should be round in shape
16.	The weight of the cable box of 1000 Feet should not be less than 34.7 lb
17.	The nominal Jacket thickness should be 0.05 inches
18.	The nominal Outside diameter should be 0.285 inches

S. No.	Description
19.	The cable should support the installation temperature: 0 to 60 ^{0}C. It should support Operating temperature of -20 to 60 ^{0}C
20.	The cable shall be available in Low-Smoke, Zero Halogen (LSZH) compatibility and the LSZH version must comply with the following Fire Safety standards: a) ISO/IEC 60332-3-22: Vertical Flame Spread b) ISO/IEC 60754-2: Acidity c) ISO/IEC 61034-2: Smoke Density
21.	The cable and cordage shall be "True UTP" components that do not include internal or external shields, screened components or drain wires. No Special Grounding requirements.
22.	The horizontal cable shall have a unique print string on the cable jacket. This unique identifier shall also be used for on-line reference to a full set of factory tests that were performed on a sample from the same mater reel. The test parameters shall include NEXT, PSNEXT, Return Loss, Attenuation, ELFEXT and PSELFEXT. The on-line reference must be available on the SCS vendor public website, such that it can be accessed at any time.
	Category 6A - 10Gigabit outlets
23.	The 8-pin modular (RJ-45) jacks shall comply with IEC 60603-7-4
24.	The Category 6A outlets shall be backward compatible with Category6 and 5Ecords and cables.
25.	The Category 6 outlets shall be of a universal design supporting T568 A & B wiring.
26.	The information outlet shall have a Current Rating of 1.5 A at 20°C
27.	The information outlet must support 90-degree cable termination.
28.	3rd Party Verification test certificates shall be provided to show compliance to ISO/IEC 11801 Amendment 2 testing for Cat 6 components.
29.	The information outlet will have insertion life of 750 cycles minimum.
	Modular RJ45 Patch Cords
30.	SCS must support patch cord lengths of 1 meter minimum and equipment cords of 2 meter minimum and the Patch cords shall be available in Stranded construction
31.	Cords shall be equipped with 8-pin modular plugs on each end.
32.	All cords shall be round, and consist of copper conductors, tightly twisted into individual pairs.
33.	Nominal cordage diameter shall not exceed 7.24 mm.
34.	Plugs shall be designed with an anti-snag latch to facilitate easy removal during move, add and change processes.

S. No.	Description
35.	The LSZH version must comply with the following Fire Safety standards: a) ISO/IEC 60332-3-22: Vertical Flame Spread b) ISO/IEC 60754-2: Acidity c) ISO/IEC 61034-2: Smoke Density
36.	3rd Party verification of the Fire Safety/ Environmental tests listed above must be provided as part of the bid response.
37.	The cordage shall be UTP components that do not include internal or external shields, screened components or drain wires.
38.	The patch cords will have insertion life of 750 cycles minimum.
	24-Port Unloaded Patch Panel
39.	When configured in worst-case 100-meter channels with full cross-connects and consolidation points with the other products proposed in this tender, the panel shall be capable of delivering the minimum guaranteed channel performance
40.	The panel shall have horizontal cord organizers available as to improve patch cord management
41.	The patch panel type shall be a 1U straight unloaded patch panel for 19" rack mounting capable of supporting 24 unshielded modular 8-pin connectors compliant with IEC 60603-7-4 while meeting the Channel Performance as specified in Amendment 1 to ISO/IEC 11801:2002
42.	The panel shall be available in 24-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable
43.	The panel shall be equipped with a removable rear mounted cable management bar and front and rear labels
44.	The panel shall be UL and CUL Listed
45.	Operating Temperature Range = -10°C to 60°C
46.	Storage Temperature Range = -40°C to 70°C
47.	Humidity = 95% noncondensing

13. Miscellaneous items

13.1 LED Monitors

LED Monitor for the BMS Room shall be a professional grade 55" monitor having the following minimum specifications:

S. No.	Feature	Requirements
1.	Screen Size	49"
2.	Aspect Ratio	16:9
3.	Resolution	1920 x 1080 (Full HD)
4.	Panel	LED backlit/edge lit
5.	Connectivity	HDMI (2), DVI-D, DP, RS232C, RJ45, USB
6.	Built in speakers	Required
7.	Power Supply	100-240V ac, 50 Hz.
8.	EMC	FCC Class "A" / CE
9.	Accessories comprising of Remote Control with battery, signal cables, power cord	Required
10.	Wall mount bracket	Required

13.2 Workstation for BMS

S. No.	Features	Minimum Required Parameters
1.	Processor	Intel Core i7, min 3 GHz
2.	RAM	8 GB DDR, 1333 MHz
3.	Hard Disk	1 TB SATA
4.	Expansion Ports	4 USB 3.0, 1 Line-in, 1 Line-out, 1 Microphone, 1 LAN, 1 VGA
5.	Keyboard & Mouse	Yes, Wireless
6.	Ethernet Port	10/100/1000 Base-T Network Interface
7.	Chipset	Intel
8.	Included Software	Windows 10 Operating System
		McAfee Anti-Virus valid for 3 years
		Recovery CD Creator
		Hard Drive based application recovery for reinstallation of applications & drivers
		Hard Drive based system recovery with option to keep user data files intact
		Microsoft Internet Explorer
		Microsoft Windows Live applications
9.	Screen	21" LED monitor

13.3   Maintenance Equipment and Tools

The following maintenance equipment and tools are required for the maintenance of the Data Centre:

S. No.	Description	Unit	Qty
1.	Double cup suction panel lifter	Nos.	2
2.	HEPA Vacuum Cleaner with all accessories	No.	1
3.	Hand held vacuum cleaner with all accessories	No.	1
4.	Aluminum Ladder with adjustable height from 4 feet to 6 feet	No.	1
5.	Portable Humidity and Temperature Monitoring units (Vaisala/GE/omega make)	Nos.	1
6.	RJ45 Crimping Tool (AMP make)	Nos.	2
7.	Digital Multimeter (Fluke make)	Nos.	2
8.	Current Clamp Meter (Fluke make)	Nos.	2
9.	LAN connectivity Tester (Fluke make)	Nos.	2
10.	Multi-bit Screwdriver Set - 30 bits)	Nos.	2
11.	Motor driven pump for filling diesel in DG Sets	No.	1
12.	Label Printer (Epson/HP)	No.	1
13.	Fiber continuity tester (visifault of Fluke make)	No.	1
14.	Mechanical Tool Kit (Taparia make)	No.	1

14. Power Sources

1. Construction of 6m x 6m Transformer Room and 6m x 6m MLT Panel Room as per the EMD requirement.
2. Arranging and supplying Architectural drawing through a MCGM approved Architect.
3. Arranging and supplying Structural drawing through a MCGM approved Structural Consultant
4. Obtaining permission for construction from Building Planning Special Cell of MCGM through the Architect.
5. Construction of the structure as RCC framed structure and masonry walls, plastering, flooring, waterproofing, doors, windows, DPC, painting etc as required.

6. Supply, installation, testing and commissioning of 2MVA indoor type transformer in the proposed Transformer Room.

7. Supply, installation, testing and commissioning of Utility Panel.

8. Supply and installation of bus bar trucking from transformer to utility panel and from utility panel to MLT panel as per the Electrical SLD.

9. Providing 2 numbers of 1m x 1m underground trench from MLT Panel Room to LT Panel Room, and from existing 625kVA DG set to Sync Panel 1 & 2.

10. Existing 625 KVA DG set ATS Panel to be removed with minimum downtime for the existing HPC server rack.

11. Statutory certification from CEA & Electricity board for installed systems.

15. Installation, Testing and Commissioning

15.1.1 Installation, Testing and Commissioning

15.1.2 Engineering

Upon award of the contract, the contractor shall complete the engineering design of the Data Centre in line with the design requirements and specifications. The contractor shall submit preliminary design, detailed design and test plan. The submittals shall include but not limited to:

- Preliminary design document
- Detailed design document
- Samples and Datasheets
- GFC drawings
- BOQ as per the design
- Acceptance test plan

Only after approval of the design documents and BOQ, the contractor can initiate their procurement process.

15.1.3 Procurement

After the design approval of every subsystem, the contractor shall go ahead with the procurement and construction as per the approved design, GFC drawings and BOQ.

When the materials are received at site, IIT Bombay will inspect the materials as per the test/inspection plan. Based on the inspection, the contractor shall prepare a Material Inspection Report (MIR), which shall be jointly signed by the authorized signatories of the contractor, and IIT Bombay Committee.

The contractor shall keep all the materials in their own safe custody until installation, commissioning and provisional acceptance.

15.1.4 Testing

The contractor shall conduct necessary tests for verification of compliance with the technical specifications. The testing shall be conducted for all critical components such as UPS, Batteries, PDUs, Cables, Panels, HVAC systems, etc. However, the tests shall not be limited to these components. IIT Bombay may require testing of any other components during execution of the projects.

15.1.5 Test Categories

- The following tests shall be conducted for acceptance of the equipment and the system before final acceptance of the system.

  ✓ Sample Approvals
  ✓ Pre-Factory Acceptance Testing
  ✓ Factory Acceptance Testing (FAT)
  ✓ Pre-commissioning test (after installation) for total integrated system.

- These tests shall be carried out on all equipment supplied by Contractor including those supplied by sub-vendors, if any.

- Contractor shall arrange all necessary test instruments, manpower, test-gear, accessories, etc.

- All technical personnel assigned by Contractor shall be fully conversant with the system specifications and requirements. They shall have the specific capability to make the system operative quickly and efficiently and shall not interfere or be interfered by other concurrent testing, construction and commissioning activities in progress. They shall also have the capability to incorporate any minor modifications/suggestions put forward by IIT Bombay Engineer.

- Contractor shall arrange power supply and any temporary commissioning facility including communication system required for installation/testing/commissioning.

- Test Plan: The Contractor shall submit to IIT Bombay 'Test Plans' well in advance of commencement of actual testing in each of the above-mentioned test categories.

The plans shall include:

- System/Equipment functional and performance description (in short) and Tests to be conducted and purpose of test.

- Test procedures (including time schedule for the tests) and identification of test inputs details and desired test results

15.1.6 Test Report

The observations and test results obtained during various tests conducted shall be compiled and documented to produce Test Reports by Contractor. The Test Reports shall be given for each equipment/item and system as a whole. The report shall contain the following information to a minimum:

- Test results

- Comparison of test results and anticipated (as per specifications) test result as given in test plans and reasons for deviations, if any.

- The data furnished shall prove convincingly that

  ✓ The system meets the Guaranteed Performance objectives
  ✓ Mechanical and Electrical limits were not exceeded.
  ✓ Failure profile of the equipment during the tests are well within the specified limits

15.1.7 Failure of Components

Till the system is accepted by the IIT Bombay Committee, a log of each and every failure of components shall be maintained. It shall give the date and time of failure, description of failed component, circuit, module, component designation, effect of failure of component on the system/equipment, cause of failure, date and time of repair, mean time to repair etc. Detailed documentation for the same shall be submitted to IIT Bombay for future reference.

If a malfunction and/or failure of a unit/module/sub-system/equipment repeats during the test, the test shall be terminated and Contractor shall replace the necessary component or module to correct the deficiency. Thereafter, the tests shall commence all over again from the start.

If after the replacement the equipment still fails to meet the specification, Contractor shall replace the equipment with a new one and tests shall begin all over again. IIT Bombay Committee's approval shall be obtained for any allowable logical time required to replace the failed component/unit/module/sub-system.

15.1.8 Readjustments

No adjustments shall be made to any equipment during the acceptance tests. If satisfactory test results cannot be obtained unless readjustments are made, Contractor shall carry out only those readjustment needed to ready the equipment/system for continuance of tests. A log of all such adjustments shall be kept giving date and time, equipment, module, circuit, adjustments, reasons, test result before and after adjustment, etc. Fresh acceptance tests shall be conducted after the readjustments have been completed.

15.1.9 Sample Approvals

The contractor shall provide samples of various components such as civil/interior materials (such as tiles), cables, accessories, furniture, etc. prior to their procurement. For components such as UPS, HVAC Systems, Power Distribution Units, etc where samples cannot be provided, the contractor shall submit OEM datasheets of those components for approval by IIT Bombay Committee. The contractor shall go ahead with the procurement only after IIT Bombay Committee's approval.

15.1.10 Pre-Factory Acceptance Testing

The Contractor on his own, exactly in line with FAT, shall conduct pre-factory acceptance testing and test reports for the same shall be forwarded to IIT BOMBAY Engineer before start of FAT.

15.1.11 Factory Acceptance Testing (FAT)

IIT Bombay may require factory acceptance testing to some or all the components to be supplied and installed by the successful Contractor.

Factory acceptance tests shall be carried out after review and approval of FAT procedure/documents as per bid requirements and review of Pre-Factory acceptance results & shall be conducted at the manufacturing facilities from where the respective equipment/subsystems are offered. The factory acceptance testing shall be conducted in the presence of the IIT Bombay Engineer. The tests shall be carried out on all equipment/items including those supplied by sub-vendors and factory acceptance certificates shall be issued.

IIT Bombay reserves the right to waive factory acceptance testing to some or all the equipment.

The factory tests shall include but not be limited to:

a. Equipment Testing

- Mechanical checks to the equipment for dimensions, inner and outer supports, finishing, welds, hinges, terminal boards, connectors, cables, painting, etc.

- Electrical checks including internal wiring, external connections to other equipment, etc.

- Check for assuring compliance with standards mentioned in the specifications.

- Individual check on each/module/sub-assembly in accordance with the modes and diagnostics programs of the Contractor.

- Checks on power consumption and heat dissipation characteristics of various `equipment

- Environment testing and other laid down tests in Type Tests plan of the specification of the equipment.

- Functional testing

- Any other test not included in FAT document but relevant to the project as desired by the IIT Bombay at the time of Factory Acceptance Testing.

b. System Integration Testing

Functional and performance test should be conducted for each complete system/component that requires integration with other components/subsystems of the Data Centre. The interfacing subsystems/components can be simulated reflecting the production scenario.
All functions of the BMS/BMS shall be demonstrated in totality with integration with all the test systems concerned.

15.1.12   Installation

After successful completion of Factory Acceptance Testing, dispatch clearance has to be obtained from IIT Bombay subsequent to which equipment shall be sent to site for installation. Equipment without factory acceptance certificates and dispatch clearance shall not be acceptable at site.
Prior to installation, all equipment shall be checked for completeness as per the specifications of equipment required. Installation shall be carried out in accordance with the installation manuals and approved installation drawings in the best workmanship.
Contractor shall bring all installation tools, accessories, special tools, test gears, spare parts etc. at his own cost as required for the successful completion of the job.
If during installation and commissioning any repairs are undertaken, the maintenance spares supplied with equipment shall not be used for the repair. Contractor shall arrange his own spare parts for such activities till such time the system has been finally accepted by the IIT Bombay Committee. A detailed report & log of all such repairs shall be made available by the Contractor to IIT Bombay and shall include cause of faults and repair details, within 2 weeks of fault occurrence.
A detailed time schedule for these activities shall be submitted by Contractor to IIT Bombay to enable their representatives to be associated with the job.
Contractor shall supply all installation materials required for proper installation of the equipment. These shall include all accessories, protection/safety accessories and any other components to complete the installation as per the technical specifications and local/international standards/best practices.

The installation of equipment shall be done as to present neat and clean appearance in accordance with approved installation document drawings.

15.1.13 Pre-Commissioning

On completion of installation of equipment, the correctness and completeness of the installation as per Manufacturer's manual and approved installation documents shall be checked by the Contractor on his own.

A list of Pre-Commissioning tests (same as approved by the IIT Bombay for site acceptance testing) and activities shall be prepared by Contractor and the test shall be carried out by the Contractor on his own. After the tests have been conducted to the Contractor's own satisfaction, the Contractor shall provide the test results for review by IIT Bombay and then offer the system for Site Acceptance Testing.

During pre-commissioning, if any fault occurs to any equipment or system, Contractor shall identify the same and provide report/history of all faults to the IIT Bombay Committee.

During installation and pre-commissioning of the systems, Contractor shall have enough number of commissioning spares so that the installation is not held up because of non-availability of commissioning spares. Contractor shall ensure that the spares meant for operation and maintenance are not used during installation and commissioning.

15.1.14 Acceptance Testing

On completion of Supply, Installation, Testing and Commissioning of the Data Centre, site acceptance testing shall be conducted as per approved acceptance test procedures and its constituents by the Contractor under the presence of IIT Bombay Committee. Provisional Acceptance Certificate shall be issued on successful completion of acceptance Testing and complying to all other requirements of Provisional Acceptance as mentioned in Special Conditions of Contract.

The tests shall include, but not be limited the following:

- Checks for proper installation as per the approved installation drawings for each equipment/item and system as a whole.

- Guaranteed performance specifications of individual equipment/item.

- Self-diagnostics test on individual equipment

- Compliance to standards/best practices

- Integration testing between various subsystems

For the Load Testing of the PACs and the UPS systems, Contractor shall arrange the heat load banks for the specified maximum IT load. Heat load banks shall have to be arranged by the Contractor.

15.1.15 Spares

a. Mandatory Spares

The contractor shall maintain sufficient mandatory spares for meeting the Service Level Requirement specified in the tender. The Contractor shall provide a list of mandatory spares as

a part of their technical bid. Unit rates for each spare required for operation and maintenance shall be provided as a part of their price bid.

Spares shall be provided from the same manufacturing facilities/location from where the respective equipment, subsystems are offered.

Contractor shall provide the address, contact person, telephone number and email id of the manufacturer of the spare parts. The Contractor shall warrant that spare parts for the system would be available for minimum of 10 years (MAF shall have this statement) from the date of supply.

b. Commissioning Spares

The commissioning spares shall be arranged by the Contractor to cater to the requirement during installation, commissioning, site acceptance testing, trial run and warrantee period. These spares shall be readily available with the Contractor.

These commissioning spares are different from mandatory spares and Contractor shall not use mandatory spares as commissioning spares.

15.1.16 Quality Assurance

- Contractor shall submit the details of Quality Assurance program followed by him beginning with raw materials, active, passive and fabricated components, units, sub-assemblies, assemblies, wiring, interconnections, structures, etc. to finished product. Contractor shall obtain and forward the Quality Assurance Program for equipment supplied by Sub-vendor, if any.

- IIT Bombay reserves the right to inspect and test each equipment at all stages of production and commissioning of the system. The inspection and testing shall include but not be limited to raw materials, components, sub-assemblies, prototypes, production units, guaranteed performance specifications, etc.

- For Factory inspection and testing, Contractor shall arrange all that is required e.g., quality assurance personnel, space, test gear, etc. for successful carrying out of the job in the presence of IIT Bombay Committee, at Contractor's cost, at the Manufacturer's works.

- IIT Bombay shall have free entry and access to any and all parts of the Manufacturer's facilities associated with manufacturing and testing of the system at any given time.

- It shall be explicitly understood that under no circumstances shall any approval of IIT Bombay relieve the Contractor of his responsibility for material, design, quality assurance and the guaranteed performance of the system and its constituents.

- Contractor shall invite IIT Bombay Committee, at least 10 days in advance, of the date at which system shall be ready for Inspection and Testing. All relevant documents and manuals, approved engineering drawings, etc. shall be available with IIT Bombay well in advance of the start of Inspection and Testing.

IIT Bombay Committee's Engineer or his representative shall, after completion of inspection and testing to their satisfaction, issue factory acceptance certificates and dispatch clearance to release the equipment for shipment. No equipment shall be shipped under any circumstances

unless a factory acceptance certificate and dispatch clearance has been issued for it, unless agreed otherwise by IIT Bombay Committee.

15.1.17 Maintenance

To ensure the following service level requirements:

- Carry out preventive and periodic maintenance required as per the recommendations of the OEM, the cost of consumables required for periodic maintenance such as oil, filters, lubricants, batteries, refrigerants, etc. during the warranty period will be to the account of the Contractor.

- Provide periodic maintenance/audits required by the appropriate regulatory authority such as local electricity boards, fire safety authorities, CCOE, etc.

- To maintain adequate spares onsite for ensuring the SLA. The Contractor has to provide a list of spares to be maintained during the support period as a part of the technical bid.

- All the equipment supplied for the Data Centre shall be with three years warranty.

- Scheduled on-site service support and call-based on-site service support to be provided during the warranty period for all the equipment/systems of the Data Centre by the OEMs/System Integrators of various systems. Contractor has to provide the following details:

  ✓ Details of OEMs/System Integrators of various systems
  ✓ Warranty documents
  ✓ Confirmation letters from OEMs/System Integrators for:
  ✓ providing the service support for the warranty period
  ✓ their commitment to the response time
  ✓ escalation matrix
  ✓ providing patches, upgrades and updates to the supplied software and ensure they are applied after due diligence and approval by the IIT Bombay Engineer in-charge.

Decision of IIT Bombay Engineer-in-charge is final and binding.

16. Operation & Maintenance

During Warranty and Long-term maintenance support, the contractor has to provide the following services:

1. **Comprehensive on-site maintenance** for all the equipment and subsystems supplied and installed by the contractor.

2. To ensure the following service level requirements:
   i. 99.982% Data Centre uptime
   ii. Any failure of critical components (power distribution equipment's, cooling system for Data Centre) shall be restored within 30 minutes from the time of failure.
   iii. Any failure of non-critical components shall be restored within 4 hours from the time of failure.

3. To carry out preventive and periodic maintenance required as per the recommendations of the OEM, the cost of consumables required for periodic maintenance such as Oil, filters, lubricants, batteries, refrigerants, etc. during the support period will be to the account of the contractor.

4. To provide periodic maintenance/audits required by the appropriate regulatory authority such as local electricity boards, fire safety authorities, CCOE, etc.

5. To carry out quarterly fire drills onsite and periodic awareness training to the customer.

6. To maintain backup of Access Control logs, CCTV recordings, BMS data, etc. as per the requirements of IIT Bombay. The contractor shall submit the backup policy as per the industry best practices that would be approved by IIT Bombay Engineer in-charge.

7. To provide patches, upgrades and updates to the supplied software and ensure they are applied after due diligence and approval by the IIT Bombay Engineer in-charge.

8. To manage the configuration of all the supplied hardware and software.

9. To implement and manage a proper change management process for carrying out changes to configuration, equipment's, replacement, etc.

10. To maintain adequate spares onsite for ensuring the SLA. The Contractor has to provide a list of spares to be maintained during the support period as a part of the technical bid.

11. To provide qualified, trained and experienced maintenance engineer onsite for critical subsystems (power & cooling) and a BMS Engineer for 24x7x365.

12. The onsite engineers shall continuously monitor the functioning of various subsystems supplied and installed by the contractor and any failures shall be identified within 2 minutes of the occurring of the problem and corrective action shall be initiated immediately.

13. The contractor has to provide an online helpdesk facility to log support calls. The support calls shall be tracked by the helpdesk until resolution. The support calls that are not resolved in stipulated time has to be escalated automatically. The contractor has to provide an escalation matrix.

14. The contractor has to provide daily, weekly, monthly, quarterly, yearly service performance reports in the format approved by IIT Bombay engineer in-charge.

15. At the end of the contract period, the contractor shall ensure that all the equipment`s are in working condition with periodic maintenance carried out.

16. Decision of IIT Bombay Engineer-in-charge is final and binding.

17. Submittals

17.1.1 Submittals

The bidder shall submit the documents including but not limited to the following as part of the technical bid:

- Detailed DC layout with cross section view

- Detailed Schedule of Procedure

- Detailed electrical SLD for the entire Data Centre

- Detailed Earthing Scheme as per IEEE 1100 and TIA 942 compliance.

- Detailed layouts of the Panels

  ✓ Cable Tray Layouts
  ✓ HVAC piping layout.
  ✓ Lighting and Switch socket layout.
  ✓ Fire Detection & Suppression layout and gas calculation sheet duly signed by OEM.
  ✓ CCTV Layout covering entire DC area, and DG Set area & Transformer area.
  ✓ Drawing indicating locations of sensors and configuration diagrams for Access Control System, Rodent Repellant System and Water Leak Detection Systems.

- Datasheet/Technical Brochures of all the Equipment proposed in Data Centre

- Detailed BOQ for all components and subsystems. Each subsystem BOQ shall contain detailed break-up of the components and quantities without prices.

- OEM/Manufacturer Authorization letter in Original duly signed by authorized signatory of OEM for UPS, PAC, PDU, Racks, Networking Infrastructure, Safety & Security Systems and BMS.

- List of documents for demonstrating compliance to Eligibility Criteria.

- Support Methodology

- Escalation Matrix

- How the bidder shall meet the SLA

- The bidder shall provide a comprehensive list of periodic maintenance tasks for all subsystems/equipment

- List of onsite spares

These submittals form part of technical evaluation process. Any bid not compliant to this requirement is liable to be rejected.

18. Approved Makes of components

1. The bidder has to use high quality components from reputed OEMs. The make/model number of all components has to be specified for all the components.
2. All the components/equipment used shall be manufactured in a facility with minimum quality certification of ISO 9001:2008.
3. The components/equipment`s shall be ISI certified wherever required/applicable.
4. The list of approved makes and model numbers are given in the following table. For those components, which are not listed in the table, they should be from reputed manufacturers with significant market share in India.
5. Any makes/brands specified in the technical specifications shall also be applicable.

List of Approved Makes for BYOH & HPC Data Centre		
S. No.	**Components/Equipment**	**Makes Preferred**
A. Civil & Interiors		
A.1	Fire Rated Doors	ShaktiHormann/MPP Technologies/Technocrat security/Acodor
A.2	False Floor	Unitile / Uniflair/Tankaria Ind
A.3	Nitrile Rubber Insulation	K-flex/Armaflex/Them flex/A- flex
A.4	Paints	Asian Paints / Berger
A.5	Furniture	Godrej/Wipro/Cosmos/Featherlite
A.6	Fire stop Material/ Cable & Pipe Sealing Solutions	Hilti/3M/Roxtec
A.7	Floor Tiles	H & R Johnson/Kajaria/Asian/Somany/Hindware
A.8	Vinyl flooring	Armstrong
B. Electrical System		
B.1	ACBs / MCCBs	Schneider Master Pack MW/Compact NSX, L&T Upower/ Dsine, Siemens 3 WL/3 VL, Legrand DMX³/DPX³, ABB
B.2	DG Sets	Powerica/Koel/Pi Kane
B.3	MCBs	Schneider/ABB/Legrand/L&T/Siemens
B.4	MCB Distribution Boards	Schneider/ABB/Legrand/L&T/Siemens
B.5	UPS system	Schneider/Vertiv/Socomec/Delta/Legrand - Numeric
B.6	Li ion Batteries	Schneider/Samsung/LG/Vision
B.7	VRLA Batteries	Amar Raja/Exide/Panasonic
B.8	LT Cables	Finolex/Polycab/Havells
B.9	Lighting	Wipro/Philips/Crompton/GE/Trilux
B.10	Electrical Switches and Sockets	Legrand/MK/Schneider/Siemens/Havells

B.11	LT Panels	CPRI approved panel builder
B.12	PVC FRLS Conduits	BEC/Sudhakar/VIP/Precision/Polycab
B.13	Earthing Electrode and Electrodite Backfill	Ashlok/JMV LPS/Alfredkim Systems

C. HVAC System		
C.1	Chiller	Schneider/Emerson/Blue box/Climaveneta
C.2	In row cooling Unit	Schneider/Emerson/Climaveneta
C.3	Comfort AC	Midea/BRIA/Trane/GET
C.4	Cold Aisle Containment	Net rack/Schneider/WQ Systems/Rittal/Climaveneta

D. Safety & Security System		
D.1	IBMS	Honeywell/Schneider/Siemens
D.2	CCTV	Honeywell/Axis/Panasonic/Tyco
D.3	Access Control System	Honeywell/Siemens/HID/Schneider Electric
D.4	Biometric Readers	Morpho/HID/Honeywell
D.5	Early Detection System	Xtralis/Siemens
D.6	Rodent Repellant System	Maser/Star Electronics/ C system
D.7	Water Leak Detection System	Sontay/Star Electronics/ C Systems
D.8	Fire Suppression	Kidde/Ansul/Siemens/Honeywell/Tyco
D.9	Addressable Fire Alarm System	Honeywell/Siemens/Schneider electric
D.10	Public address system	Bosch/Honeywell

E. Passive Network System		
E.1	Racks	APC Schneider/Emerson/Rittal
E.2	LED workstation monitors	HP/Dell/Lenovo
E.3	LED displays	Panasonic/Sony/Samsung/LG

F. Power System		
F.1	Transformer	CromptonGreaves/Kirlosakar/Voltamp/ Raychem
F.2	VCB	Siemens/ABB/Schneider
F.3	Sandwich Busduct	Legrand/L&T/Godrej/GE/C&S
F.4	Cables	CCI/Asian(RPG)/polycab/Havells/Finolex
F.5	HT Termination	Raychem
F.6	Flexible wire	Finolex/ polycab/RR kabel/Anchor(FRLS)
F.7	ACBs	L&T/Siemens/ABB/Legrand
F.8	MCCBs	L&T/Siemens/ABB/Legrand
F.9	MCBs	L&T/Siemens/Legrand(MDS)/Hager
F10	Relays	L&T/ABB/Alstom/Schneider/Siemens/GE
F.11	Load Manager	L&T / ABB / Secure
F.12	Meters – Analog type	AE/IMP/RISHABH

F.13	CT at LV Side	AE/Pricise/RISHABH
F.14	PT / CT at HT side	CGL/Pragati/AE/kappa/ECS
F.15	Glands	Dowell/jaison/3D
F.16	Lugs	Dowell/Jaison/3D
F.17	Selector switch	Kaycee /Equivalent make
F.18	Auto / manual switch	Kaycee /Equivalent make
F.19	Control switches (Rotary)	Kaycee /Equivalent make
F.20	Indicating lamp / push button	Siemens/Vaishno/TEKNIC/Equivalent make
F.21	Insulating Mat	Premier Polyfilm ltd/Equivalent make

Annexure – 1

List of Drawings

1. Interior Layout
2. Partition Layout
3. Ceiling Layout
4. Flooring Layout
5. Electrical Schematic Layout
6. Lighting Fixture Layout
7. Cable Tray Layout
8. Earthing Layout
9. DG Set Location Layout
10. DG Set Sectional View Layout
11. Electrical Power Socket Layout
12. Chiller Location Layout
13. Chiller Sectional Layout
14. Chilled Water Piping Schematic Layout
15. Acoustic enclosure layout
16. Fire Alarm System Layout Sheet 1 of 2
17. Fire Alarm System Layout Sheet 2 of 2
18. Fire Suppression System
19. Access Control System Layout
20. Surveillance System Layout Sheet 1 of 2
21. Surveillance System Layout Sheet 2 of 2
22. Public Address System Layout
23. Rodent Repellant System Layout
24. Water Leakage Detection System Layout
25. Aspiration System Layout
26. Temp & RH Sensor Layout
27. BMS Schematic Layout
28. Data outlets Layout Sheet 1 of 2
29. Data outlets Layout Sheet 2 of 2
30. Overall Site Layout