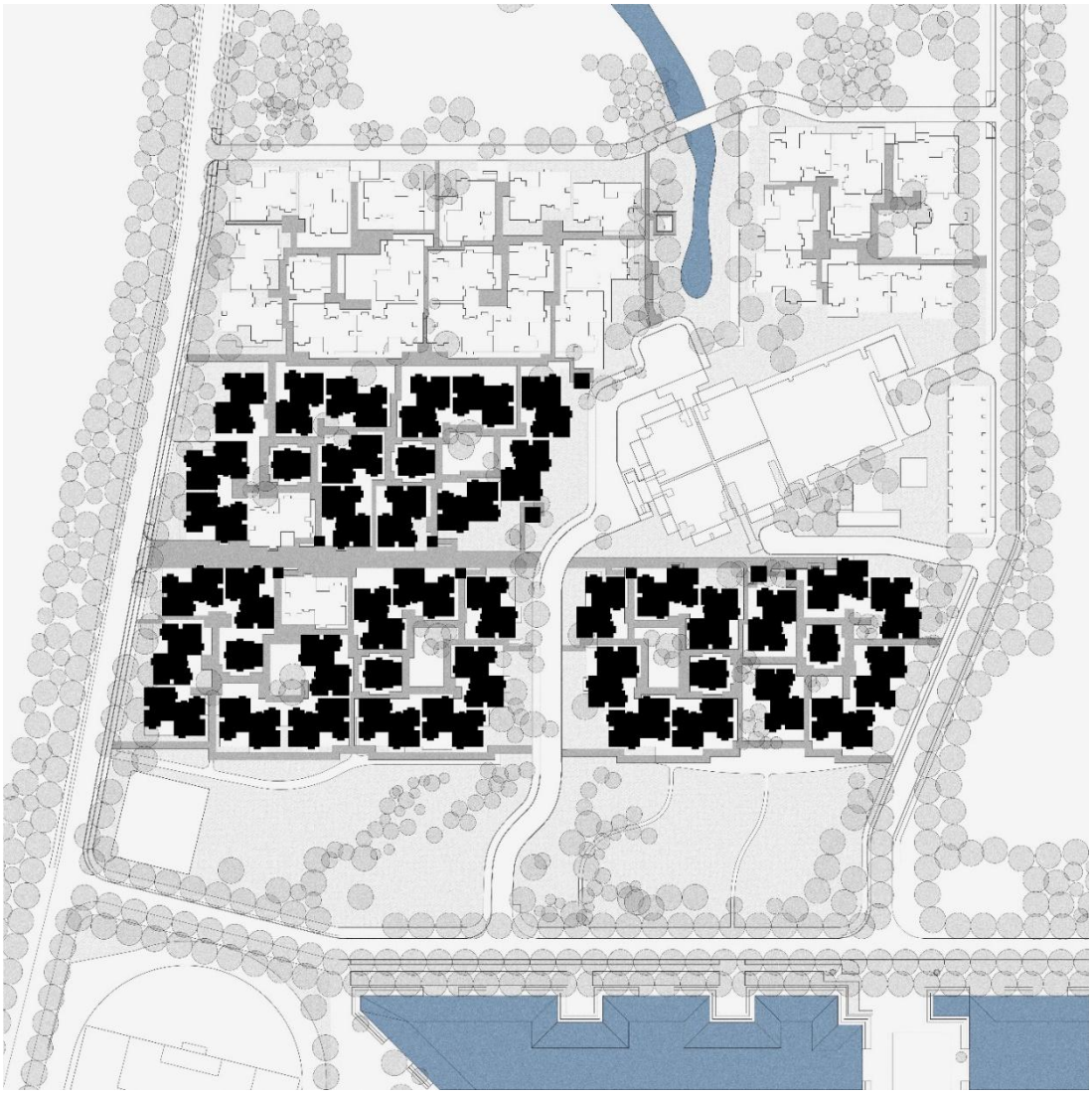
TENDER FOR CONSTRUCTION AND DEVELOPMENT WORKS OF 38 NOS. STUDENT HOSTEL BUILDINGS AT

NALANDA UNIVERSITY, RAJGIR



TECHNICAL SPECIFICATIONS PART- II

(SERVICES WORKS)

TECHNICAL SPECIFICATIONS FOR MEP SERVICES PART-II

1. SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Drawings, Specifications and Schedule of Quantities confirming the BEE 5 star ratings as per the latest norms and GRIHA LD. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Owner's site representative. The contractor shall furnish all labour, materials and equipment (except those to be supplied by the owner) as listed under Schedule of Quantities and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete Plumbing system as described in the Specifications and as shown in the drawings. This also includes any material, equipment, appliances and incidental work not specifically mentioned herein or noted on the Drawings/Documents as being furnished or installed, but which are necessary and customary to be performed under this contract. The Plumbing System shall comprise of following:

a) Sanitary Fixtures and Fittings.

b) Cold Water Supply and Hot Water Supply

c) Internal drainage

d) External Drainage

e) Civil and Miscellaneous items

f) Plumbing pumps, equipment and electrical panel including connection to the various equipment.

g) Water Treatment Plant

h) Chilled Drinking Water system

i) Wiring & Earthing from MCC panels to various plumbing, control wiring & interlocking.

j) Other Miscellaneous Items.

k) Cutting holes, chases & like through all types of walls /floors and finishing for all services crossings, including sealing, framework, fire proofing, providing sleeve, cover plates, making good structure and finishes to an approved

standard.

l) Balancing, testing & commissioning of the entire plumbing system.

m) Test reports, list of recommended spares, as-installed drawings, operation & maintenance manual for the entire plumbing system.

n) Training of Owner's staff.

o) Compliance on BEE 5 Star rating and GRIHA LD, 5 star certifications.

p) All associated ELECTRICAL WORKS shall be installed by in accordance with approved shop drawings of, and under direct supervision of the contractor.

q) The main civil contractor shall engage the specialized agencies or OEMs, or manufacturer or System Integrator of the domain concerned after approval of the University Engineer. The techno commercial credentials inline of the CPWD guidelines will be evaluated and approved by the EIC upon submission of the documents by main civil contractor.

2. ASSOCIATED CIVIL WORKS

Following civil works associated with Plumbing installation are excluded from the scope of this contract. These shall be executed by other agencies in accordance with approved shop drawings of, and under direct supervision of the Plumbing contractor.

i. RCC foundation for machines, pumps & large equipment with angle iron frame work at the edges to protect these from damage.
ii. RCC work for water tanks
iii. PCC foundation blocks with angle iron framework edging for all motor control centre.
iv. Water proofing of floors.
v. Masonry drain channels and sumps in plant room.

3. ASSOCIATED SERVICES WORKS

All associated ELECTRICAL WORKS shall be installed by in accordance with approved shop drawings of, and under direct supervision of the contractor.

The main civil contractor shall engage the specialized agencies or OEMs, or manufacturer or System Integrator of the domain concerned after approval of the University Engineer. The techno commercial credentials inline of the CPWD guidelines will be evaluated and approved by the EIC upon submission of the documents by main civil contractor.

4. BUILDING AUTOMATION SYSTEM

The scope of Plumbing Contractor shall include the following for the interface to Building Automation System, and no additional cost shall be paid for providing the interface feasibility.

i. Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.

ii. Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.

iii. Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all 1-phase equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.

iv. Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipelines.

v. The space provision in all the equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing contractor. Separate current transformers shall be provided by Plumbing contractor for monitoring current / KWH (wherever required) through BAS.

vi. The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing contractor. All transducers shall be supplied by BAS contractor.

vii. The low voltage BAS Cables shall be brought upto the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements of the Plumbing system, lies solely with the contractor.

viii. All necessary Hardware/ Software shall be made available by the Plumbing Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS.

5. IMPORTED EQUIPMENT

The successful tenderer shall submit upon award the following to facilitate the Owner in their application for concessional duty for equipment/material proposed to be directly purchased and imported by them.

a. Four copies of proforma invoice from Manufacturer/Supplier drawn in the name of Owner identifying FOB price from the country of origin and Freight cum Insurance up to site.

b. Four sets of Technical, Literature, high lighting model number and all technical details of the actual equipment/material offered by them.

c. Successful bidder shall indicate packing specification for imported equipment / material.

d. Successful bidder shall furnish undertaking from local agents for all imported equipment that they will provide all technical data & engineering information on the product through their principles, all back-up services during detailed engineering testing and commissioning and service during and after the defect's liability period.

6. PROJECT EXECUTION AND MANAGEMENT

The Contractor shall ensure that senior planning and erection personnel from his organization are assigned exclusively for this project. They shall have minimum 10 years experience in this type of installation. The Contractor shall appoint one Project Director holding senior management position in the organization. He shall be assisted on full time basis by a minimum of one erection engineers & two senior supervisors. The entire staff shall be posted at site on full time basis.

The project management shall be through modern technique. The Contractor's office at site shall be fully equipped with modem, computers, plotter and photocopier. Erection engineers and supervisors shall be provided with mobile communication system so that they can always be reached.

For quality control & monitoring of workmanship, contractors shall assign at least one full- time engineer who would be exclusively responsible for ensuring strict quality control, adherence to specifications and ensuring top class workmanship for the installation.

The Contractor shall arrange to have mechanized & modern facilities of transporting material to place of installation for speedy execution of work.

7. PERFORMANCE GUARANTEE

The contractor shall carry out the work in accordance with the Drawings, Specifications, Schedule of Quantities and other documents forming part of the Contract.

The contractor shall be fully responsible for the performance of the selected equipment (installed by him) at the specified parameters and for the efficiency of the installation to deliver the required end result.

The contractor shall guarantee that the Plumbing system as installed shall maintain the design conditions as described under "Basis of Design" and

relevant clauses in the specifications. The guarantee shall be submitted in the proforma given in Appendix-I.

Complete set of architectural drawings is available in the Architect/Consultant's office and reference may be made to same for any details or information. The contractor shall also guarantee that the performance of various equipment individually shall not be less than the quoted capacity; also, actual power consumption shall not exceed the quoted rating, during testing and commissioning, handing over and guarantee period.

8. BYE-LAWS AND REGULATIONS

The installation shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities concerned, in so far as these become applicable to the installation. But if these Specifications and Drawings call for a higher standard of materials and / or workmanship than those required by any of the above regulations and standards, then these Specifications and Drawings shall take precedence over the said regulations and standards. However, if the Drawings and specifications require something which violates the Bye-laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation.

9. SPECIFICATIONS

The detailed specifications given hereinafter are for the items of works described in the schedule of quantities attached herein, and shall be guidance for proper execution of work to the required standards. It may also be noted that the specifications are of generalized nature and these shall be read in conjunction with the description of item in schedule of quantities and drawings.

Work under this contract shall be carried out strictly in accordance with specifications attached with the tender.

Item not covered under these specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per specifications of the latest applicable standards with latest amendments as applicable in the contract or as directed by Engineer in Charge.

Works not covered under Para 2.1 and 2.2 shall be carried out as per relevant Indian standards specifications or codes of practice.

Unless specifically otherwise mentioned, all the applicable codes and standards published by the Indian Standard Institution and all other standards which may be published by them before the date of receipt of

tenders, shall govern in all respects of design, workmanship, quality and properties of materials and methods of testing, method of measurements etc.

Wherever any reference to any Indian Standard Specification occurs in the documents relating to this contract, the same shall be inclusive of all amendments issued there to or revisions thereof, if any, up to the date of receipt of tenders. In case there is no I.S.I. specification for the particular work, such work shall be carried out in accordance with the instructions in all respects and requirements of the Engineer-in-Charge.

For the items not covered under any of the specifications stated above, the work shall be executed as per manufacturers specifications/ General good engineering practice/ or as per direction of Engineer in charge and shall be carried out in a manner complying in all respects with the requirement of relevant byelaws of municipal corporation/ Development Authority etc. under the jurisdiction of which the work is to be carried out.

In case of any difference or discrepancy between specifications & the description of Schedule of Quantities, Schedule of Quantities shall take precedence. In case of any difference or discrepancy between specification and drawings, the drawings shall take precedence. In case any difference or discrepancy between the specifications for civil works and specification for Public Health Engineering works, specifications for civil works shall take precedence.

In case of any dispute arising out of the interpretation of any tender condition, the decision of Engineer-In-Charge shall be final and binding on the contractor.

Detail specifications for Sanitary & CP fittings like model/ makes shall be selected by Architect/ Owner and the same shall be binding for execution.

All electrical installation shall comply with the requirements of relevant Indian Standards, Indian Electricity rules & Indian Electricity Act amended up to date & local bye laws.

10. CONTRACTOR'S RATES

Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octroi and levies, breakage, wastage, excavation, refilling, bedding, encasing, transportation of lifts/leads and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

Rates quoted are for all heights and depths required for this work.

All rates quoted must be for complete items inclusive of all such accessories, fixtures and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item except where specially mentioned otherwise.

All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/ concrete of appropriate mix and strength as directed by Architect/ Engineer in Charge.

Rates quoted shall be inclusive of cost incurred in testing, commissioning of work and materials.

Rates quoted shall be inclusive of any rework to be carried on in the installation system due to the instructions given by Statutory/ Approval authority.

For all the items/ equipment's supplied free of cost by the Owner, the contractor's rate shall take care of transportation to the site, storage at site, installation, testing & commissioning of those items/equipment's.

All rates quoted by the contractor under this contract shall include bailing or pumping out of all the water which may accumulate during the progress of work either through seepage, springs, rain or any other cause.

All rates quoted by the contractor shall include all miscellaneous civil work related to Plumbing work like excavation, refilling, timbering, bedding, encasing, etc. required as per actual site condition.

All water and electricity charges for testing and commissioning of the system shall be borne by the contractor.

In case of discrepancy/ calculation error between rate & amount quoted by the contractor, the quoted rate shall be considered as final to derive the amount.

11. DRAWINGS

The Plumbing Drawings, which may be issued with tenders, are diagrammatic only and indicate arrangement of various systems and the extent of work covered in the contract. These Drawings indicate the points of supply and of termination of services and broadly suggest the routes to be followed. Under no circumstances shall dimensions be scaled from these Drawings. The architectural/interiors drawings and details shall be examined for exact location of equipment and water supply / drainage piping etc.

The contractor shall follow the tender drawings in preparation of his shop drawings, and for subsequent installation work. He shall check the drawings of other trades to verify spaces in which his work will be installed.

Maximum headroom shall be maintained at all points. Where headroom appears inadequate, the contractor shall notify the

Architect/Consultant/Owner's site representative before proceeding with the installation. In case installation is carried out without notifying, the work shall be rejected and contractor shall rectify the same at his own cost.

The contractor shall examine all architectural, structural, plumbing, electrical and other services drawings and check the as-built works before starting the work, report to the Owner's site representative any discrepancies and obtain clarification. Any changes found essential to coordinate installation of his work with other services and trades, shall be made with prior approval of the Architect/Consultant/Owner's site representative without additional cost to the Owner. The data given in the Drawings and Specifications is as exact as could be procured, but its accuracy is not guaranteed.

12. REFERENCE DRAWINGS

The contractor shall maintain one set of all construction drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion (as built) drawings. All changes to be made shall be initialed by the Engineer in charge.

One complete set of construction drawings shall be made available to the execution engineer & shall be maintained in good condition throughout the execution activities.

13. SHOP DRAWINGS

All the shop drawings shall be prepared on computer through Autocad System based on Architectural Drawings, site measurements and Interior Designer's Drawings. Within four weeks of the award of the contract, contractor shall furnish, for the approval of the Architect/Consultant, two sets of detailed shop drawings of all equipment and materials including layouts for Plant room, Pump room, Typical toilets drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; external insulation details for pipe insulation etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations. These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Architect/Consultant/Owner's site representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the

completion of all shop drawings. Minimum 12 sets of drawings shall be submitted after final approval along with CD.

Each item of equipment/material proposed shall be a standard catalogue product of an established manufacturer strictly from the manufacturers listed in Appendix-II and quoted by the tenderer in technical data part of Appendix-III.

When the Architect/Consultant makes any amendments in the above drawings, the contractor shall supply two fresh sets of drawings with the amendments duly incorporated along with check prints, for approval. The contractor shall submit further twelve sets of shop drawings to the Owner's site representative for the exclusive use by the Owner's site representative and all other agencies. No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/ installation.

Shop drawings shall be submitted for approval four weeks in advance of planned delivery and installation of any material to allow Architect/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

Manufacturers drawings, catalogues, pamphlets and other documents submitted for approval shall be in four sets. Each item in each set shall be properly labelled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials like valves, pipes, insulation, control wires etc shall be submitted to the Owner's site representative prior to procurement. These will be submitted in two sets for approval and retention by Owner's site representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed a mockup or sample installation shall be carried out for approval before proceeding for further installation.
Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supercede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

Where the contractor proposes to use an item of equipment, other than that specified or detailed on the drawings, which requires any redesign of the structure, partitions, foundation, piping, wiring or any other part of the mechanical, electrical or architectural layouts; all such re-design, and all

new drawings and detailing required therefore, shall be prepared by the contractor at his own expense and gotten approved by the Architect/Consultant/ Owner's site representative. Any delay on such account shall be at the cost of and consequence of the Contractor.

Plumbing Contractor shall prepare coordinated services shop drawings based on the drawings prepared by Electrical, HVAC, Fire protection & Low Voltage Contractors to ensure adequate clearances are available for installation of services for each trade.

Where the work of the contractor has to be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so directed by the Owner's site representative, the contractor shall prepare composite working drawings and sections at a suitable scale, not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make all the necessary changes without extra cost to the Owner.

Within four weeks of approval of all the relevant shop drawings, the contractor shall submit four copies of a comprehensive variation in quantity statement, and itemized price list of recommended (by manufacturers) imported and local spare parts and tools, covering all equipment and materials in this contract. The Project Manager shall make recommendation to Owner for acceptance of anticipated variation in contract amounts and also advise Owner to initiate action for procurement of spare parts and tools at the completion of project.

14. QUIET OPERATION AND VIBRATION ISOLATION

All equipment shall operate under all conditions of load without any sound or vibration which is objectionable in the opinion of the Owner's site representative. In case of rotating machinery sound or vibration noticeable outside the room in which it is installed, or annoyingly noticeable inside its own room, shall be considered objectionable. Such conditions shall be corrected by the Contractor at his own expense. The contractor shall guarantee that the equipment installed shall maintain the desired NC levels.

15. MATERIALS AND EQUIPMENT

All materials and equipment shall conform to the relevant Indian Standards and shall be of the approved make and design. Makes shall be in conformity with list of approved manufacturers as per Appendix - III.

16. MANUFACTURE INSTRUCTIONS

Where manufacturer has furnished specific instructions, relating to the material and equipment used in this project, covering points not specifically mentioned in these documents, such instructions shall be followed in all cases.

17. EXECUTION OF WORK

The contractor shall arrange to carry out all works with least interference practicable with public footpath and vehicular traffic and with existing waste water or storm water drainage arrangements and provide all necessary road barriers, fences, notices, lights, gangways, access crossings, diversions for traffic, temporary drains, dewatering channels, chutes pumping or water lifting arrangements and all other facilities for the proper execution of the works to the approval and satisfaction in all respects of the Engineer-in-Charge. Any work carried out by the contractor in this connection shall be deemed as temporary works incidental to the construction work.

For any free issue items by Owner, the contractor shall maintain the same properly & install as per good engineering practice.

No structural member shall be chased or cut without the written permission of the Architect/ Engineer in charge.

The work shall be executed in a manner complying in all respects with requirements of relevant bye-laws of the municipal corporation/Development Authority/ Applicable Statutory Authority, the jurisdiction of which the work is to be executed or as directed by the Engineer-In-Charge.

All plumbing services shall be handed over to Engineer-In-Charge complete in all respects. Incomplete work will not be taken over. Any loss or damage to these services due to any reasons by anybody whatsoever before handing over will be at contractors risk and cost, Any damage to any structural, finishing work done during the testing or rectification shall be made good by the contractor at his own cost and risk.

18. MATERIALS & WORKMANSHIP

All materials used in the works shall conform to the list of approved vendor in tender specifications. The approved samples shall be maintained at site till the completion of work.

As far as possible materials bearing I.S. certification marks shall be used with the approval of the Architect/ Engineer in Charge/ Engineer in charge.

Unless otherwise specified and expressly approved in writing by the Architect/ Engineer in Charge, materials of makes and specifications mentioned with tender shall be used. In case of any items, list of approved

vendors is not given; the contractor shall submit his recommendation to Engineer in charge with proper technical back up justifying the selection.

Workmanship and general finish shall be of first-class quality and in accordance with best workshop practice. All similar items of the Plant and their component parts shall be completely interchangeable.

Spare parts shall be manufactured from the same materials as the originals and shall fit all similar items.

Machining fits on renewable parts shall be accurate and to specified tolerances so that replacements made to may be readily installed.

All equipment shall operate without excessive vibration and with minimum noise.

All revolving parts shall be truly balanced both statically and dynamically so that when running at normal speeds at any load up to the maximum there shall be no vibration due to lack of balance.

All parts which can be worn or damaged by dust shall be totally enclosed in dust proof housings

All materials selected in the work shall be most suitable for duty concerned, free from imperfections, selected for long life and minimum maintenance.

All necessary accessories required for satisfactory and safe operation of the Plant shall be supplied by the Contractor unless it is specifically excluded from his scope.

All valves shall be closing on clockwise rotation of the hand wheel. The effort required to close/ open under all operating conditions shall be limited to 7 kg. The direction of opening/ closing shall be cast on the hand wheel.

All flanges shall be drilled in accordance with requirements of IS: 1538. All flanges shall be full or spot faces on the back side. The flange thickness shall be uniform throughout. Flange outside periphery shall be concentric with the bore. Flanges shall be finished smooth on periphery also Castings and fabricated materials shall be finished smooth all over.

19. INSPECTION AND TESTING OF MATERIALS

Contractor shall be required, if requested, to produce manufacturers test certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian standards.

Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for all mandatory tests.

Testing charges for optional tests shall be paid by the Dept. However, the incidental charges and cost of sample for testing shall be borne by the contractor.

In case of non-I.S. materials, it shall be the responsibility of the contractor to establish the conformity of material with relevant I.S. specification by carrying out necessary tests. Testing charges including incidental charge and cost of sample for testing shall be borne by the contractors for such tests.

The materials should pass all tests and tolerance in dimensional, chemical, physical properties should be within the limit as stipulated in relevant I.S. for acceptance. Such materials will be accepted as standard.

Payments shall be restricted to standard unit mass, or as specified in the schedule, without making any cost adjustment towards mass or any other properties provided the material pass all the tests and tolerance are within the specified limit.
For examination and testing of materials and works at the site contractor shall provide all testing and gauging equipment necessary but not limited to the followings:

a) Theodolite b) Dumpy level c) Steel tapes d) Weighing machine e) Plumb bobs, spirit levels, Hammers f) Micrometers g) Thermometers, Stoves h) Hydraulic test machine i) Smoke test machine.

All such equipment shall be tested for calibration at any approved laboratory, if required by the Architect/Engineer in Charge.

All testing equipment should be preferably located in special room meant for the purpose.

20. MOCK UP

The contractor shall install all pipes, fixtures, clamps and accessories and fixing devices in mock-up shaft and room so constructed as directed by Architect/ Engineer in Charge without any cost. The materials used in the mock-up may be reused in the works if found undamaged.

The contractor shall have to assemble at least one set of each type of sanitary fixtures and CP fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to determine the location of puncture holes, holding devices etc. which will be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the Architect/ Engineer in Charge/ Engineer In charge.

Any tiles or finished surfaces or floors damaged by the contractor while doing his work shall be made good with new tiles or other finishing material. No payment shall be admissible for such repairs. The Architect / Engineer in

Charge may, at his discretion get the damaged work repairs to the contractor.

21. REFERENCE POINTS

Contractor shall provide permanent benchmarks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

All such reference points shall be in relation to the levels and locations given in the Architect/ Engineer in Charge and plumbing drawings.

22. ELECTRICAL INSTALLATION

The electrical work related to Plumbing services, shall be carried out in full knowledge of, and with the complete coordination of the contractor. The electrical installation shall be in total conformity with the control wiring drawings prepared by the contractor and approved by the Architect/Consultant. All equipment shall be connected and tested in the presence of an authorized representative of the contractor.
The Plumbing system shall be commissioned only after the contractor has certified in writing that the electrical installation work for Plumbing services has been thoroughly checked, tested and found to be totally satisfactory and in full conformity with the contract Drawings, Specifications and manufacturer's instructions. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the electrical installation work for Plumbing services, lies solely with the contractor.

23. SITE CLEARANCE AND CLEANUP

The contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

After the fixtures, equipment and appliances have been installed and commissioned, contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

On completion of all works, contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at contractors' risk and cost.

24. BALANCING, TESTING AND COMMISSIONING

Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

Tests shall be performed in the presence of the Engineer in Charge. The engineer in charge shall issue a certificate for approved testing of all systems duly signed & stamped.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

Contractor shall provide all labour, equipment and materials for the performance of the test.

After completion of work and during the maintenance liability period of contract, the work shall be subjected to "Post construction and testing". In case, if the materials incorporated in the work are found to be inferior, though the sample collected from the materials might have been passed at the time of execution, it shall be the responsibility of the contractor to replace the same without any cost to the Owner failing which the Owner may rectify the same at the risk and cost of the contractor or the Owner may accept the same as substandard, and cost be adjusted from the outstanding security deposit as per the terms and condition of the contract for the work.

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guidelines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect/Consultant and Owner's site representative.

"Preventive Maintenance Schedule for each equipment / panel shall be submitted along with Operation and Maintenance Manual".

25. UPTIME GUARANTEE

The contractor shall guarantee for the installed system an up time of 99%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall. In case of shortfall beyond the defects liability period, the contract for Operation and Maintenance shall get extended by a month for every month having the shortfall and no reimbursement shall be made for the extended period.

The Contractor shall provide log in the form of diskettes and bound printed comprehensive logbook containing tables for daily record of all pressures, power consumption. starting and stopping times for various equipment, daily services rendered for the system alarms, maintenance and record of unusual observations etc. Contractor shall also submit preventive maintenance schedule.

Each tenderer shall submit along with the tender, a detailed operation assistance proposal for the Owner's site representatives/Consultant's review. This shall include the type of service planned to be offered during Defects Liability Period and beyond. The operation assistance proposal shall give the details of the proposed monthly reports to the Management.
The tenderer shall include a list of other projects where such an Operation Assistance has been provided.

APPENDIX – I GUARANTEE PROFORMA

GUARANTEE FOR PLUMBING INSTALLATION

We hereby guarantee the year round Plumbing system which we have installed In The Complex Described Below :

Building : Nalanda University
Location : Rajgir (Bihar)

For a period of --- Months from the date of acceptance of the total installation, WE AGREE TO repair or replace to the satisfaction of the Owner, any or all such work that may prove defective in workmanship, equipment or materials within that period, ordinary wear and tear and unusual abuse or neglect excluded, together with any other work, which may be damaged or displaced in so doing. In the event of our failure to comply with the above-mentioned conditions within a reasonable time, after being notified in writing, we are collectively and separately, do hereby authorize the Owner to proceed to have the defects repaired and made good at our expense, and we shall pay the cost and charges thereof, immediately upon demand.

We also hereby undertake to test the entire installation in first summer, winter and monsoon on following the completion of the installation, to check and do everything necessary to ensure that the specified design conditions and functional requirement are met, that all water, sewage, air pollution control systems are properly balanced, that all controls are calibrated accurately, and that all units are functioning satisfactorily.

SIGNATURE OF CONTRACTOR
for PLUMBING SYSTEM

TECHNICAL SPECIFICATIONS FOR ELECTRICAL SERVICES

SUMMARY PAGE

ELECTRICAL MATERIAL SPECIFICATION

SUBSTATION & AUXILIARIES INSTALLATION

1.1 Scope :

The specification covers H. T. cable laying and H. T. joints of outdoor type and certain safety materials required to be kept in the substation for the safety purposes. The SCADA system shall be provided with all Panels and it will be integrated by the contractor through its specelsied contractor or system integrator or manufacture with existing central SCADA. All Panels shall be TTA. Automation compatible with necessary communicable protocols (as per the approval of Nalanda University) including hardware and software and with SCADA/PLC systems.

1.2 HIGH VOLTAGE XLPE –FRLS CABLE

1.2.1 H. V. Cable type

11KV unearthed grade with standard and compacted aluminum conductor triple extruded semi conducting compound screen extruded XPLE insulated (dry cured) with triple extruded semi conducting compound with a layer of non magnetic metallic tape for insulation screen extruded PVC (ST-2) inner sheathed (for multi-core cable) extruded FRLS PVC 9 (TYPE ST-2) outer sheathed cables conforming to IS-7098part_2

Cables shall be capable of operating at a sustained conductor temperature of 90 C and suitable for a maximum conductor short- circuit temperature of 250 C.

This specification gives the requirement of cable. However, it is the responsibility of the contractor to obtain clients approval before the purchase of cable.

1.2.2 REFERENCE CODES & STANDARDS

IS-8130-1984 - Conductors of Insulated Cables.
IEC-228 - Conductors of Insulated cables.

IEC-230	-	Impulse Tests on cables and their accessories.
IEC-502	-	Extruded Solid Dielectric-Insulated Power Cables for rated voltage from 1 KV up to 30 KV.
IEC-540	-	Test Methods for Insulation and Sheaths of Electric cables and chords.
IEC-229	-	Test on Cable over sheaths which have a special protective functions and are applied by extrusion.
IEC-287	-	Calculation of continuous current rating of cables (100% load factor).
IS-708(part-II)	-	Cross linked polyethylene insulated PVC sheathed cable for voltage from 3.3 KV upto 33 KV.
IS-5831-1984	-	PVC insulation & sheath for electrical cables.
IS-3975	-	Mild steel wires / strips and tapes for armouring of cables.
IEC-885(2)-1987-		Electrical test methods for electric cables part-II partial discharge test.
IS-10810	-	Methods of test for cables.
IEC-811	-	Common test methods for insulating and sheathing materials of electric cables.
IEC-230	-	Impulse test on cables & other accessories.
IEC-859	-	Cable termination for gas insulated switchgear.

1.2.3 OPERATING CONDITIONS

Electric System

- System Voltage 11.0 KV RMS
- Frequency 50 Hz.
- Short Circuit current 21 KA for 1 Second.

Environment

- Ground Temperature 45° C
- Design Ambient Air temperature 50° C
- Atmospheric Conditions Dry and dusty

1.2.4 CONSTRUCTION

a) Conductors

The conductors shall be of circular stranded Copper to IEC- 228. Sizes shall be from 3x50 mm^2 upto 3x400 mm^2. Final cable sizes shall be approved by Client. The conductors shall be compacted stranded circular. It shall be clean, reasonably uniform in size & shape smooth & free from harmful defects. Any other form of conductor may also be accepted if in line with modern trends.

b) Semi conducting barrier tape / tapes

The semi conducting barrier tape/tapes shall be provided over the conductors.

c) Conductor Screen

The conductor screen shall consists of an extruded layer of thermosetting semi-conducting compound which shall be extruded simultaneously with the core insulation.

d) Insulation

The insulation shall be super clean XLPE compound applied by extrusion and vulcanized to form a compact homogeneous body.

e) Insulation Screen

Each insulation have an insulation screen in two parts consisting of
(I) A water barrier tape/ Non-metallic semi conducting sellable tape part and a metallic screen part
(ii) The non-metallic part shall be directly applied upon the insulation of each core and may consist of an impregnated butylnylon tape or a similar approved material or, an extruded semi-conducting material extruded simultaneously with the conductor screen and insulation (triple extrusion).
The semi-conductor shall be readily strippable and must not be bonded in such a manner that it has to be shaved or scraped to remove.

The metallic part shall consist of a copper tape helical applied with a 30 % overlap. Over the water barrier tape/ blocking tape. A binder tape of copper shall be applied over the copper wire metallic screen.

f) Laying Up

The cores shall be identified on the non-metallic part of the insulation screen by legible printing on the length of each conductor or, by the inclusion of a marker tape.

The cores shall be laid up with a right-hand direction of lay.

Binder tape /Moisture barrier

During lay up, a suitable open spiral binder may be applied, at the manufacturers discretion, before the application of an extruded inner covering.

g) Fillers

Fillers shall be polypropeline.

h) Inner Covering /Sheath

The inner covering shall be extruded over the laid up cores to form a compact and circular bedding for the metallic layer.

i) Metallic Layer

The metallic layer shall be round galvanized steel wire.

j) Outer sheath

The outer sheath, black colored FRLS polyethylene for the operating temperature of the cable shall be provided over the armour as specified in relevant standards by extrusion process.

k) Cable Marking

- Embossing of outer sheath :

The PVC outer sheath shall be legibly embossed with the legend : "ELECTRIC CABLE 11000/11000 VOLT"

The letter and figures shall be raised and shall consist of upright block characters. The maximum size of the characters shall be 13 mm and the minimum size 15 % of the cable circumference or 3 mm whichever be the greater. The gap between the end of one set of embossed characters as above and the beginning of the next shall not exceed 150 mm.

- Identification of Manufacturer & year of manufacture.

An identification of the manufacturer and indication of the year of manufacture shall be embossed at regular intervals on the PVC outer sheath. This shall not affect the spacing between repetitions of the legend as given above.

1.2.5 Sealing and Drumming

After tests at the manufacturers works, both ends of the cable shall be sealed to prevent the ingress of moisture during transportation and storage.

Cable shall be supplied in lengths of 500 meters on non- returnable drums of sufficiently sturdy construction.

The spindle hole shall be 110 mm minimum diameter.

Each drum shall bear on the outside flange, legibly and indelibly in the English language, a distinguishing number, the manufacturer's name and particulars of the cable, i.e. Voltage, length, conductor size, cable type, insulation type and gross weight shall also be clearly visible. The direction for rolling shall be indicated by an arrow.

e.g. Manufacturer's Name :
11/11 K.V. 3 x 185 mm^2 Aluminum XLPE drum Number.

1.2.6 TESTING

Type tests and Routine tests shall be carried out in accordance with the relevant IEC standards/IS.

1.3 H. V. CABLE TERMINATION

The cable joints shall be suitable for the outdoor application with EPDM (ethylene Propylene Diene Monomer) Rubber Components. The joint should

impair optimum combination of both impulse strength of the termination and field grading at the outer semi conducting screen edge. There should not be formation of air pockets in the joints and also formation of cavities should be avoided. Creepage should be approximately 4 cm/KV. The joint should have flame retardant properties and should be easily re-opened. The joint should confirm to IS 13573.

1.4 Safety Equipment (Rubber mats, rubber gloves, First aid kit, Sign boards, Sand Buckets, Fire Extinguishers etc.)

The Danger notice labels shall be made on indestructible non deteriorating material with lettering engraved in red, black, white background except where otherwise specified. The letters shall be atleast of 12 MM and shall be of radium sticker type so as to be visible in the night time also.

Rubber mats, Rubber gloves, boots shall confirm to the safety equipment standard and shall with ISI approval.

Sand Buckets and Fire extinguishers shall be as per the fire safety norms and shall be operated as specified in the item.

Emergency lights shall be with maintenance free rechargeable batteries.

LT SWITCHGEAR & POWER PANEL

1.0 PARTIALLY TYPE TESTED PANEL

1.1 Scope:

The scope covers supply, installation, testing and commissioning of power panels, incorporating circuit breakers, fuse units, busbars, interconnections, earthing etc., meeting the requirements shown in equipment schedule and the drawings. These panels shall be manufactured by authorized/ approved franchisee of OEMs for IS 8623 panel assemblies.

1.2 Standards:

AS PER SCHEDULE OF INDIAN STANDARD; ATTACHED WITH THE DOCUMENT.
The PCCs & MCCs shall comply with the latest edition of relevant Indian standards and Indian Electricity rules and regulations. The following Indian Standards shall be complied with:

IS : 4237: General requirements for switch gear and control gear for voltage not exceeding 1000v.
IS : 375: Switchgear bus-bars, main connection and auxiliary wiring, marking and arrangement.
IS : 2147: Degree of protection provided by enclosures for low voltage switch gear and control gear.
IS : 8197: Terminal marking for electrical measuring instrument and their accessories.

IS : 2516: Specification for AC circuit breaker.
IS : 8623: Specification for factory built as symbolize of switch gear and control gear for voltage up to and including 1000v. A.C.& 1200 v. D.C.
IS : 8828: Miniature Circuit Breaker.
IS : 2705: Current transformer.
IS : 3155: Voltage transformer.
IS : 3231: Electrical relay for protection.
IS : 1248: indicating instrument.
IS : 6875 : Control switches & push buttons.
IS : 2959 : Auxiliary contactor.
IS : 13947: Switch Board General Requirement

1.3 TYPE OF M.V. SWITCH GEAR:

All the PCC's / PDB's / MCC's shall be metal clad, totally enclosed, rigid, floor / wall mounted, air - insulation, cubical type suitable for operation on three phase / single phase, 415 / 230 volts, 50 Hz. neutral effectively / Non effectively grounded at transformer. The PCC's / MCC's shall be designed the withstand and heaviest condition at site and should be IEC 61439.

1.4 STRUCTURE:

The PCCs, MCCs & PDBs shall be metal clad enclosed and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor mounting type. All CRCA sheet steel used in the construction of PCCs / MCCs / PDBs shall be 2 mm thick and shall be folded and braced as necessary to provided a rigid support for all components. Joints of any kind in sheet shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal.

The PCCs / MCCs / PDBs shall be totally enclosed, completely dust and vermin proof and degree of protection being not less than IP42 to IS 2147. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasket with foam rubber and / or rubber strips and shall be lockable. All panels and covers shall be properly fitted and secured with the frame, and holes in the panel correctly positioned. Fixing screw shall enter into holes taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of PCCs / MCCs / PDBs.

PCCs / MCCs /PDBs shall arranged in multi-tier formation. The PCCs / MCCs / PDBs shall be of adequate size with a provision of 20 percent spare space to accommodate possible future additional switch gear. The size of the PCCs / MCCs/ PDBs shall be designed in such a way that the internal space is sufficient for hot air movement, and the electrical component does not attain temperature more than 45 degree celsius. If necessary openings shall provided for natural ventilation, but the said openings shall be screened with fine weld mesh. Knockout holes of appropriate size and number shall be provided in the PCCs /

MCCs/ PDBs in conformity with number, and size of incoming and outgoing conduits / cables. Alternatively the PCCs / MCCs / PDBs shall provided with removable sheet plates at top and bottom to drill holes for cable / conduit entry at site. The PCCs / MCCs / PDBs shall be designed to facilitate easy inspection, maintenance and repair. The PCCs / MCCs / PDBs shall be sufficiently rugged in design and shall support the equipment without distortion under normal and short circuit condition, they shall be suitable braced for short circuit duty.

1.5 PROTECTION CLASS:

All the indoor PCCs / MCCs / PDBs shall have protection class as applicable BIS.

1.6 PAINTING :

All sheet steel work shall undergo a process of decreasing pickling in acid, cold rinsing, phosphating, passivating and then sprayed with a high corrosion resistant primer. The primer shall be backed in an oven. The finishing treatment shall be by application. Three coats of synthetic enamel paint of approved colour shall be applied by spray and stoves in dust free atmosphere or the panel shall be powder coated.

- Nano Ceramic Coating
- Intermittent Coating – Zinc rich premier
- Powder Coat – Epoxy Polyester

1.7 CIRCUIT COMPARTMENT:

Each circuit breaker and switch fuse units shall be housed in separate compartments and shall be enclosed an all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker / switch fuse units in ON and OFF position. Safety interlocks shall be from being drawn out when the breaker is in ON position. The door shall not form as integral part of the drawout position of the circuit breaker. All instruments and indicating lamp shall be mounted on the compartment door. Sheet steel barriers shall be provided between the tires in a vertical section.

1.8 INSTRUMENT COMPARTMENT

Separate and adequate compartment shall provided for accommodating instruments, indicating lamp, control contactors, relays and control fuses etc. These components shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, switch fuse units, busbars and connections.

1.9 BUSBARS

The busbar shall be air insulated and made high quality, high conductivity, high strength copper / Aluminium and as per relevant IS code. The busbar shall of

three phases and neutral system with separate neutral and earth bar. the busbar and interconnection between busbar and various components shall be of high conductivity, hard drawn, electrolytic copper. the busbar shall be of rectangular cross section designed to withstand full load current for phase busbar and full rated current for neutral busbar and shall be extensible type on either side.

The busbar and interconnection shall be insulated with heat shrinkable PVC sleeves and be colour coded in red, Yellow, Blue and Black to identify the three phases and neutral of the system. The busbar shall be supported on unbreakable, non-hygroscopic DMC insulated supports at sufficiently close interval to prevent busbar sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity of 50 KA or as per I/C breaker RMS symmetrical for one second and a peak short circuit withstand of 105 KA minimum. The busbar shall be housed in a separate compartment. The busbar shall be isolated with 3 mm thick Bakelite sheet to avoid any accidental contact. The busbar shall be arranged such that minimum clearance between the busbar are maintained as per below.

Between phases :27 mm min.
Between phases and neutral :25 mm min.
Between phases and earth :25 mm min.
Between neutral and earth :23 mm min.

All busbar connection shall be done by drilling holes in busbars and connecting by chromium plated brass bolt and nuts. Additional cross section of busbar shall be provided in all PCCs / MCCs / PDBs to cover-up the holes drilled in the busbars. Spring and flat washers shall be used for tightening the bolts. All connection between busbar and circuit breaker / switches and between circuit breaker/ switches and cable terminals shall be through solid copper strips above 100A and of proper size to carry full rated current. These strips shall be insulated with insulating strips.

1.10 ELECTRICAL POWER & CONTROL WIRING CONNECTION

Terminal for both incoming and outgoing cable shall be suitable for 1100 volts grade, aluminum/copper conductor XLPE insulated and FRLSH sheathed, armoured cable and shall be suitable for connections of solder less sockets for the cable size as indicated on the appended drawing for the PCCs, MCCs, PDBs. Both control and power wiring shall be brought out in cable alley for ease of external connections, operation and maintenance. Both control and power terminals shall properly be shrouded. 10% spare terminal shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire connected per terminal.

Terminal strip for power and control shall preferably be separated from each other by suitable barriers of enclosures. Wiring inside the module for power, control protection and instrument etc. shall be done with use of 660/1100 confirming to IS 694 and IS 8130. Power wiring inside the starter module shall be rated for full current rating of contactor, but not less than 4 sq mm cross

section area. For current transformer circuits, 2.5 sq mm FRLSH copper conductor wire shall be used. Other control wiring shall be done with 2.5 sq mm FRLSH copper conductor wires. Wires for connections to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.

Control power for the motor starter module shall be taken from the respective module switchgear outgoing from R phase and Neutral. Control wiring shall have control MCB / fuse (HRC type). Particular care shall be taken to ensure that the layout of wiring neat and orderly. Identification ferrules shall be filled to all the wire termination for ease of identification and to facilitate and testing. "CUPAL" washers shall be used for all copper and aluminum connections. Final wiring diagram of the PCC, MCC, PDB power and control circuit with ferrules number shall be submitted along with the PCC/ MCC/ PDB as one of the documents.

1.11 TERMINALS

The outgoing terminals and neural link shall be brought out to a cable alley suitably located and accessible from the panel front. The current transformer for instrument metering shall mounted on the disconnecting type terminal blocks. No direct connection of incoming and outgoing cables to internal components connection of the distribution board is permitted, only one conductor may be connected in one terminal.

1.12 WIREWAYS

A horizontal FRLSH wire way with screwed covers shall provided at the top to take interconnecting control wiring between different vertical sections.

1.13 CABLE COMPARTMENT

Cable compartment of adequate size shall be provided in the PCCs, MCCs, PDBS for easy termination of all incoming and outgoing cables entering from bottom or top. Adequate support shall be provided in the cable compartment shall be brought out to terminal blocks in the cable compartment.

1.14 EARTHING

Copper earth busbar as per BOQ shall be provided in the PCCs, MCCs, PDBS for the entire length of panel. The frame work of the PCCs, MCCs, PDBs shall be connected to this earth busbar. Provisions shall be made for connection from earth busbar to the main earthing bar coming from the earth pit on both side of the PCCs, MCCs, PDBs.The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp and the clamp shall be ultimately bounded with the earth bar.

1.15 LABELS

Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the

distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.

1.16 NAME PLATE

A name plate with panel designation in bold letter shall be fixed at top of the central in panel. A separate name plate giving feeder giving feeder details shall be provided for each feeder module door. Inside the feeder compartment, the electrical component, equipment, accessories like switchgear, contactor, lamp, relays etc. shall suitably be identified by providing stickers. Engraved name plates shall preferably be of 3 ply, (red-white-red or black-white-black) lamicold sheet. However black engraved perplex sheet name plates shall also be applicable. Engraving shall be done with square groove cutters. Name plate shall be fastened by counter sunk screws and not by adhesives.

1.17 DANGER NOTICE PLATE

The danger plate shall be affixed in a permanent manner on operating side of the panel. The danger notice plate shall indicate danger notice both in Hindi and English and with a sign of skull and bones. The danger notice plate in general shall meet to requirements of local inspecting authorities. Overall dimension of the danger notice plate shall be 200 mm wide and 150 mm high. The danger notice plate shall be made from minimum 1.6 mm thick mild steel sheet and after due pretreatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate. The letter, the figure, the conventional skull and bones shall etc. shall be positioned on the plate as per recommendations of IS : 2551-1982. The said letter, the figure and the sign of skull and bones be painted in single red colour as per IS : 5-1978. The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit design of the panel. The danger notice plate, if possible, be of ISI certification mark.

1.18 INTERNAL COMPONENTS

The PCC / MCC / PDB shall be equipped complete with all type of required number of air circuit breakers, switch fuse unit, contactor, relays, fuses, meters, instruments, indicating lamps, push buttons, equipment, fittings, busbar, cable boxes, cable glands etc. and all the necessary internal connections /wiring as required and as indicated on relevant drawings. Components necessary for proper complete functioning of the PCC / MCC / PDB but not indicated on the drawings shall be supplied and installed on the PCC / MCC / PDB.

All part of the PCC / MCC/ PDB carrying current including the components, connections, joints and instruments shall be capable of carrying their specified rated current continuously, without temperature rise exceeding the acceptable values of the relevant specifications at any part of the PCC / MCC / PDB. All units of the same rating and specifications shall be fully interchangeable.

1.19 INSPECTIONS

Each equipment should inspect and witness by client & consultant. The PCC / MCC / PDB shall be inspected and checked as per inspection manual of the PCC / MCC / PDB manufacturer. Various electrical components and accessories of the PCC / MCC / PDB shall be checked as per drawing for the respective PCC / MCC / PDB. The PCC / MCC / PDB shall be checked for rigid mounting, earthing connections, proper rating and size of components, internal wiring, etc. All mechanical fasteners and electrical connections shall be checked and tightened before installation. Type test certificates for all ACB for similar rating shall be submitted. Prior to dispatch of the PCC / MCC / PDB minimum following tests shall be carried out, however not limited to this.

- Mechanical endurance test shall carried out by closing and opening of all the ACB's, MCB's switches etc.
- Over voltage and Insulation resistance test shall be carried out between phases and between phase to earth bus, keeping the isolating switch in ON position. Similar test shall be carried out keeping the isolating switch in closed position.
- All the interlocks, controls and tripping mechanism of the switch gears shall be tested for their proper functioning.

1.20 COMPONENTS :

The type, size, and rating of the components shall be as indicated on the relevant drawings. While selection of the capacity of the components resulting from the prevailing conditions like room temperature shall be allowed for the Thermal and magnetic trip rating shall be compensated for the ambient temperature. The rating indicated on the drawings are rating anticipated at prevailing site condition.

A) SWITCHGEAR : LT Air Circuit Breakers

General

The circuit breakers shall be of the air break type, robust and compact design suitable for indoor mounting and shall comply with the requirement IEC 60947-1 and 2. Rupturing capacity shall be as stipulated in Schedule of quantities. The breaker shall comply with the isolation function requirement of IEC 60 947-2 section 7.12 to be marked as suitable for isolation / disconnection to facilitate safety of operating personal while the breaker is in use. The breaker shall provide class II insulation between the front panel and internal power circuits to avoid any accidental contact with the live main current carrying path with the front cover open. Protective devices, metering, CTs, PTs, push buttons and indicating lamps shall be provided as per schedule of quantities.

Constructional Features

The Circuit Breaker shall be flush front, metal clad, horizontal draw-out pattern, three/four pole as required and fully interlocked. Each Circuit Breaker shall be housed in a separate compartment enclosed on all sides.The Circuit Breaker cradle shall be designed and constructed to permit smooth withdrawal

and insertion. The movement shall be free of jerks, easy to operate. Mechanical Latch to be provided to identify the Isolated, test & service position of breaker to prevent over racking.

All current carrying parts in the breaker shall be silver plated and suitable arcing contacts shall be provided to protect the main contacts which shall be separate from the main contacts and easily replaceable. In addition, Arc chutes shall be provided for each pole, and these shall be suitable for being lifted out for the inspection of the main and the arcing contacts, preferably with or without any tool. The circuit breaker shall have indication of mechanical wear of contacts enabling visible indication of contact life. Self-aligning cluster type isolating contacts shall be provided for the Circuit Breaker, with automatically operated shutters to screen live cluster contacts when the Breaker is withdrawn from the cubicle. Sliding connections including those for the auxiliary contacts and control wiring shall also be of the self-aligning type. The fixed portion of the sliding connections shall have easy access for maintenance purposes.

There Shall be preferably flexibility in changing the types of terminals at site/ manufacture works to suit the bus bar orientation if required. ACB frame size shall be optimum designed for carrying rated currents. All 4 Pole ACBs shall be of 100% N capacity.

Operating Mechanism

The Circuit Breaker shall be trip free with independent manual spring operated or motor wound spring operated mechanism as specified and with mechanical ON/OFF indication. The operating mechanism shall be such that the circuit breaker is at all times free to open immediately the trip coil is energized. The breaker shall be provided with anti-pumping mechanism. The closing time shall be less than or equal to 80 ms to ensure faster closing of the breaker. And tripping time should be less than 50 ms to reduce the let through energy in the event of fault.The operating handle and mechanical trip push button shall be at the front of and integral with the Circuit Breaker. There shall be electrical/ mechanical indicator on the front panel for 'Ready to close' situation for the breaker by checking all interlocking.

The Circuit Breaker shall have the following four distinct and separate positions and Service, Test & Isolated positions shall be confirmed by Electrical Position Indicator/ on the face of the panel. The breaker shall get latched in each of three position namely Service, Test and Isolated, operator to de latch before racking in/out to other position

- "Service" -- Both main and secondary isolating contacts closed
- "Test" -- Main isolating contacts open and secondary isolating contacts closed
- "Isolated" -- Both main and secondary isolating contacts open
- "Maintenance" -- Circuit Breaker fully outside the panel ready for maintenance

Locking arrangement for each of above position shall be provided

Circuit Breaker Interlocking

Sequence type strain free interlocks shall be provided to ensure the following: It shall not be possible for the Breaker to be withdrawn from the cubicle when in the "ON" position. To achieve this, suitable mechanism shall be provided to lock the Breaker in the tripped position before the Breaker is isolated. It shall not be possible for the Breaker to be switched "ON" until it is either in the fully inserted position or, for testing purposes, it is in the fully isolated position. It shall not be possible for the Circuit Breaker to be plugged in unless it is in the OFF position.

For operator/ installation safety, it is preferred that ACB closing shall not be possible without properly securing the arc chutes. A safety latch shall be provided to ensure that the movement of the Breaker, as it is withdrawn, is checked before it is completely out of the cubicle, thus preventing its accidental fall due to its weight. For planning periodic maintenance, mechanical operation counter shall be provided for each ACB. Mechanical and electrical anti-pumping devices shall be incorporated in the ACB's as required.

Circuit Breaker Auxiliary Contacts

The Circuit Breaker shall have suitable free / minimum 4 NO/NC auxiliary contacts rated at 10 amps 415 volts 50 Hz. These contacts shall be approachable from the front for connecting all external wiring from the front. They shall close before the main contacts when the Circuit Breaker is plugged in and vice versa when the Circuit Breaker is Drawn Out of the cubicle.

All electrical auxiliaries, including the spring charging gear motor shall be instalable on site without requiring adjustment or any tools other than a screw driver. The auxiliaries shall be placed in a compartment which under normal operating conditions, shall not contain any conducting parts capable of entering into electrical contact with the circuit breaker poles. It shall be possible to connect all auxiliary wiring from the front of the circuit breaker.

Circuit breaker Releases Air Circuit breaker (ACB)

ACB shall comply with standards IS/IEC 60947-1 & 2. ACB shall have a rated operational voltage of 690V AC, rated insulation voltage of 1000 volts AC, rated impulse voltage of 12kV. ACB front facia shall be IP 42 with or without cover rating/ details of all fitted accessories, vis. Shunt, U/V, Mechanical operation counter, details, closing coil details, etc. shall be visible thru. front facia. ACB shall be of 3pole or 4pole (as per BOQ), air break for longer life along with less maintenance requirement.All ACBs shall be of same model to optimize requirement for spares management. ACB shall have a Ready to close mechanism preferably having a ready to close mechanical indication on front of ACB. All EDO ACBs ready to close indication contact which shall be used to give a single indication via indicating lamps on panel door if ACB is ready to be closed, after checking all the given conditions (UV release energized, Shunt release de-energized, spring charged, Breaker is not "ON", Breaker has not

tripped on fault, Breaker is not mechanically interlocked with other breaker and ACB is not racked in completely in service position) ensuring safety for user and electrical distribution. ACB shall comply with the environmental directives like RoHS Performance:

ACB shall have the breaking performance Ics = Icu = Icw (1sec) = 100%. The Breaking Capacity value shall be as per SLD. ACBs, upto 2500 A shall have minimum Mechanical life of 20000 operations with maintenance . For higher rated ACBs, minimum mechanical life shall be 10000 Operations with maintenance . For the purpose, mechanical operation counter shall be provided for each ACB The operating mechanism of ACB shall be of the Open/Closed/Open stored-energy spring type. The closing time shall be less than or equal to 80ms, and of fast opening type with break time of breaker should be <50ms (including breaker opening & arc extinguishment time) to ensure higher life of distribution cables.

Accessories & Auxiliaries: Shunt trip and closing coil (having common AC/DC supply up-to 250V) shall be rated. For Incomer ACBs. Incomer ACB delayed type under voltage release shall be used to avoid nuisance tripping during voltage surges. ACBs shall have minimum 4 change-over auxiliary contacts, available to be used for indication and interlocking, rated at minimum 10A 240/380V 50 Hz and shall be wired on chassis/cradle. There should be facility to add one more set of 4 contacts if required. ACB shall be provided with two programmable contacts for fault/Alarm indications on panel door via LED lamps. It shall be possible to program the contacts for pre overload alarm and pre earth alarm. Panel builder shall wire these contacts to LED lamps on panel's front door. Pre wired Fault trip contact should be provided with Release as standard. Indication lamps On, Off,Trip, Ready to close ,Electrical fault to be provided on front door of ACB. Spring charge indication required for EDO ACB only.

Safety : Draw-out ACBs shall preferably be provided with a mechanical latch on chassis/ or through smart racking shutter, which latches the ACB at Connected-Test-Disconnected positions while racking in and racking out the circuit breaker. This feature will help the operator in placing the circuit breaker at right position inside the chassis and can help in avoiding the accident.

Interlocks. : The racking handle shall be stored on the air circuit breaker in such a manner as to be accessible without defeating the door interlocking.

Terminations: All air circuit breaker shall be fully tropicalized as standard & suitable for terminating copper or aluminum bus bars.. Silver plated copper/ copper alloy adapters shall be provided on both sides for ACBs.

Protections: Air circuit breaker shall be provided with microprocessor release, which should be self powered type without the need of any auxiliary power supply during normal operation of the breaker. The circuit breaker control unit shall measure the true RMS value of the current, voltage & energy. Circuit breaker trip unit shall have LED display for measurement of current, voltage, energy. It shall be possible to view last 10 trip cause and 10 event history on trip unit. All trip units provided shall have thermal memory as standard. All trip

units shall be EMC/EMI tested. The protection release shall have following protections as standard, Adjustable phase over load current (Ir) settings from 40% to 100% of rating of ACB (In). Over load time setting (tr) from 0.5s,1s, 2s, 4s…….24s, 30s (or as per IEC)as field selectable curves. There shall be total selectivity between all the switchgear from ACB to MCCB to final distribution ,OEM shall provide total selectivity chart during drawing approval,if rating of switchgear need to increase to achieve the total selectivity ,OEM shall do. It shall be possible to change the protection settings online and the circuit breaker need not be switched off while adjusting the settings. All incomer ACB shall display ACB terminal temperature with required alarm/ trip feature.

It shall be possible to view the absolute percentage loading of three phases at once on trip unit LED/LCD display to help the user in identifying the current load balancing of the network. This will help in preventing the deterioration of loads affected by load balancing by identification of the balancing related issue.

All 4 Pole ACBs shall have fully rated neutral equal to rating of the breaker.

Communication: The advanced communication system is required to connect all the ACB release, Energy meter, MV relays, temperature sensors to a SCADA/Energy management software for continuous monitoring all the parameter of electrical facility. Software shall be cyber secured & compliance to IEC 62443 with third party certificate. Energy management system shall capable to provide energy data on hourly, daily, weekly & monthly basis. Software shall be capable to do the analytics like, contact wear of ACB, energy benchmarking, harmonic level compliance as per IEEE519, Energy management software shall capable to record all the electrical events with date & time stamping.

Specifications for communication (Shall be applicable wherever mentioned in SOQ)

Energy Management software shall be provided by OEM & necessary cabling from PCC/Panels, All required breakers to computers (where software installed) shall be provided by OEM / Vendor. Nos. of Panels & switchgears / Meters to connecting with Energy management system shall be provided by Engineer In Charge.

All ACBs shall be provided with individual Modbus communication port for data transfer. Panel shall be Ethernet ready. TCP/IP Ethernet port for better speed of data transfer (with at least 10mbps speed on Ethernet network). Ethernet port provided shall be with minimum one Ethernet ports to minimize the number of Ethernet switches required in the system. Panel builder shall provide circuit break communication test report having the data like.. Circuit breaker settings at the time of communication test. Settings on the circuit breaker, at the time of communication test, shall be same as recommended by the client. Circuit breaker number of operation measurement through physical operation counter. Circuit breaker control (ON/OFF). Circuit breaker ready to close and spring charge status, Circuit breaker settings, Circuit breaker last 10 trip history etc.Cat 6 cable and Ethernet cable are to be provided wherever required for echaving comminucation without any extra cost.

All ACB's should have communication module and it should communicate on Modus bus/ Ethernet, vendor to consider all Accessories like gateway/ convertors. All MCCB should communicate ON/OFF Trip status and it should communicate on Ethernet vendor to consider all communication Accessories. Successful bidder has to submit detailed communication Architecture. Following communication Architecture should be considered at the time of quoting.

Energy Management system: Energy management system shall have two years of analytics services for provide report about health of electrical system. This will help to maintain the compliance & prescheduling the maintenance plan & actioned required to reduce the energy cost. This EMS & Services shall be the part of LT panel.

All kind of Software must be tested for security & suitable to perform in overall set up.

B) MINIATURE CIRCUIT BREAKER

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965, IEC 898-1995 and IS :8828 (1996). The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 10000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications. The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a faculty current. Tightening torque at terminals shall be not less than 2.5 Nm. Power losses should not be more than as specified in IEC 898-1995.The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with over current and short circuit protection.

The overload or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.For protection of electric circuits with equipment that does not cause surge current (i.e. lighting and socket outlet circuits)'B' curve MCB to be used in which magnetic releases operates between 3 and 5 In. For protection of electric circuits with equipment that cause surge current (i.e. inductive and motor circuits) 'C' curve MCB to be used in which magnetic releases operates between 5 and 10 In. For protection of electric circuits with equipment that cause surge current (i.e. transformer, heavy start motors circuits) 'D' curve MCB to be used in which magnetic releases operates between 10 and 20 In.

C) MOULDED CASE CIRCUIT BREAKERS

General

The circuit breakers shall comply with the requirement of IEC 60 947 / IS 13947: 1993. MCCBs shall be suitable for nominal voltage of 3 phase 440 Volts

AC 50 HZ supply. The circuit breaker shall comply with the isolation function requirement of IEC 60 947-2 section 7.1.2 to be marked as suitable for isolation / disconnection to facilitate safety of operating personnel while the breaker is in use. The MCCBs shall be of double break contacts up to 630A & above 630A as per OEM standard shall be acceptable.

Constructional features

The MCCBs shall be made of halogen free high strength heat resisting and flame retardant thermo setting insulating material. Three phase MCCBs shall have a common handle for simultaneous operation and tripping of all the three phases. The contact tips shall be made of suitable arc resistant sintered alloy. Terminals shall be of liberal design with adequate clearances.

Operating mechanism

The operating handle of the MCCBs shall be quick make / break, trip free type. The operating handle of the MCCBs shall have suitable, ON, OFF and TRIPPED indicators. The operating handle and mechanical trip push button shall be at the front of and integral with the circuit breaker. MCCBs shall be capable of limiting the fault currents. The maximum thermal I2 t shall be indicated by the manufacturer. These characteristics shall allow high cascading performance with MCCBs / MCBs downstream. MCCBs shall comprise of the mechanism designed to trip the circuit breaker in the event of high value short circuit currents. endurance of MCCBs shall be more or equal to that specified by IEC 60 947-2 standard. MCCBs range shall have established and documented type 2 coordination harts readily available for motor duty MCCBs. MCCBs should be of the same family. All MCCBs above 100A shall have Variable Thermal (O/L) and variable S/C protection setting. MCCBs of 250A and above shall be with Microprocessor release with inbuilt Overload, short circuit, Instantaneous and Earth Fault protection.

The electrical endurance of MCCBs shall be more or equal to that specified by IEC 60 947-2 standard. Earth fault protection if specified should be an integral part of the breaker, direct operating type & adjustable. MCCBs range shall have established and documented type 2 coordination charts readily available for motor duty MCCBs. MCCBs should be of the same family. All MCCBs above 100A shall have Variable Thermal (O/L), & Variable Magnetic (S/C) protection settings. MCCBs of 250A and above shall be with Microprocessor release with in-built and settable Short Circuit, Overload, Instantaneous and Earth Fault Protection with indusial fault protection. All MCCBs of 100A and above shall be provided with Silver Plated Copper Spreader Links for enhancing termination capacity. Also, Phase Barriers & Extended Rotary Operating Handles for ease in operation shall be provided.

Circuit Breaker Interlocking

MCCBs shall be provided with following interlocking devices.

- Handle interlock to prevent unnecessary manipulations of the breaker.
- Door interlock to prevent door being opened when the breaker is in ON position
- De interlocking device to open the door even if the breaker is in ON position

Circuit breaker auxiliaries

The circuit breaker shall be provided with following accessories, if specified in drawings/schedule of quantities

- Under voltage trip
- Shunt trip
- Alarm switch
- Auxiliary switch

Type test certificate

The contractor shall submit type test certificate from a international recognized test house for the circuit breakers offered.

D) CONTACTORS :

The contactor shall meet with the requirements of IS : 2959 and BS : 775. The contactors shall have minimum making and breaking capacity in accordance with utilization category AC 3 and shall be suitable for minimum class II intermittent duty. If the contactor forms part of a distribution board then a separate enclosure is not required, but the installation of the contactor shall be such that it is not possible to make an accidental contact with live parts.

E) METER

The meter should meet the following requirement unless and otherwise specified in the bill of material or drawings.

Ameter : The Ameter should be digital type 96 x 96 mm size having facility to read current parameters.

Voltmeter : The Voltmeter should be digital type 96 x 96 mm size having facility to read voltage parameters.

KWH METER : Digital KWH meter 96 x 96 x 80 mm size Acc Class 1.0 suitable for true RMS reading having reverse LED. Optically isolated pulse output having pulse with 500 ms and pulse amplitude 12 volts. It should be with RS 485 port with Modbus TCP-IP protocol, and ToD-Time of Day features.

LOAD MANAGER:

The load manager should meet the following requirement unless and otherwise specified in the bill of material or drawings.

Multi function meter - should be having facility to read all the parameter as mentioned in the below table. The meter should be field programmable and to generate high / low profile for all power parameters with date & time, also able

to store previous period integrated data. The meter should have RS 485 port with Modbus TCP-IP protocol for networking purpose. All the programming should be password protected.

List of Parameters received for Various multi function meters		
Location	**Category**	**Key Parameters**
(A)Sub Panel incomer and outgoing Basic MFM	**Instantaneous Parameters**	V1, V2, V3, V12, V23, V31
		A1, A2, A3
		PF-1, PF-2, PF-3, PF (Avg)
		W1, W2, W3, W(total)
		VA1, VA2, VA3, VA(total)
	Cumulative Parameters	Import Wh
		Import VAh
		Import load hours
	Reset (old) Cumulative parameters	Import Wh
		Import load hours
	Communication	Modbus TCP/IP or (converted RTU etharnet port with converter is accepted.
(B)Main PCC outgoings / DG Outgoing Panel MFM level 3 All Above (A) and these parameters – along with SCADA	**Instantaneous Parameters**	An (Computed)
		% A Unbal, % V Unbal (Avg and Phase wise)
		VAr1, VAr2, AVr3, VAr (total)
	Cumulative Parameters	Import VArh (Lead & Lag)
		No of Interrupts
	Reset (old) Cumulative parameters	Import VAh
		Import VArh (Lead & Lag)
	Min / max value	VLL, VLN, A, F, W, VA, VAr, PF
(C) HT Panel I/C and O/C Main LT PCC Incomer DG Panel I/C APFC MFM level 1 & 2 All Above (A+B) and these parameter along with PLC comparable and SCADA system.	**Instantaneous Parameters**	RPM (Rotations per minute)
		Phase Angle A°1, A°2, A°3, V°1, V°2, V°3)
	Cumulative Parameters	Export Wh
		Export VAh
		Export VArh (Lead & Lag)
		Export run hours
	Reset (old) Cumulative parameters	Export Wh
		Export VAh
		Export VArh (Lead & Lag)
		Export run hours

	Harmonic	Individual harmonics upto 31st (V, A)
		V THD%, V1, V2, V3 - harmonic
		A THD%, A1, A2, A3 - harmonic
	Demand / Load parameters	Maximum demand MD W, MD VA, MD VAr max avg A (with RTC)
		Max MD & occurrence time
	Others	Data log (8MB)
	Input and Output	As per IO summary in IBMS package
		Pulse Output

F) INDICATING LAMP :

Indicating Lamp shall be transformer operated low voltage rated and shall supplied complete with translucent covers to diffuse the lamp light.

Colour shade for the indicating lamps shall be as below :

ON indicating lamp	:	Red
OFF indicating lamp	:	Green
TRIP indicating lamp	:	Amber
PHASE indicating lamp	:	Red, Yellow, Blue.

G) CURRENT TRANSFORMER

Where ammeter are called for, CT's shall provided for current measuring. Each phase shall be provided with separate CT of class 1 accuracy and suitable VA burden for operation of associated metering and controls. Current transformer shall be in accordance with IS : 2705-19 64 as amended up to date.

H) PUSH BUTTON :

The push button unit shall comprise of the contact element, a fixing holder , and push button actuator. The push button shall be momentary contact type. The contacts shall be of silver alloy and rated at 10 Amps. continuous current rating. The actuator shall be of stranded type and colour as per its usage for ON, OFF and Trip.

1.21 SPECIAL REQUIREMNTS.

Bottom most feeder shall be minimum 300 mm above the bottom of panel base frame. Necessary floor stand to be provided whenever required along with the panels

1.22 Testing & Co-ordination:

Testing and setting the relay set – point and co-ordination between relay on LT/HT fuses, breaker, setting shall be done by contractor. The downstream of the setting should be provided

The following drawings shall be submitted before procurement for approval from the client.

General arrangement and Fabrication details.

- Power wiring diagram of the panel.
- Control wiring diagram of panel.
- C.T. ratios with connection.
- Material list with make, catalogue nos and

Testing and setting the relay set – point and co-ordination between relay on LT/HT fuses, breaker, setting shall be done by contractor. The downstream of the setting should be provided.

The relay should be tested by reputed agencies and test report of the relay should be submitted by the contractor.

L T DISTRIBUTION BOARDS

1.1 Scope :

It includes Supply, Installation, Testing and Commissioning of Distribution Boards standard company fabricated or to be fabricated by fabricator.

1.2 Standards :

IS : 8623 : Distribution Boards

1.3 Distribution Boards :

a) Distribution boards along with the controlling MCB's/Fuse or Isolator as shown shall be fixed in an M.S. Box with hinged door suitable for recessed mounting in wall. Distribution boards shall be made of minimum 18 SWG steel sheet duly rust inhibited through a process of de-greasing, acid pickling, phosphating and powder coated to an approved colour of adequate micron rating duly approved by architect/consultant.

Three phase boards shall have phase barriers and a wire channel on three sides. Neutral bars shall be solid tinned copper bars with tapped holes and chase headed screws. For 3 phase DB's, 3. independent neutral bars shall be provided for per phase isolation in addition to main neutal links.

b) Conduit knockouts shall be provided as required/shown on drawings and the entire board shall be rendered dust and vermin proof with necessary sealing gaskets. The top and bottom side of DB should be detachable.

c) All DB's shall be internally pre-wired using copper insulated Busbars of appropriate rating.Bus bars shall be suitable for the incoming switch rating and sized for a temperature rise of 35° C over the ambient. Each board shall have two separate earthing terminals. Circuit diagram indicating the load distribution shall be pasted on the inside of the DB as instructed. Two earthing terminal for single phase and two terminals for 3 phase DB's shall be provided with one earth strip connecting the studs and the other earth link should be provided with base insulator in such a way that link should in contact with body of distribution board.

1.4 RCCB/RCBO:

a) The RCCB should suffices all the requirements of IS as per code IS - 12640 (Part I) - 2000. The RCA should be current operated and not on line voltage.

a) The RCCB/RCCB should ensure mainly the following functions.

1) Measurement of the fault current value.
2) Comparison of the fault current with a reference value.

c) The RCCB/RCBO should have a toroidal transformer witch has the main conductors of primary (P - N) which check the sum of the current close to zero. All metal parts should be inherently resistant to corrosion and treated to make them corrosion resistant. It should be truly current operated. It should operate on core balance toroidal transformer. It's accuracy should be ± 5 %.It should operate even in case of neutral failure. It should trip at a present leakage current within 30 M.S. It's enclosure should be as per IP 30.It's mechanical operation life should be more than 20,000 operations. It should provide full protection as envisaged by IE rules - 61-A, 71 - ee, 73 - ee, 1985 and also rule 50 of IE rule1956.It should conform to all national and international standards like IS, BS 4293 - 1983, CEE 27 (International commission Rules for the approved of electrical equipment).

1.5 MCB/ Isolators:

Miniature circuit breakers shall be quick make and break and break type conform with British standard BS : 3871 (Part-I) 1965, IEC 898-1995 and IS :8828 (1996). The housing of MCBs shall be heat resistant and having a high impact strength. The fault current of MCBs shall not be less than 10000 amps, at 230 volts. The MCBs shall be flush mounted and shall be provided with trip free manual operating mechanism with mechanical "ON" and "OFF" indications.

The circuit breaker dollies shall be of trip free pattern to prevent closing the breaker on a faculty current. Tightening torque at terminals shall be not less than 2.5 Nm. Power losses should not be more than as specified in IEC 898-1995.

The MCB contact shall be silver nickel and silver graphite alloy and tip coated with silver. Proper arc chutes shall be provided to quench the arc immediately. MCB's shall be provided with magnetic fluid plunger relay 3 as for over current and short circuit protection. The over load or short circuit devices shall have a common trip bar in the case of DP and TPN miniature circuit breakers. All the MCB's shall be tested and certified as per Indian Standard, prior to Installation.

For protection of electric circuits with equipment that does not cause surge current (i.e. lighting and socket outlet circuits)'B' curve MCB to be used in which magnetic releases operates between 3 and 5 In.

For protection of electric circuits with equipment that cause surge current (i.e. inductive and motor circuits) 'C' curve MCB to be used in which magnetic releases operates between 5 and 10 In.

For protection of electric circuits with equipment that cause surge current (i.e. transformer, heavy start motors circuits) 'D' curve MCB to be used in which magnetic releases operates between 10 and 15 In.

Isolators shall confirm to IS 13947-3 and IEC 60947-3.

1.6 Voltage Surge Protector Devices (SPDs):

SPDs (Surge Protection Devices) shall be of Type II for DB level internal Protection (Class S, 8/20 microseconds waveform, UP-1.4KV, Imax 15KA) and DIN-rail type (Unless & otherwise specified).

SPDs shall be tested in accordance with the requirements of IEC 61643-1.

SPDs shall be suitable for TT, TNC, TNS or TNC-S earthing systems.

SPDs shall provide protection between line to earth (common mode), neutral to earth (common mode) and line to neutral (differential mode).

SPDs shall be of the "withdrawable cartridge" type. The base of the SPDs shall be able to accept cartridges of different discharge ratings of Imax: 15kA, 20kA, 40kA & 65kA (8/20 microseconds waveform).

Optional auxiliary contacts for remote indication shall be integrated in the base of the SPDs to eliminate possibility of wrong installation.

SPDs shall limit the transient let-through voltage of not more than 1.4kV in accordance to IEC 60364.

Protection against SPDs short-circuit (in the event of end-of-life of SPDs or/and short circuit at 50hz like neutral disconnection, inversion of Neutral /line,…) shall be provided by a dedicated miniature circuit breaker that has been tested to co-ordinate with the manufacturer's SPDs in accordance to IEC 60364.

Type 1 for Increased protection at Panel level(Class I, 8/20 microseconds waveform, UP-1.2KV, Imax 40KA) SPDs shall be installed in the All Floor panel of installation/building fitted with a lightning rod. Type 1 SPDs shall be rated Iimit of 40kA per phase in accordance to IEC 61643-1 appendix A & IEC 62066 clause 12.3.2.1.

L T CABLING AND TERMINATION

1.1 Scope :

The scope consists of Supply, laying, testing and commissioning of L.T. XLPE Cable and its termination.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS; ATTACHED IN THE DOCUMENT

1.3 Cables :

A) LV POWER CABLES will be 1100 Volts grade single / multicore standard aluminum conductor extruded XPLE insulated with extruded PVC inner sheath outer sheath made of FRLS PVC compound conforming to IS-7098 part-1. single core will be used for DC application. Cables in buried insulation shall be armored type.

B) Control cables will be 1100 Volts grade multicore minimum 2.5 sqmm cross section standard copper conductor minimum 7 strands PVC insulated inner extruded sheathed and other sheath made of extruded FRLS PVC compound conforming to IS-1554 part-1. . Cables in buried insulation shall be armored type.

C) All cables shall be new without any kind or visible damage. The manufacturers name, insulating material, conductor size and voltage class shall be marked on the surface of the cable at every 600 mm centers.

1.4 Cable joints and termination :

A) Connectors :

Cable terminations shall be made with copper/Aluminium Heavy duty long nack copper crimping lugs only crimped type solderless lugs for all aluminium cables and stud type terminals. For copper cables copper crimped solderless lugs shall be used.

Crimping shall be done with the help of hydraulically operated crimping tool. All cable lugs should be long neck type only.

B) Cable Glands :

Cable glands shall be of heavy duty brass single compression type as specified. Generally single compression type cable glands shall be used for indoor protected locations and double compression type shall be used for outdoor locations. Glands for classified hazardous areas shall be CMRS approved.

C) Ferrules :

Ferrules shall be of self sticking type and shall be employed to designate the various cores of the control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

D) Cable joints :

Kit type joint shall be done and filled with insulating compund. The joint should be for 1.1 KV grade insulation.

1.5 HEAT / FIRE RESISTANT COATING OF CABLE

Supply and application of intumescent based coating on cables/ cable tray using CP 678 firestop cable coating of HILTI India Pvt Ltd,along the horizontal runs at every 6 mtr for 1 mtr and full length in case of vertical runs .The coating shall have a density in the range of 1.2 to 1.4 Kg/ L. The coating shall be non-toxic, asbestos and halogen free and shall have good mechanical strength. The coating shall comply with IEC 332 part 3 (1992) **Cable coating should be Hilti make cat No CP678 or equivalent.**

CABLE TRAY

1.1 Ladder type cable tray

The cable tray shall be fabricated out of 2 mm thick slotted/ perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted as specified.

1.1.1 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler and cable tray shall be scraped and removed before the installation.

1.1.2 The permissible uniformly distributed load for various type of cables trays and for different supported span shall be as per IS.

1.1.3 The width of the cables tray shall be chosen so as to accommodate all the cables In one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 1000mm.

1.1.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

1.1.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing. Flat type suspenders may be used for channels up to 450 mm width bolted to

cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.

1.1.6 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

1.1.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.

1.1.8 The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

1.1.9 The ladder type of cable tray shall be fabricated of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a center to center spacing of 250 cm as per IS.

1.2 Perforated type cable tray

The cable tray shall be fabricated out of slotted/ perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted as specified. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mmx50x6mm as two longitudinal members, with cross bracings between them by 50mmx5mm flats welded/bolted to the angles at 1 m spacing . 2mm thick MS perforated sheet shall be suitably welded/bolted to the base as well as on the two sides.

1.2.1 The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler and cable tray shall be scraped and removed before the installation.

1.2.2 The maximum permissible uniformly distributed load for various all the cables trays and for different supported span are given in Table IV. The sizes shall be specified considering the same.

1.2.3 The width of the cables tray shall be chosen so as to accommodate all the cables In one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 800mm.

1.2.4 Factory fabricated bends, reducers, tee / cross junction. Etc shall be provided as per good engineering practice. The radius of bends, junctions etc. shall be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

1.2.5 The cable tray shall be suspended from the ceiling slab with the help of 10 mm dia MS round or 25 mm x 5 mm flats at specified spacing (based on table III) Flat type suspenders may be used for channels up to 450 mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angle 50 mm x 50 mm x 5mm at the bottom and as specified These shall be grouted to the ceiling slab at the other and through an effective means, as approved by the Engineer – in – charge, to take the weight of the cable tray with the cables.

1.2.6 The entire tray (except in the case of galvanized type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

1.2.7 The cable tray shall be bonded to the earth Terminal of the switch bonds at ends.

1.2.8 The cable tray shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

1.3 Anchor Fastener

Anchor fastener shall be Hilti make and it will be install as per standard instruction from supplier / manufacturer and install in proper manners.

For Slab / RCC : Hilti make – Cat No. HKD-E M10/40 / Std stud anchor HSA M8x85 35/25/- or equivalent as per requirements.

For Wall / Bricks : Hilti make – Cat No. HRD-C 10x80 / HRD-UGT 10x80/10

1.3.1 All installation of Anchor fastener has been approved by Hilti Technical staff and certified the same.

1.3.2 If require, 1% of total quantity Pull out test will be carried out at site.

1.3.3 Electrical contractor has to submit Material Test Certificate / Material Safety Data Sheet (MSDS) for all material to be used for hanging of cable tray.

INTERNAL WIRING

1.1 Scope :

The scope covers supply, laying, testing and commissioning of wiring in rigid PVC pipes , Switches, Sockets and accessories.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS, ATTACHED IN THE DOCUMENT

1.3 Rigid and Flexible conduits :

A) All conduits shall be rigid PVC having minimum wall thickness of medium gauge 1.6 to 1.8 approved by F.I.A. & I.S.I. All rigid pipe and its accessories shall be of suitable material complying with IS:3419-1989 and IS :9537 (Part 5) 2000 for flexible conduits.
The conduits shall be circular in cross-section and designated by their nominal outside diameter. Minimum thickness of walls shall be as follows:

a) Up to 38 mm. diameter - minimum 1.8 mm. wall thickness.
b) Above 40 mm. diameter - minimum 2.2 mm. wall thickness.

The maximum number of PVC insulated copper conductor cables of 650/1100V grade confirming to IS:694-1990 that can be drawn in one conduit of various sizes shall be as specified.

B) Flexible conduits shall be formed from a continuous length of spirally wound interlocked steel strip with a fused zinc coating on both sides. The conduit shall be terminated in brass adapters.

1.4 Accessories :

A) PVC conduit fittings such as bends, elbows, reducers, chase nipples, split couplings, plugs etc. shall be specifically designed and manufactured for their particular application. All conduit fittings shall conform to IS:2667-1964 and IS:3857-1966. All fitting associated with galvanized conduit shall also be galvanized.

1.5 Wires :

A) All wires shall be single core multi-strand/ flexible copper or single strand Copper FRLS type PVC insulated as per IS:694 and shall be 660 V\1100 V grade.

B) All wires shall be colour coded as follows :

Phase	**Colour of wire**
R	Red
Y	Yellow
B	Blue

N	Black
Earth	Green (insulated)
Control (If any)	Grey
All off wires	Same as Phase wire

C) Both end of wires should be terminated with adequate size copper crimping type lugs and ferrules as per instructions of engineer in charge.

1.6 Outlets switches & Sockets :

A) Switches shall be moulded plate type flush piano type with silver-coated contacts. Sockets shall be multipin pin with switch and plate type cover. Combination of multiple switch units and sockets should be used to minimize the switch boxes. All screws shall be brass – chromium plated and shall be counter sunk type with half round head or flat headed.

B) For heavy duty, metal clad sockets with M.C.B/ Isolator mounted in a galvanized steel box shall be provided.

C) The switch boxes shall be made of either rigid PVC molding or mild steel or cast iron on all sides except at the front. PVC boxes shall comply with the requirements laid down in IS :14772-2000. These boxes shall be free from internal roughness. Wall thickness of PVC boxes shall not be less than 2 mm. Clear depth of the box shall not be less than 60 mm and this shall be increased suitably as per requirements. An earth terminal with stud and washer shall be provided in each MS boxes for termination of protective conductors.

D) All the fan boxes shall be of cast iron type only with minimum wall thickness of 3 mm.

1.7 Additional requirements

1.7.1 Making Chase

The chase in the wall shall be neatly made and of ample dimensions to permit the conduit to be fixed in the manner desired. Chase shall be done with machine cutter only. In the case of building under construction, the conduits shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. In case of exposed brick/ RCC work, special care shall be taken to fix the conduit and accessories in position along with the building work.

1.7.2 Fixing conduits in chase

The conduit pipe shall be fixed by means of staples, J-hooks, or by means of saddler, not more than 60 cm apart or by any other approved means of

fixing. All threaded joints of conduit pipes shall be treated with some approved preservative compound to secure protection against rust.

1.7.3 Fixing conduits in RCC work (slab / wall / floor etc)

The conduit pipes shall be laid in position and fixed to the steel reinforcement bars by steel binding wires before the concreting is done. The conduit pipes shall be fixed firmly to the steel reinforcement bars to avoid their dislocation during pouring of cement concrete and subsequent tamping of the same. Fixing of standard bends or elbows shall be avoided as far as practicable, and all curves shall be maintained by bending the conduit pipe itself with a long radius, which will permit easy drawing in of conductors. Location of inspection/ junction boxes in RCC work should be identified by suitable means to avoid unnecessary chipping of the RCC slab subsequently to locate these boxes.

At either side of the bends, saddles/staples shall be fixed at a distance of 15 cm from the center of the bends.

1.7.4 Fixing of inspection boxes

As far as possible inspection boxes shall be avoided or to be minimized as much as possible. If necessary suitable inspection boxes to the minimum sizes shall be provided to permit inspection and to facilitate replacement of wires with prior approval of engineer in charge. These shall be mounted flush with the wall or ceiling concrete with minimum depth of 65 mm for slab and as per IS : 2667 – 1988 for other places.

1.7.5 Fish Wire

To facilitate subsequent drawing of wires in the conduit, GI fish wire of 1.6mm /1.2mm (16/18 SWG) shall be provided along with the laying of the recessed conduits.

1.7.6 Earthing

A protective earth conductor shall be drawn inside the conduit in all distribution circuits to provide for earthing of non-current carrying metallic parts of the entire installation. These shall be terminated on the earth terminal in the switch boxes, and/or earth terminal blocks at the distribution boards. Gas or water pipes shall not be used as protective conductors (earth medium). Every sub main will hae earth continuity conductor to run along with sub main wiring. Every circuit will have its earth continuity conductor to run along with circuit wiring. In case of 3 phase sub main wiring two earth continuity conductors shall be provided.

LIGHT FIXTURES AND FANS

1.1 Scope :

The scope covers supply, installation, testing and commissioning of different types of light fixtures, fans and exhaust fans.

1.2 Standards :

AS PER SCHEDULE OF INDIAN STANDARDS.

1.3 Type of fixtures :

1.3.1 General Requirement:

1.3.1.1 All fixtures shall be complete with accessories necessary for installation whether so detailed under fixture description or not.

1.3.1.2 Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening.

1.3.1.3 Fixtures shall be installed at mounting heights as detailed on the drawings or instructed on site by the Architects/Consultants.

1.3.1.4 Fixtures and/or fixture outlet boxes shall be provided with hangers to adequately support the complete weight of the fixture. Design of hangers and method of fastening other than shown on the drawings or herein specified shall be submitted to the Architect/Consultant for approval.

1.3.1.5 Pendant fixtures within the same room or area shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation as per Architect's/Consultant's instructions.

1.3.1.6 Flush mounted and recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface.

1.3.1.7 Fixture mounted on outlet boxes shall be tightly secured to a fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation.

1.3.1.8 Fixture shall be completely wired and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified. Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved.

1.3.1.9 Wiring within the fixture and for connection to the branch circuit wiring shall be not less than 1.0/1.5 sq.mm. copper for 250 volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve.

1.3.1.10 Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with the specification or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks.

Solder shall not be used as mechanical fastening device on any part of the fixture.

1.3.1.11 Ferrous metal shall be bonderized and given a corrosion resistant phosphate treatment or other approved rust inhibiting prime coat to provide a rust-proof base before application of finish.

1.3.1.12 Non-reflecting surfaces such as fixture frames and trim shall be finished in baked enamel paint.

1.3.1.13 Light reflecting surface shall be finished in baked white enamel having a reflection factor of not less than 80%. All parts of reflector shall be completely covered by finish and free from irregularities. After finish has been applied and cured, it shall be capable of withstanding a 6 mm radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to an ultraviolet sun lamp placed 10 cm from the surface without discoloration, hardening or warping and retain the same reflection factor after exposure. Test results shall be furnished for each lot of fixtures.

1.3.1.14 Fixture with visible frames shall have concealed hinged and catches. Pendant fixtures and lamp holders shall be provided with ball type Algiers or similar approved means. Recessed fixtures shall be constructed so as to fit into an acoustic tile ceiling or plaster ceiling without distorting either the fixture or the ceiling plaster rings/flanges shall be provided for plaster ceiling. Fixtures with hinged diffuser doors shall be provided with spring clips or other retaining device prevent the diffuser from moving.

1.3.1.15 Detailed catalogue cuts for all fixtures, or, if so required by the Architect/Consultant sample fixtures shall be submitted for approval to the Architect/Consultant before orders for the fixtures are placed. Shop drawings for non-standard fixture types shall be submitted for approval to the Architect/Consultant.

1.3.1.16 Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.

1) Lamps shall be supplied and installed in all lighting fixtures furnished under this contract. All lamps shall be rated for 250 volts.

2) Lamps used for temporary lighting service shall not be used in the final lighting of fixtures units.

3) Lamps shall be of wattage and type as shown on the drawings and schedule. Where not shown, the details shall be ascertained from the Architect/Consultant before procurement.

4) Lamps for permanent installation shall not be placed in the fixtures until so directed by the Architect/Consultant, and this shall be accomplished directly before the building portions are ready for occupation.

1.3.2 Fluorescent fittings :

1.3.2.1 Only single and/or two lamp ballast shall be used in any one fixture. Ballast shall be completely enclosed inside sheet steel casing and shall have a corrosion - resistant finish. Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. Compound shall not support combustion. All ballast shall be of high power factor compensated to above 0.9PF. Ballast temperature and sound rating shall be specified by the manufacturer and guaranteed. Ballast shall be for operation at the voltages and frequencies indicated and under temperature conditions prevailing in the various locations of the premises. Tapped ballast are preferred.

1.3.2.2 All fluorescent fixtures shall be provided with separate wiring channel with cover plate and an earth terminal. All screws shall be chromium brass screws. Lamp and starter holders shall be out of tough moulded plastic with spring loaded rotor type contactors rendered shock and vibration proof. Condensers shall be low loss paper impregnated hermetically sealed complying with IS 1969-196 . Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistant barrier or sleeve shall be provided.

1.3.2.3 Surface mounted fixtures longer than two feet shall have one additional point of support besides the outlet box fixture stud when installed individually. Pendant individually mounted fixtures four feet long and smaller shall be provided with twin stem/conduit hangers. Stems shall have ball aligners or similar devices and provided for a minimum of 25 mm vertical adjustment. Stems shall be of appropriate length to suspend fixtures at required mounting height.

1.3.2.4 Lamps shall have bi-pin bases and a minimum approximate rated and guaranteed life of 6000 hrs. Colour spectrum of light shall be equivalent to `Philips White'. Lamp starter and ballast shall match the lamp.

1.3.3 Incandescent fittings :

1.3.3.1 Incandescent fittings shall be of the type generally specified on the drawings. Contractor should have sample approved by Architects/Consultant before procurement.

1.3.3.2 Incandescent fixtures shall be equipped with porcelain, medium base, screw type sockets for lamps upto and including 200 watt and mogul screw type pin type base for lamps 300 watt and over.

1.3.3.3 Re-lamping the fixture shall be possible without having to remove the fixture from its place.

1.3.3.4 Incandescent lamps shall be inside frosted/or clear type as required by the Architect/Consultant.

1.3.4 LED Light Fixtures Specifications :

1.4.1 General Purpose Led Luminaires should be suitable for indoor/outdoor installation for Office applications. The Fixtures should be Operational for 220-240 V Single Phase 50 HZ AC , and operational from 170-280 V without significant variation in output .The LED modules should be from approved make list Only with efficiency of a min 110 lm/watt and efficacy of fixtures should be greater than 80 lm/w for both indoor and outdoor fixtures.

1.4.2 Luminaries should be with built in Integral driver only. The Min degree of Protection for Indoor Fixtures should be IP20 and IP 44 for Semi Indoor an IP65 for Outdoor Fixtures. The THD of fixtures should be strictly <10 % and drivers should be compulsorily provided with overload, short circuit and over voltage protections. Power factor should be >0.90.

1.4.3 For Indoor applications the housing should be made of die cast/ Metal Housing and diffusers should be polycarbonate only, outdoor fixtures should be with die cast aluminium / extruded aluminium housing only .The Fixtures should be prewired up to the terminal block and easy to mount and Install and maintain.

1.4.4 The fixture should comply LM79-08 certification criteria and also module should be backed with LM80-08 Certificate from the OEM. The fixtures should be warranted for minimum period of 3 years from the date of Installation. The fixtures should have some kind of embossing/ engraving to identify the brand name. The manufactures should provide all kind of test report, technical details as and when called for. If required contractor have to provide test certificate from Government approved Lab for Claimed parameters by the manufacturer without any extra cost.

Technical specification of Lighting Fixtures :

	Description	**Value**
	Site Parameters	

	Ambient Temperature	0°C to 50°C
	Electricity Efficiency Management/Electronic Driver	
	Input Operating Voltage	110 to 270Volts, AC 50Hz±2
	AC Power Factor	Not Less than 0.95
	Efficiency of driver	More than 85%
	THD (AC current 110V to 250V)	Not more than 10%
	LED Drive Current	Not more than 500mA
	Led Efficacy	≥110lm/watt
	Optical Management	
	Colour Temperature	2700°K to 6500°K
	LED life with L70 criteria	Above 50,000 operating hours
	CRI	More than 70
	Thermal Management	
	Jn. Temperature of LED at 25°C	≤65°C
	Heat Sink temperature rise above ambient	≤30°C
	General parameters	
	Mounting Arrangement	Mounting Angle Adjustment facility should be provided
	IP Clause & Environment Protection	Minimum IP 20 for indoor, IP 44 for semi covered area and IP 65 for outdoor

	Overall system efficiency	Not less than 75%

Successful Contractor has to submit test report of similar LED light fixture for following parameters from any Government Approved Test Laboratories for approval. However, test certificates of the lot to be supplied are required to be produced before supply of material at site.

For LED

- LM 80 report of the LED chip being used

For Fixtures

- Endurance Test
- Thermal Test
- IP rating test
- Power factor, efficiency
- Harmonic test
- Surge test
- Mechanical strength test
- Dielectric test
- IR test
- Goniophotometer Reading for the LED Light

Contractor have to give three year unconditional guarantee for replacement for each light fixture after installation.

The electronic components used shall be as follows:-

a) IC (Integrated circuit) shall be of industrial grade or above.

b) Metallic film / Paper/Polyester Capacitor shall be rated for a sustained operating temperature of 105ºC.

c) The resistors should be preferably made of metal film where suitable, of adequate rating. The actual rating versus loading shall be by a factor of >2.

d) The junction temperature of the Switching devices such as transistors and MOSFETs etc. shall not exceed 125ºC (allowing thermal margin of 25 ºC).

e) The protective cum adhesive coating used on PCBs should be clear and transparent and should not affect color code of electronic components or the product code of the company.

f) The construction of PCBs and the assembly for components for PCBs should be as per relevant Indian / international standards.

g) The electronics covered for this equipment shall pass all the tests covered under relevant Indian / International standards specification.

h) The infrastructure for Quality Assurance facilities must be available at the manufacturing facility. In house testing facility for Quality Assurance should be present.

i) The connecting wires used inside the luminaries, shall be low smoke halogen free, fire retardant e-beam cable and fuse protection shall be provided in input side.

j) For outdoor fixtures, Care shall be taken in the design that there is no water stagnation anywhere. The entire housing shall be dust and water proof having IP66 or above protection and the light shall pass driving rain test/jet water test.

k) The LED Module(s), Driver gear, etc. shall be designed in such a way so that temperature of heat sink shall not exceed 30ºC above the ambient temperature.

l) All the material used in the luminaries shall be halogen free and fire retardant confirming to UL94.

m) The LED Luminaries shall have an input connector which shall be made of fire retardant material & its construction shall be water proof

n) The Contractor shall submit all the necessary support documents alongwith the compliance statement of all technical requirements w.r.t. Electrical, Optical, Thermal & environmental performance, including the Technical specification mentioned herewith.

o) Each LED should have necessary lens /reflector for better distribution of light at surface.

p) All the applicable test reports for complete fixtures and spare parts have to be submitted.

q) The manufacturer should have in house testing facilities within the India for the fixtures intending to supply.

1.3.5 Ceiling Fans :

1.3.4.1 Ceiling fans shall be complete with fan suspension stem canopies and regulators. 30 cm suspension stem shall be standard accessory and stems shall be heavy duty galvanized steel tubes to IS 1239- 1958.

1.3.4.2 Fans shall be mounted on a pre-embedded hook with hard rubber isolator. Regulators shall be no-step type mounted in the switch box. The box in all such cases shall be large enough to accommodate the regulator and switches. One sample box with top cover shall be got approved before procurement.

Earthing

1.0 SCOPE OF WORK :

The scope of work shall cover supply, laying, installation, connecting, testing and commissioning of:

1.1 copper/galvanized/aluminium/chemical or Electrode type Earthing station.

1.2 Earthing G.I./Aluminum/copper strips from earthing station to equi-potential bar.

1.3 Earthing G.I./ Aluminum/ copper strips/ wires from equi-potential bar to lay feeder mains and circuit to connect power panels, DBs, switchboards etc.

1.4 Bonding of Non-current carrying parts, and metallic parts of the electrical installation.

1.5 Provide inter connection between all earth pits of same type.

2.0 STANDARDS

2.1 The following standards and rules shall be applicable:

1) IS: 3043 - 2018 Code of practice for Earthing.

2) Indian Electricity Act and Rules

2.2 All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the British Standard Codes of Practice in absence of Indian standard.

3.0 GENERAL

All the non-current carrying metal parts of the electrical installation and mechanical equipment shall be earthed properly. The metal conduits, trucking, cables armored and sheath, electric panels boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal shall be bonded together and connected by means of specified earthing system.

An earth continuity conductor shall be installed with all the feeders and circuits and shall be connected from the earth bar of the panel boards, to the conduit system, earth stud of the switch box, lighting fixture, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of motors shall be also connected to the earthing system.

4.0 TYPE OF EARTHING STATION

4.1 PLATE EARTHING STATIONS

4.1.1 The earthing station shall be as shown on the drawing IS:3043.

4.1.2 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.1.3 The resistance of each earth station should not exceed the limit specified in IS : 3043.

4.1.4 The earth lead shall be connected to the earth plate through copper/brass bolts in case of copper earth plate and shall be hot dip galvanized iron for G.I. plate earth plate as shown on the drawing.

4.1.5 The earthing grid and the earthing conductors shall be of copper strip in case of copper earth plate and hot dip galvanized iron strip in case of G.I. earth plate of size as mentioned on the drawing.

4.1.6 G.I. pipe with funnel with filter of approved quality shall be used for watering the earthing electrodes \ stations.

4.1.7 The block masonry chamber with Cast Iron hinged cover of 300 x 300 mm shall be provided for housing the funnel and the pipe for watering the earthing electrodes \ stations.

4.2 PIPE EARTHING STATIONS

4.2.1 The substation earthing shall be with GI Pipe earthing station and equipment earthing grid shall be with hot dip galvanized iron earthing station.

4.2.2 The Pipe electrode shall 38mm dia GI pipe for earthing

4.2.3 The earthing station shall be as shown on the drawing.

4.2.4 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.2.5 The resistance of each earth station should not exceed 4 ohms.

4.2.6 The earth lead shall be connected to the earth plate through copper/brass bolts in case of copper earth plate and shall be hot dip galvanized iron for G.I. Pipe earth as shown on the drawing.

4.2.7 The earthing grid and the earthing conductors shall be of hot dip galvanized iron strip of size as mentioned on the drawing.

4.2.8 The block masonry chamber with Cast Iron hinged cover of 300 x 300 mm shall be provided for housing the funnel and the pipe for watering the earthing electrodes \ stations.

4.2.9 The hardware and other consumable for earthing installation shall be of copper/brass in case of copper earth plate and shall be hot dip galvanized iron material in case of G.I. Pipe , as per details shown in the drawing .

4.3 ELECTRODE / CHEMICAL TYPE EARTHING STATIONS:

4.3.1 The substation earthing and equipment earthing shall be done with details given in earthing scheduled in BOQ & Drawing.

4.3.2 The earthing station shall be as shown on the drawing.

4.3.3 The earth resistance shall be maintained with suitable soil treatment as shown in the drawing.

4.3.4 The resistance of each earth station should not exceed the limit specified in IS : 3043.

4.3.5 The earthing grid and the earthing conductors shall be of copper strip of size as mentioned on the drawing.

4.3.6 The block masonry chamber with Cast Iron hinged cover shall be provided for housing the termination block as shown in the drawing.

4.3.7 The hardware and other consumable for earthing installation shall be of copper/brass, as per details shown in the drawing.

4.3.8 GROUNDING: The grounding system shall incorporate the following individual components or a combination of the following:

- Deep driven copper bonded steel core ground rod/ Copper Plate / Copper Rod as central injection point for flow of fault current which is securely connected to the lower end of the down conductor.

- The use of ground resistance improvement material shall be applied in order to reduce the resistivity levels of the grounding system and maintain a constant low resistivity. The grounding system shall be maintenance free.

Maintenance Free Earthing System consist of following material:
- Copper Bonded Earth Rod- Length 1.5Mtr/3Mtr Dia. 5/8”
- Ground Rod Clamp – For Earth Termination.
- Ground Resistance Lowering Compound.

The Copper bonded earth rods are made in accordance with national and international standards such as BS6651, BS7430 and UL467. Threads are

rolled onto the rod ensuring an even copper covering which eliminates the risk of chipping whilst driving.

Description: Threaded Copper bonded Earth Rod

Material: Carbon steel rod bonded with Copper

Length: 1.5Mtr./3Mtr

Rod Diameter (Actual): 5/8”

Weight: 1.92kg / 4Kg.

A low resistance, non corrosive earth enhancing compound designed for use in standard soil conditions is to be used for these earthings. This compound shall have following characteristics:

- Will not dissolve or leach away with time
- Maintains constant resistance for the life of the earthing system.
- Effective in normal soil conditions.
- No maintenance required

Ground Resistance Improvement Powder to be used which shall not wash away under seasonal conditions and therefore provides a permanent presence in working to improve and maintain the integrity of the earthing system.

U-Bolt Rod Clamp.

Suitable for clamping earth rods to tape or round conductor.

Description: Suitable for Rod Diam. : 5/8” & Copper Tape Size: 25mm x 3mm
Weight: 90 grm.

5.0 INSTALLATION AND CONNECTION :

5.1 The plate \ pipe electrode, as far as practicable, shall be buried below permanent moisture level but in no case not less than 2.5 M below finished ground level.

5.2 The plate \pipe electrode shall be kept clear of the building foundation and in no case, it shall be nearer by less than 2 M from outer face of the respective building wall \ column.

5.3 The plate electrode shall be installed vertically and shall be surrounded with 150 mm. thick layers of Charcoal dust and Salt mixture.

5.4 G.I. pipe for watering, shall run from top edge of the plate \ pipe electrode to the mid level of block masonry chamber.

5.5 Top of the pipe shall be provided with G.I. funnel and screen for watering the earth \ ground through the pipe.

5.6 The funnel with screen over the G.I. pipe for watering to the earth shall be housed in a block masonry chamber as shown in the drawing.

5.7 The masonry chamber shall be provided with a Cast Iron hinged cover resting over the Cast Iron frame which shall be embedded in the block masonry.

5.8 Construction of the earthing station shall in general be as shown in the drawing and shall conform to the requirement on earth electrodes mentioned in the latest edition of Indian Standard IS : 3043, Code of Practice for Earthing Installation.

5.9 The earth conductors (Strips / Wires copper/ Hot dip G.I.) inside the building shall properly be clamped / supported on the wall with Galvanized Iron clamps and Mild Steel Zinc Passivated screws \ bolts. The conductors outside the building shall be laid at least 600 mm. below the finished ground level.

5.10 The earth conductors shall either terminate on earthing socket provided on the equipment or shall be fastened to the foundation bolt and / or on frames of the equipment. The earthing connection to equipment body shall be done after removing paint and other oily substances from the body and then properly be finished.

5.11 Over lapping of earth conductors during straight through in joints, where required, shall be of minimum 75mm. long.

5.12 The earth conductors shall be in one length between the earthing grid and the equipment to be earthed.

6.0 EARTH LEADS AND CONNECTIONS :

6.1 Earth lead shall be bare copper or galvanized steel as specified with sizes shown on drawings. Copper lead shall have a phosphor content of not over 0.15 %. Galvanized steel buried in the ground shall be protected with bitumen and Hessian wrap or polytene faced Hessian and bitumen coating. At road crossing necessary hume pipes shall be laid. Earth lead run on surface of wall or ceiling shall be fixed on saddles so that strip is at least 8 mm away from the wall surface.

6.2 The complete earthing system shall be mechanically and electrically bonded to provide an independent return path to the earth source.

7.0 EQUIPMENT EARTHING :

All apparatus and equipment transmitting or utilizing power shall be earthed in the following manner. Copper/G.I. earth strips/wires shall be used unless other wise indicated in the Schedule B.

8.0 POWER TRANSMISSION APPARATUS

8.1 Metallic conduit shall not be accepted as an earth continuity conductor. A separate insulated / bare earth continuity conductor of size 50 % of the phase conductor subject to the minimum and maximum shall be provided.

Copper	**Aluminum**	**G.I.**
Minimum(sqmm)	2.5	4.0	6
Maximum(sqmm)	75	100	200

The earth continuity conductor be drawn inside the conduit shall be insulated.

8.2 Non metallic conduit shall have an insulated earth continuity conductor of the same size as for metallic conduit. All metal junction and switch boxes shall have an inside earth stud to which the earth conductor shall be connected. The earth conduct or shall be distinctly coloured (Green or Green/Yellow) for easy identification.

8.3 Armored cable shall be earthed by two distinct earth connections to the armoring at both the ends and the size of connection being as for the metallic conduit.

8.4 In the case of Unarmored cable, an earth continuity conductor shall either be run outside along with the cable or should form a separate insulated core of the cable.

8.5 Three phase power panel and distribution boards shall have two distinct earth connections of the size correlated to the incoming cable size. In case of single phase DB's a single earth connection is adequate.

9.0 UTILIZING EQUIPMENT :

9.1 Three phase motors and other three phase apparatus shall have two distinct earth connections of the size equal to 50% of the connecting cable subject to the following:

	Copper	Aluminum	G.I.
Minimum(sqmm)	6.5	10	20
Maximum(sqmm)	75	10	200

9.2 For single phase motors and apparatus, the single earth connection shall be provided of the above size. For all light fittings and fans a single earth connection with 1.5 sqmm copper or equivalent size shall be provided.

9.3 All street light poles shall have an earth stud and shall be connected to the cable armoring using 6.5 sqmm copper or equivalent unless shown otherwise. For street lighting poles planted in ground, 2.4 M long 10 SWG bare copper wire shall be coiled and buried with every fourth pole in addition to connection to cable armoring.

9.4 An equipment earthing grid shall be established as shown in the drawing. All earth connections to all panels, DB's and equipment shall be connected to the nearest point of the earthing grid.

10.0 TEST :

10.1 The entire earthing installation shall be tested as per requirements of Indian Standard Specification IS : 3043.

10.2 The following earth resistance values shall be measured with an approved earth meggar and recorded.

1) Each earthing station
2) Earthing system as a whole
3) Earth continuity conductors

10.3 Earth conductor resistance for each earthed equipment shall be measured which shall not exceed 1 Ohm in each case. This is responsibility of contractor to get the final value for resistance.

10.4 Measurements of earth resistance shall be carried out before earth connections are made between the earth and the object to be earthed.

10.5 All tests shall be carried out in presence of the consultant..

11.0 METHOD OF MEASUREMENT :

11.1 Provision of earthing station complete with excavation, plate, earth lead upto chamber, earth link in the chamber, electrode, GI watering pipe, Salt,

Charcoal, soil treatment to achieve the earth resistance less than 4 ohm, masonry chamber with cast iron cover etc. shall be treated as one unit of measurement.

11.2 The following items of work shall be measured and paid per unit length covering the cost of the earth wires/strips, clamps, labour etc.

a) main equipment earthing grid and connection to the earthing stations.
b) Connection to the power panels, DB etc.

11.3 The cost of earthing the following items shall become part of the cost of the item itself and no separate payment for earthing shall be made.

a) Light fittings - form part of installation of the light fitting.
b) Conduit wiring, cabling - should form part of the wiring or cabling.
c) Street lighting - should form part of the street light poles.

External Lighting

1.0 Scope :

1.1 The scope of work covers the supply, installation and testing of lighting poles, weather proof light fixtures, wiring to the fixtures, cable laying, earthing as specified and shown on drawings.

2.0 Standards :

As per Applicable standard

3.0 Light Fixtures :

3.1 The light fixture construction shall be of IP 65 die cast aluminium with a separate compartment for integral ballast equipment. The reflector shall be anodized polished aluminium. The glass refractor shall be heat-resistant.

3.2 Lamp holder shall be of porcelain and shall comprise of a terminal block of non-hygroscopic material. The luminaries shall have integral ballast housed in water tight and dust tight metal cases. Ballast shall be pre-wired to the Lamp socket and terminal block, requiring only power supply leads to the ballast primary terminals.

3.3 The Lamp & Laminar shall generally follow the specification under section `LIGHT FIXTURES'.

4.0 Lighting Poles : Lighting Poles for street lights /flood lights shall be swaged type GI pole construction

4.1 The lighting poles shall be fabricated from heavy duty cold-rolled steel tubes to IS:1239-1958 and hot dip galvanized or painted as specified. The pole shall have a base plate, a large access panel, and necessary fixture

mounting bracket at top. The access panel shall provide easy access to a multi-way porcelain connector and fuse board, to be mounted inside the pole. The access shall be specially fabricated with adequate reinforcement and weather gasket to prevent ingress of moisture and vandal proof. Poles shall have large diameter entries for incoming and outgoing cable and two earth studs. The pole fabrication shall conform to the drawings and where such drawing is not available, the contractor shall make such drawing and have it approved before fabrication.

4.2 The pole shall house a multi-way porcelain terminal block and re-wirable fuse as shown on the drawings. Pole shall have a concrete coping.

5.0 Cable laying :

5.1 Cabling shall be generally as specified in the section `CABLING'.

5.2 Cables shall be terminated in a 4-way terminal block inside the pole or attached therewith as shown on drawings.

5.3 Cable route shall be as shown on the drawings or the contractor shall mark out the route and lay the cables only upon approval of the route.

6.0 Earthing :

6.1 All street lights fixtures and poles shall be earthed as specified under section `EARTHING'.

7.0 Mode of Measurement :

7.1 Each light fitting with lamp, control gear, earthing etc. shall be considered as one unit for measurement and payment.

7.2 Each lighting pole, concrete coping, base plate earthing etc. shall be considered as one unit for measurement and payment.

7.3 All cabling work shall be measured on the basis of unit length and the cost shall include, cost of cable ,cable termination in junction boxes or pole terminal box etc.

8.0 LT SECTION FEEDER PILLAR - SFP

8.1 SCOPE :

(i) This specification covers the scope of design, fabrication, assembling, inspection at vender's works and delivery in properly packed condition to project site of cubical pattern MV Metal Enclosed Switchgear.

(ii) The switchgear would comprise Main L.T.power distribution panel , Section pillar, sub-section pillar, power distribution board(PDB).

8.2. CODES AND STANDARDS :

(A) The equipment shall be designed to conform to the requirements of following Indian Standards :

: 8623 and IEC-439	ctory built assemblies of switchgear and control gear.
: 4237	neral requirements for switchgear and control gear for voltage not exceeding 1000 volts.
: 2147	gree of protection provided by enclosures for low voltage switchgear and control gear.
: 375	rking and arrangement of busbars.

(B) Individual equipment housed in the Medium Voltage Switchgear shall conform to the following IS specifications.

: 13947(part-3) & IEC: 947-3 :	break switches and fuses combination units for voltage not exceeding 1000 Volts (specific requirements for the direct switching of individual motors) i.e. suitable for AC 23 duty.
: 1248	ect acting electrical indicating instruments.
: 694 (1990) and IS : 8130 (1994)	C insulated cables and aluminium conductors.
: 13703 (PART 2)	w voltage fuses.
: 13947 (PART 2)	circuit breakers.
: 2705	rrent transformers
13947(PART-4/SEC-1) & IEC-60947-4-1	ntactors.
13947(PART-4/SEC-1)	ermal overload relay

& IEC-60947-4-1

lian amended up to date

. Electricity Rules

proval From T.A.C./F.I.A. OR C.P.R.I. Tested.

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8.3 DESIGN & CONSTRUCTION REQUIREMENTS :

(a) The switch board shall be for indoor application, metal enclosed, dust & vermin roof, free standing, floor mounting, compartmentalized, modular type & extensible on both sides.

(b) The switch board shall be fabricated from CRCA sheet steel having following minimum thickness :

- Frames, load bearing members & large doors : 2.5 mm(12 swg)
- Partitions & small doors : 2.03 mm(14 swg)
- Front, back & side covers : 2.03 mm(14 swg)
- Section pillar : outer side(Front, back & side covers) 12 SWG and inner side 14 SWG

(c) The board shall be divided in to distinct vertical sections, each comprising of :

- A completely metal enclosed bus bar chamber running horizontally throughout the length of the switchboard.
- Individual feeder modules.
- Vertical busbar chamber at the side of feeder modules or back of the feeder module.
- Cable alley shall be with 250 mm width for double front execution.

(d) The switchboard shall be provided with degree of protection of not less than IP 42 as per IS 2147 for indoor application and all section pillar /sub-section pillar shall be of not less than IP-55 as per IS outdoor application.

(e) Maximum height of the board including the height of the Base Channel shall be 2450 mm. Also, the minimum & maximum mounting height of the switches, relays & instruments etc. shall be 200 mm & 2000 mm respectively, above the bottom of the Base Channel.

(f) Suitable sized thick neoprene gaskets shall be provided all round the perimeter of doors, covers etc for making the construction dust & vermin proof.

(g) Power/control terminals in the cable alleys for each module & also the busbar chamber shall be covered with hinged & bolted type hylum shrouds respectively to prevent accidental contact when the door/cover

is withdrawn. In each feeder module, the phase barrier of hylum sheet shall be provided between the adjacent phases.

(h) Suitable lifting hooks shall be provided on each shipping section of the board. **Each module shall be considered as separate shipping section.**

(i) In case of double front type design the vertical busbar chamber shall be common for the front sided feeders as well as for the rear sided feeders in each panel of the switchboard.

(j) Gland plate of 5 mm thickness shall be provided at the top or bottom of the board, and gland plate shall be of **non -magnetic type. (Where ever required)**

(k) All the feeder modules & the cable alleys are provided with hinged type doors and cam lock with key lock chromium plated, whereas all the busbar chambers are provided with bolted type .

(l) Main earth bus of aluminium flat shall be suitably placed running throughout the length of the switchboard.

(m) All the hardwares used in the construction of the switchboard shall be chromium /zinc plated passivated type with spring washers to avoid loosening of the fixed parts.

8.4 METAL TREATMENT AND PAINT FINISH :

(a) PRE TREATMENT CHEMICAL PROCESS :

All sheet steel work used in the construction of the switchboards shall be pre-treated with 7-tank chemical process as specified in the specific requirement sheet before applying the two coats of zinc cromate primer followed by synthetic enamel/epoxy paint as follows :

7-TANK PROCESS :-

1. DEGREASING :-

In this process the M.S. sheets shall be effectively cleaning by dipping in hot alkaline degreasing solution for the period of about 10-20 minutes.

2. WATER RINSING :-

After degreasing process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the loosened oil, grease and adhering alkali from the surface.

3. DERUSTING :-

In this process the M.S. sheets shall be pickled in dilute sulphuric acid to remove oxide scales and rust formation for the period of about 30 minutes.

4.WATER RINSING :-

After the derusting process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the traces of acidic solution from the surface.

5. PHOSPHATING :-

In this process the M.S. sheets shall be dipped in to the zinc phosphating solution for the period of about 30 minutes to facilitate durable coating of the paint on the metal surfaces.

6.WATER RINSING :-

After the phosphating process the M.S. sheets shall be rinsed in to the water for the period of about 1-2 minutes to remove the traces of phosphate solution from the surface.

7. PASSIVATION :-

In this process the M.S. sheets shall be dipped in to the de-oxalite solution for the period of about 1 minute to retain and augment the effects of phosphating on the surface.

After completion of 3-tank/7-tank process a fine grained, smooth and compact coating of iron/zinc phosphate shall be produced, which is an excellent base for paint and provide under film protection against corrosion. The coating shall meet the Indian Standard Specification IS:3618-1966 class C.

(b) DRYING :

After the above pre treatment chemical process, the M.S. sheets shall be dried either by means of hot air circulation oven (stoving) or by means of blast of compressed air (air drying).

(c) PRIMER COATING :

Primer coating with two coats of highly corrosion resistant zinc cromate primer shall be done before applying the final paint finish.

(d) PAINT FINISH :

The final finishing of synthetic enamel/epoxy paint of **RAL-7032** shall be matt finish powder coated.

8.5 MATERIAL/COMPONENT SPECIFICATIONS :

(A) BUSBAR :

(a) The busbar shall be air insulated with heat shrinkable coloured sleeves and made of high conductivity high strength Aluminium complying to the requirements of IS : 5082.

(b) The busbar shall be suitably braced with non-hygroscopic epoxy resin cast/SMC supports at regular distance to provide a through fault withstand capacity of 50 KA RMS symmetrical for one second and a peak short circuit withstand of 150 KA minimum. Ridges shall be provided on the busbar supports to prevent tracking between adjacent busbars.

(c) The main horizontal busbars shall be positioned at top portion running throughout the length of the switch board. The cross section of the busbar shall be uniform throughout the length of busbar. The busbars shall be insulated with coloured PVC heat shrinkable sleeves i.e. red coloured for R-phase, yellow coloured for Y-phase, blue coloured for B-phase and black coloured for Neutral. Also the sequence of R, Y & B phase busbars shall be from top to bottom/left to right/front to back respectively and Neutral busbar shall be fixed near to R or B phase busbar.

(d) The vertical busbars shall be provided in separate vertical busbar alley adjacent to individual feeder modules. Suitable barrier shall be provided in front of vertical busbar against accidental contact after the module has been withdrawn.

(e) Pre-drilled holes shall be provided on the vertical risers so that modules can be changed at site, for vacant feeders also.

(f) High tensile bolts and spring washers shall be provided at all busbar joints. Also, all busbar joints shall be protected by using hylum/plastic shrouds.

(g) The minimum clearance in air between phase to phase busbars as well as between phase to earth shall be 25 & 20 mm respectively or as per fault level requirement.

(h) Main busbars shall be adequately sized, so that, while carrying rated current continuously the maximum temperature of busbars, even at joints, does not exceed 85 degree centigrade.

(i) Danger caution plates shall be provided on each busbar chamber cover.

(j) Busbar shall be of sufficient cross section so that a current density of 160 A/ Sq.cm (1000 A/ sq. inch) is not exceeded at nominal current rating for copper bus bars.

(B) UNIT MODULE :

(a) Each module shall be suitable for mounting drawout type air circuit breakers/MCCB/MCB power fuses, control fuses, contactors, relays, push buttons, indicating lamps, terminal blocks etc. as may be required.

(b) Each module shall be provided with individual door and the door shall be mounted on the main structure. The doors shall be provided with concealed hinges. The module door with cromium plated locks / key operation.

(c) Unit doors shall be interlocked mechanically with breaker/switch/fuse switch to prevent unintentional opening of the door while the units is in energized condition. However, provision should be made to open the door in energized condition i.e. defeat facility, for testing purpose.

(d) Main HRC fuses shall be positioned before the isolator to eliminate any position hazards during a fault at the isolator terminals. The HRC fuses however, shall not be accessible when they are in live condition.

(C) CIRCUIT BREAKERS :-

(a) The circuit breaker shall be air break type, FOUR pole, Drawout type and electrically operated type as specified in the schematic drawing complying to the requirements of IS : 13947(PART 2)

(b) The circuit breaker shall be provided with shunt trip mechanism.

(c) The circuit breaker shall be provided with inbuilt over current, short circuit and earth fault releases or separate protection relays as may be specified in the schematic drawing. All release shall be micro processor based.

(d) The circuit breaker shall be provided with 6 NO + 6 NC auxiliary contacts rated 10 Amp, 240 Volt AC supply duly wired up to the terminal block for purchaser's use.

(e) The circuit breaker shall be provided with red, green, amber and white indicating lamps for indicating closed, open, auto trip and trip circuit healthy conditions of the breaker. all release shall be micro processor based.

(f) Automatic safety shutters shall be provided to completely cover the female primary contacts when the breaker is withdrawn from service position.

(g) Compartment door of breaker should not open unless the associated breaker is in open position. The interlock defeat also to be provided.

(h) Closing action of the breaker shall charge the tripping spring ready for tripping.

(i) Manually operated breaker shall be of the spring charging stored energy type.

(j) Electrically operated breaker shall be provided with following :-

(i) 1 no 240 V, 1-ph, 50 Hz AC universal motor for charging the breaker closing spring along with HRC fuse link with base and carrier or SP MCB of appropriate rating and of approved make. Motors shall be sized such that maximum spring charging time is less than 15 seconds.

(ii) Limit switches with 2 NO + 2 NC contacts for cutting off the power supply to spring charging motor when spring is under fully charged conditions.

(iii) Closing of breaker shall automatically initiate the recharging of closing spring ready for next closing.

(D) SWITCHES/FUSE SWITCHES : Not Applicable

(E) FUSES :

(i). Fuses shall be of HRC cartridge link type having rupturing capacity of not less than 80 KA at 440 Volt.
(ii). Fuses shall preferably be mounted in moulded plastic carriers and shall be complete with fuse bases.
(iii). Fuses shall be suitably rated to prevent damage of the switchgears incorporated in the respective circuit of the particular module in case of overloading or any other fault occuring in the circuit.

(F) CONTACTOR :

(i). All the motor starter feeders shall be provided with electro magnetic type tripple pole contactors suitably rated for uninterrupted AC-3 duty and shall comply with the requirements of IS : 13947 (PART 4 /SEC. 1)
(ii). Main contacts of the contactors shall be of silver plated copper.
(iii). Each contactor shall be provided with 2 NO + 2 NC auxiliary contacts.
(iv). Operating coils of contactors shall be suitable for operation from the control supply of 420V/240V/110V AC.

(G) TIMER WITH POWER RESERVE CAPACITY :

(i). Power reserve capacity of timer shall be minimum upto 150 HRS. And timer with 24 HRS. Programmer.
(ii). Timer shall be with High switching capacity and with inbuilt over-ride facility.
(iii). Modular construction, Flush\Base\Dinrail mounting

(H) THERMAL OVERLOAD RELAYS :

(i). All the motor starter feeders shall be provided with triple pole bimetal thermal overload relays with inbuilt single phasing protection to furnish protection against overload and single phasing and shall comply to all the requirements of IS : 13947 (PART 4 /SEC. 1)

(ii). Thermal overload relays shall be provided with adjustable settings. The setting range shall be properly selected in accordance with the rating of the motor.

(iii). Thermal overload relays shall be provided with at least 1NO + 1 NC auxiliary contacts.

(iv). Thermal overload relays shall be either self reset type or hand reset type. In case of hand reset type thermal overload relays, the reset push button shall be mounted flush on the compartment door separate from start/stop push button.

(I) CURRENT TRANSFORMERS :

Current transformers shall have adequate class of accuracy and VA burden to comply with all the requirements of IS : 2705.The design of current transformers shall be of ring tape wound type.Unless otherwise specified, the minimum performance requirement of current transformers are as follows :

- Measuring CT :- rated burden 15 VA, accuracy class 1.0
- Protective CT :- rated burden 15 VA, accuracy class 5P10

All current transformers shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformer insulation resistance.Secondary windings of current transformers shall be rated for 1 Amp as specified in the schematic diagram of the switchboard.

(J) INDICATING INSTRUMENTS :

(i). Ammeters and Voltmeters shall be of moving iron spring controlled (MISC) industrial type suitable for flush mounting of size 144x144/96x96 sq.mm. of suitable range as specified in the schematic drawing of the switchboard.

(ii). Ammeters with suppressed scale current rating shall be provided for specific requirements.

(iii). Energy meter (KWH meter) of direct reading 3-phase 4 wire unbalance type shall be provided wherever specified in the schematic drawing of the switchboard. It should be mounted inside the compartment but can be read through cutout on the compartment door.

(iv). Power factor meter (PF meter), frequency meter (Hz meter), Watt meter (KW meter) etc. shall be provided if specified in the schematic drawing of the switchboard.

(K) INDICATING LAMPS :

(i). Indicating lamps shall be of LED. The lamps shall have translucent lenses to diffuse light.

(ii). Indicating lamps shall be provided in the respective colours i.e. Red, Yellow, Blue, Green, Amber, White etc. as required in the schematic drawing of the switchboard.

(L) PUSH BUTTONS :

(i). Push buttons shall be rated for 10 Amp at 240 Volt AC and provided with 1 NO + 1 NC auxiliary contacts.

(ii). On/start push button actuator shall be of Green colour, off/stop push button actuator shall be of Red colour and O/L relay reset push button actuator shall be of Black colour.

(M) INTERNAL WIRING :

(i). All power/control wiring of the switchboard shall be made with 1100/660 Volt grade Black/Gray
FRLS-PVC insulated flexible/stranded copper wires.
(ii). The size of control wiring shall be 2.5 sq.mm. except for CT secondary circuit of 2.5 sq.mm. wire.
(iii). Pin type crimping lugs shall be provided for flexible wire terminations.
(iv). Power wiring shall be terminated preferably on stud/clamp type terminal blocks, whereas, control wiring
shall be terminated on clip-on type terminal blocks.
(v). All electrical connections are made vibration proof by proper tightening by using plain washers and
spring washers etc.

(N) TERMINAL BLOCK :

(i). Terminal blocks for power circuits shall be of 660 V grade with contacts of rating not less than 10 Amps.
They shall be of the stud type of Elmex/Connecwell make with insulated barriers between adjacent terminals.
(ii). Terminal blocks for control circuits shall be of clip on type of Elmex/Connectwell make complete with mounting channel.
(iii). The wire terminations to the blocks shall be screw type suitable for crimp type socket.
(iv). Suitable provision shall be made to terminate power/control connections in the respective module.

(J) SPACE HEATER :

Space heater with thermostate and switch shall be provided in each cable alley of the cubical switchboard if specified in the specific requirement sheet.

(O) LABLES :

Lables shall be of anodized aluminium or acrylic sheets with white engraving on black back-ground. The engraving shall provided at the

back side of lable. They shall be properly secured by fastners at convenient location on each feeder module, busbar chamber and cable alley of the cubical switchboard.

8.6. TESTS :

The switchboards shall be tested for all the following routine tests in accordance with IS:8623 of specification for Factory Built Assembly (FBA) of switchgear & controlgear for voltage up to and including 1000 V AC and 1200 V DC.

a. Inspection of the switchboard including inspection of wiring and electrical operational test, where necessary.
b. High voltage test
c. Insulation resistance test (Megger test)

8.7 DRAWINGS AND DOCUMENATION :

(a) General Arrangement (GA) drawings indicating front, rear, side, sectional views, dimentions of the feeder modules and overall dimentions of the switchboards shall be furnished alongwith the offer.

(b) After getting the order, the supplier should submit two sets of the following drawings and technical data to us for our review and approval.

(i) General Arrangement (GA) drawings indicating front, rear, side, sectional views, dimensions of the feeder modules and overall dimensions of the switchboards.
(ii) Single line diagrams of the switchboards.

(iii) Control schematic drawings for various types of feeders.

(iv) Bills of quantity sheet indicating details of components (make,cat.no.,rating, type etc.) in each feeder of the switchboards.

(c) According to the changes/comments we have mentioned, the supplier should submit the final three sets of the above drawings/documents for our reference and record. One will remain with us, one with client and one will be return back to supplier duly signed & sealed.

Lightning Arrestor

1.1 General

Installation of Lightning Protection System shall be strictly in accordance with IS/IEC: 62305-2010.
Contractor to submit design drawing with calculation sheet for approval of consultant before execution.
1.2 Zone of Protection

The zone of protection of a lightning conductor define the space within which a lightning conductor provides protection against a direct lightning stroke

by diverting the stroke to itself. For a single vertical conductor, this zone is described as a cone with its apex at the highest point of the conductor and with an angle called as protective angle. For the purpose of providing an acceptable degree of protection the protective angle of termination network shall be considered as 45°. Between two or more vertical conductors of equal height spaced at a distance not exceeding twice their height, the protective angle within the space bounded the air termination shall be taken as 60° to the vertical, while the protective angle away from the conductor will be taken as 45° to the verticals.

1.3 Material and Dimensions

The materials of lightning conductor, down conductors, earth termination etc. shall be copper / GI as per schedule of quantities and shall be protected against corrosion.

All air terminations and down conductors shall be of copper / GI as per schedule of quantities and shall conform to IS/IEC: 62305-2010.

1.4 Joints and Bonds

The lightning protective system shall have as few joints as far as possible. Wherever joints in the conductor are necessary they shall be mechanically and electrically effective, and shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner.

1.5 Earth Terminations

Each down conductor shall have an independent earth termination. All the earth termination shall be inter connected and shall be capable of isolation for testing.

1.6 Earth Electrode

Earth pits shall be installed in accordance with IS : 3043-Latest edition.

The resistance of earthing system shall not exceed 1 ohm.

1.7 Air Terminations Mesh (On the Terrace)

As an alternative to vertical air termination, grid of horizontal air termination may also be provided as per IS 2309. Often combination of both may be provided when stucture to be **protected for high** ratio of length to height. Air termination mesh shall be provided not greater than 10mx20m. Down conductor shall be not more than 10 m apart where the building height in more than 20 m.

1.8 Fasteners

Conductors shall be securely fixed to the building to be protected by fasteners which shall be not more than 1.20 meter apart for horizontal run and 1.0 meters for vertical run.

A : UPS SYSTEM

1.0 Scope:

The scope covers supply, installation, testing & commissioning of UPS system given in BOQ, complete with batteries & all accessories along with its configuration into SCADA.

UPS:-
"True Online-Double conversion type single module UPS.
Input 415V Nominal; 50Hz; 3Phase 4wire system. (single phase input up to 7.5 kva)
Output 415V Nominal; 50Hz; 3Phase 4 Wire system (single phase output up to 7.5 kva)
with Battery each UPS comprising of the following Major components

IGBT based Rectifier cum charger
IGBT based Inverter
Sealed maintenance free battery with back up time of 10Mins
Inter connecting cables; Links; Racks and standard accessories
(Attach Battery Sizing calculation for back up)
Built in SNMP card

The Client will only give the connection to the Incoming terminals and take the load from Outgoing terminals of the UPS.
All other equipment necessary to operate the UPS is in the scope of the Vendor. Any deviation from this scope has to be intimated to the client well in advance.

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2.0 GENERAL
SUMMARY

This specification describes the operation and functionality of a continuous duty, dual input feed with configurable single-phase or three-phase output power (3:1 or 3:3), solid-state, static Uninterruptible Power System (UPS) hereafter referred to as the UPS.

The UPS shall utilize double conversion online topology designed to protect electronic equipment by supplying reliable, network-grade power with extremely tight voltage and frequency regulation. The UPS shall feature an internal static bypass and input power factor correction.

Configuration Specifics:

The system power train shall comprise of, input disconnect and filter stage, input PFC power stage, energy storage stage (DC bus capacitor bank), output power stage (inverters), static bypass switch for connecting bypass line to the output, and battery charger.

The system shall also include, field-replaceable fan module, removable input/output wiring trays, battery disconnects, an LCD interface display, EPO, and an integrated UPS network management card with temperature monitoring.

The UPS and associated equipment shall operate in conjunction with a primary power supply and an output distribution system to provide quality uninterrupted power for mission critical, electronic equipment load.

All programming and miscellaneous components for a fully operational system as described in this specification shall be available as part of the UPS.

STANDARDS

EN50091-1/ EN/IEC62040-1-1

EN50091-2 / IEC62040-2

EN55022 Class A

EN55024

EN61000-4-2, 4-3, 4-4, 4-5, 4-6, 4-11

EN60950

IEC 60950

CE

VDE

C-tick

ISO 9001

ISO 14001

MODES OF OPERATION

Normal: The input Power Factor Corrector (PFC) stage and output inverter stage shall operate in an on-line manner to continuously regulate power to the critical load. The input and output converters shall be capable of full battery recharge while simultaneously providing regulated power to the load for all line and load conditions within the range of the UPS specifications.

Battery: Upon failure of the AC input source, the critical load shall continue being supplied by the output inverters, which shall derive their power from the battery system. There shall be no interruption in power to the critical load during either transfer to or from battery operation back to normal operation.

During the re transfer from battery to on-line operation, the load shall be softly transferred from battery back on-line within 10 seconds, to avoid step load changes on the mains supply.

Recharge: Upon restoration of the AC input source, the input converters and output inverters shall simultaneously provide regulated power to the critical load and recharge the battery.

Bypass operation: Bypass mode shall be reached either as a user selection or automatically.

Bypass mode can be selected through the Control menu screen on the PowerView display

The UPS will automatically switch into bypass mode if:

Both normal and battery operation modes are unavailable
An output overload condition occurs
The UPS has an internal fault

During bypass operation the utility power is connected to the load, bypassing the internal converters. If the bypass mode becomes unavailable the UPS will automatically switch to mains power. In the event that mains power is unavailable the system will switch to battery power.

With the UPS supplied from dual feeds and operating on battery, due to a mains failure, it shall be possible to request the unit to go to bypass, in addition to automatically transfer to bypass when the batteries are depleted. In this bypass mode the inverter shall become a PFC and back-feed the DC buses. This allows the charger to continue charging the batteries.

SUBMITTALS

Proposal Submittals:

As bid system bill of materials.

Product catalog sheets or equipment brochures.

Product guide specifications.

System single-line operation diagram.

Installation information, including weights and dimensions.

Information about terminal locations for power and control connections.

Delivery Submittals:

Installation manual, which includes instructions for storage, handling, examination, preparation, installation, and start-up of UPS.

User manual, which includes operating instructions.

PRODUCT

MECHANICAL DESIGN

The UPS shall be contained in two rugged steel cabinets one containing the power electronics and the other containing the batteries and single phase distribution outlets;

The UPS and battery cabinets shall be capable of conversion between Tower / Stack and Rack-Mount configurations;

The power electronics cabinet dimensions including terminations shall be

Rack configuration 263 x 432 x 773mm (10.35 x 17 x 30.43 in.) (Height x Width x Depth), requires 6U of rack space and the side rack mounting brackets shall increase the overall width to 482mm (19 in);

Tower configuration 432 x 263 x 773mm (17 x 10.35 x 30.43 in.) (Height x Width x Depth);

SYSTEM CHARACTERISTICS

System Capacity:

The system shall be rated for .8 Pf output:

60,000VA or 48,000W whichever limit is reached first (60kVA model).
100,000VA or 80,000W whichever limit is reached first (100kVA model).

Input:

AC input nominal voltage:

220/230/240VAC, single phase, 3 wire (L + N + G) Up to7.5 KVA
380/400/415VAC, three phase, 5 wire (L1+L2+L3+N+G); for above 10 KVA

AC input voltage window:

Full Load, 160 -275V (Line-Neutral) for single phase input or 277 -476V (Line-Line) for three phase input;
Half Load, 100 -275V (Line-Neutral) for single phase input or 173 -476V (Line-Line) for three phase input;

Input frequency range: 40-70Hz;

Input Power Factor; > 0.98 at 100% load

Input Current Distortion: < 4% at 100% load, 230VAC (<7% for 3 phase output)

Crest factor: 3:1.

UPS Output:

AC Output Nominal Output: (Customer configurable)
220VAC, 230VAC or 240VAC, Single Phase three wire, 50/60Hz; up to 10 KVA

380VAC, 400VAC or 415VAC, Three phase five wire, 50/60Hz; above 10 KVA

AC output voltage distortion: Max. 2% @ 100% linear load; Max. 5% @ 100% non-linear Load;

AC output voltage regulation (Static): +/-1%;

Voltage Transient Response : +/- 8% maximum for 100% load step

Voltage Transient Recovery within < 10ms recovery time;

Output Voltage Harmonic Distortion:

<2% THD maximum for a 100% linear load
<5% THD maximum for a 100% non-linear load

Overload Rating:

Online: 105% - infinite; 125% - 1 minute; 150% - 30 seconds;

In bypass: Overload is limited by the external input circuit breaker feeding the UPS.

System AC-AC Efficiency:
> 91 % for 6, 10kva
> 94% for 15 and 20 kva
> 96 % for 30 kva

Output Power Factor Rating: 0.2 –1.0 lagging, nominal: 0.8 lagging.

Output frequency: 50/60 +/- 3Hz tracking or 50/60 +/- 0.1Hz tracking (user selectable);

Output connectors:

Single phase: Hardwire 3-wire (Phase + N + G),
Three phase: Hardwire 5-wire (3 Phase + N + G)

Output frequency Slew rate : 1.0Hz/Sec, 0.5Hz/Sec 0.25Hz/Sec

ENVIRONMENTAL

Storage Ambient Temperature:

-15° to +45° C (+5° to +113° F) charge the UPS battery every 6 months.
+30° to +70° C (+86° to +158° F) charge the UPS battery every 3 months.

Operating Ambient Temperature: 0°C to +40°C (+32°F to +104°F). (+25°C (+77°F) is ideal for most battery types).

Relative Humidity: 0 to 95% non-condensing

Storage altitude: 15,240m (50,000 feet) above sea level

Operating altitude: 3,000m (10,000 feet) above sea level. At an altitude of 3,000 m the UPS shall be capable of supporting a load of up to 90% of its nominal capacity.

Audible noise:

a. <50dBA at <70 % load at 1m,
b. <60dBA at >75 % load at 1m

INPUT PFC POWER STAGE

The input PFC power stage of the UPS shall constantly rectify the power imported from the mains input of the system, converting the input mains AC power to DC power for precise regulation of the DC bus voltage, battery charging, and output power stage (inverter) regulated output power.

Input Current Total Harmonic Distortion: The input current THD_I shall be held to 6% or less at full system load, while providing conditioned power to the critical load bus, and charging the batteries under steady-state operating conditions. This shall be true while supporting loads of both a linear or non-linear type. This shall be accomplished with no additional filters, magnetic devices, or other components.

Input Current Limit:

The input converter shall control and limit the input current drawn from the utility supply

Overloads at low line input voltages shall draw power from the battery, (battery assist mode) in order to support the load and maintain the input current below the set current limit points.

Charging:

The battery charging shall maintain the DC bus float voltage of +/-219V, +/-1% at the nominal temperature of 20°C (68°F)

The battery charging circuit shall contain a temperature monitoring circuit, which will regulate the battery charging current to optimize battery life.

The battery charging circuit shall remain active when in automatic Bypass and in Normal Operation.

The battery charging system shall adjust the charging current by automatically sensing the number of battery modules and by monitoring the individual battery current. Maximum charger power shall be 3kW.

OUTPUT POWER STAGE (INVERTER)

The UPS output power stage (inverter) shall constantly recreate the UPS output voltage waveform by converting the DC bus voltage to AC voltage through a set of IGBT switches. In both online operation and battery operation, the output power stage (inverter) shall create an output voltage waveform independent of the mains input voltage waveform. Input voltage anomalies such as brown-outs, spikes, surges, sags, and outages shall not affect the amplitude or sinusoidal nature of the recreated output voltage sine wave of the output power stage (inverter).

Overload Capability: The output power stage (inverter) shall be capable of withstanding 150% overload for 30 seconds or 125% overload for 1 minute or 105% overload for an indefinite length of time. The system shall transfer to bypass if the overload persist and then return back on-line when the overload is removed.

Battery Protection: The UPS shall have monitoring and control circuits to limit the level of discharge on the battery system.

AUTOMATIC BYPASS

As part of the UPS, a system automatic bypass switch shall be provided. The system automatic bypass shall provide a transfer of the critical load from the Inverter output to the automatic bypass input source during times when the inverter cannot support the load. Such times may be due to prolonged or severe overloads, or UPS failure. The UPS shall constantly monitor the output current, as well as the bypass source voltage, and inhibit potentially unsuccessful transfers to automatic bypass from taking place.

The design of the automatic bypass switch power path shall consist of an electromechanical bypass contactor and series SCR's.

Automatic Transfers: An automatic transfer of load to bypass shall take place whenever the load on the critical bus exceeds the overload rating of the UPS. Automatic transfers of the critical load from bypass back to normal operation takes place when the overload condition is removed from the critical bus output of the system. Automatic transfers of load to bypass shall also take place if for any reason the UPS cannot support the critical bus.

Manual Transfers: Manually initiated transfers to and from bypass shall be initiated through the UPS interface display or via the serial communications port.

DISPLAY AND CONTROLS

Control Logic: The UPS shall be controlled by an embedded microcontroller which performs the following functions:

Monitoring quality of input, bypass and output voltages;

Monitoring vital parameters of the UPS;

Executing the state machine;

Intelligent battery management;

Remaining runtime calculation;

Self-diagnostics, self-test and proactive fault detection;

Communication to the host server via serial port;

Communication to the Network Interface Card or another SmartSlot accessory card if equipped.

Display Unit: A microprocessor controlled display unit shall be located at the front of the system. The display shall consist of an alphanumeric display with backlight, providing system status, LED alarm indicators and a keypad consisting of pushbutton switches for control and status reading selection.

Metered Data: The following metered data, shall be available on the alphanumeric display:

Year, Month, Day, Hour, Minute, Second of occurring events

Source and Bypass Input Voltages

Output AC voltage

Input, Bypass and Output AC currents

Input, Bypass and Output Frequency

Battery voltages and currents

Internal and battery pack temperature

Event log: The display unit shall allow the user to display a time and date stamped log of the 100 most recent status and alarm events.

Alarms: The display unit shall allow the user to display a log of all active alarms. The following minimum set of alarm conditions shall be available:

Input Frequency outside configured range

AC adequate for UPS but not for Bypass

Low/No AC input, startup on battery

Number of Batteries changed since last ON*

Number of Batteries increased*

Number of Batteries decreased*

Need Battery Replacement*

UPS Fault

On Battery

Shutdown or unable to transfer to battery due to overload

Load Shutdown from Bypass. Input Frequency Volts outside limits

Fault, Internal Temp exceeded system normal limits

System level fan failed

Runtime is below alarm threshold

Load is above alarm threshold

Load is no longer above alarm Threshold

Minimum Runtime restored

Bypass is not in range (either frequency or voltage)

UPS in Bypass due to Internal Fault

UPS in Bypass due to overload

Low Battery Shutdown

Low Battery Warning

Controls: The following controls or programming functions shall be accomplished by use of the display unit. Pushbutton switches shall facilitate these operations.

Silence audible Alarm

Display or set the date and time

Transfer critical load to and from bypass

Test battery condition on demand

Set intervals for automatic battery tests

Adjust set points for different alarms

Communication Interface Board: A communication interface shall provide the following communication ports which can be used simultaneously:

RS232 Serial Port #1

RJ-45 Interface port for PowerView Display

RJ-45 Ethernet connection, on installed Network Management Card

BATTERY

External SMF Battery

The UPS battery system shall comprise of user replaceable external batteries providing 192VDC nominal for the positive DC bus rail and 192VDC nominal for the negative DC bus rail.

The battery blocks shall be of the Valve Regulated Lead Acid (VRLA) type.

The UPS shall incorporate an Intelligent Battery Management system to continuously monitor the health of the battery system and notify the user if that system is weak or needs replacing.

General description for Batteries

Batteries shall be of the Sealed Lead-Acid type.

Two separate, isolated 192 V battery systems shall be provided. One cable shall be wired to each 192 V battery system. Two cable assemblies shall be included with the UPS, one for each 192 V battery system.

Each battery system shall have identical Amp-hrs capacity.

Ground wires shall be supplied for connection from the UPS to each battery enclosure grounding point.

Charging:

The intelligent battery management system shall contain a temperature monitoring circuit and compensation algorithm that regulates the battery charging current so as to optimize battery life. The UPS shall monitor the temperature of all proprietary battery packs and use the highest one as a reference to adjust the battery float voltage.

The battery charging circuit shall remain active when in bypass or on-line.

Charging system shall automatically adjust the maximum charger power, up to 3kW, based on the installed proprietary battery capacity and current through each battery string to avoid excessive charging that could result in bloated batteries. Each proprietary battery pack shall report its battery currents and temperature to UPS through CAN communication

ACCESSORIES

REMOVABLE INPUT/OUPUT ELECTRICAL TERMINAL

The input and output terminal connections shall be designed to be removable trays for easy electrical connection and unit removal.

The removable input and output trays shall contain a means of configuring the system for 1 or 3 phase input and output as well as for single or dual feed input.

SOFTWARE AND CONNECTIVITY

Network Adaptor: Built in SmartSlot Network Management Card shall allow one or more network management systems (NMS) to monitor and manage the UPS in TCP/IP network environments.

Unattended Shutdown

The UPS, in conjunction with a network interface card, shall be capable of gracefully shutting down one or more operating systems when the UPS is operating in the battery mode. Network Shutdown software shall be available with the UPS.

The UPS shall also be capable of using an RS232 port to communicate with the host computer by means of serial communications so as to gracefully shut down one or more operating systems during an on battery situation.

REMOTE UPS MONITORING, CONFIGURATION AND CONTROL

The following three methods of remote UPS control, configuration and monitoring are available:

Web Monitoring: Remote monitoring shall be available via a web browser such as Internet Explorer.

RS232 Monitoring: Remote UPS monitoring shall be possible via either RS232 or contact closure signals from the UPS.

Simple Network Management Protocol (SNMP): Remote UPS Monitoring shall be possible through a standard MIB II compliant platform.

SOFTWARE COMPATIBILITY

The UPS manufacturer shall have available software to support graceful shutdown and remote monitoring for the systems detailed on the following web link:

EXECUTION

START-UP

Start-up is requested, factory trained service personnel shall perform the following inspections, test procedures, and on-site training:

Visual Inspection:

Inspect equipment for signs of damage.

Verify installation per manufacturer's instructions.

Inspect cabinets for foreign objects.

Inspect battery chassis and modules.

Inspect power chassis

Mechanical Inspection

Check all UPS and internal power wiring connections.

Check all UPS and nuts, and/or spade lugs for tightness.

Electrical Inspection:

Verify correct input and bypass voltage.

Verify correct UPS control wiring and terminations.

Verify voltage of all battery modules.

Verify neutral and ground conductors are properly landed.

Inspect external service bypass panel for proper terminations.

Site Testing:

Ensure proper system start-up.

Verify proper control functions.

Verify proper bypass operation.

Verify system set points.

Verify proper inverter operation and regulation circuits.

Simulate utility power failure.

Verify proper charger operation.

Document, sign, and date all test results.

On-Site Operational Training: During the factory assisted start-up, operational training for site personnel shall include key pad operation, LED indicators, start-up and shutdown procedures, maintenance bypass and AC disconnect operation, and alarm information.

MANUFACTURER FIELD SERVICE

Worldwide service: The UPS manufacturer shall have a worldwide service organization available, consisting of factory trained field service personnel

to perform start-up, preventative maintenance, and service of the UPS system and power equipment. The service organization shall offer 24 hours a day, 7 days a week, 365 days a year service support.

Replacement parts: Parts shall be available through the worldwide service organization 24 hours a day, 7 days a week, 365 days a year. The worldwide service organization shall be capable of shipping parts within 4 working hours or on the next available flight, so that the parts may be shipped to the customer site within 24 hours.

MAINTENANCE CONTRACTS

A complete offering of preventative and full service maintenance contracts for the UPS system and the battery system shall be available from the vendor. All contract work shall be performed by the vendor's factory trained service personnel.

TRAINING

UPS service training workshop: A UPS service training workshop shall be available from APC. The service training workshop shall include a combination of lecture and practical instruction with hands-on laboratory sessions. The service training workshop shall include instruction about safety procedures, UPS operational theory, sub-assembly identification and operation, system controls and adjustment, preventative maintenance, and troubleshooting.

B. APPLICABLE STANDARDS

Sr. No.	IS No. Description		
1)	IS: 2026-1977 1981 -1994	:	Power transformers & fittings.
2)	IS 3639-1966	:	Fittings and acc. For P.T.
3)	IS10028-Part III 1981	:	Installation of Transformer
4)	IS: 13118-1991	:	Specification for High voltage AC circuit breakers.
5)	IS: 335-1993	:	Insulating oil for Transformers & switch gear.
6)	IS: 2705-1992 protection	:	CT for measuring and.
7)	IS: 3156-1992 Transformers.	:	Voltage (Potential)
8)	IS: 3156-1992	:	Voltage Transformer.
9)	IS: 8623-Part II 1993	:	Bus-bar arrangement and marking.
10)	IS: 2099-1986	:	Bushing
11)	IS: 5621-1980	:	Large Hollow Porcelains Insulator

12) IS: 2544-1973 : Insulators greater than 1000V

13) IS: 2629-1985 : Hot Dip Galvanizing

14) IS: 2633-1986

15) IS: 3842-1967 : Relays for AC system

16) IS: 1248-2003 : Meters (measuring).

18) IS: 10118-1982 : Installation of Switch gears.

19) IS: 692-1994 : VHV Cable Paper Insulated Lead Sheathed Cables for Rated Voltage up to and Including 33 k–Specification

18) IS: 1255 -1983 : Installation of HV cables and jointing.

19) IS: 3043-1987 : Code of practice for earthing.

20) IS:13947-Part III -1993: HD Air breaker, Switch gears and fuses for Voltage not exceeding 1000 Volts.

21) IS: 13703-Part IV : Selection, installation and -1993 maintenance of fuses up to 650 Volts.

22) IS: 13947-Part I : General requirements for switch -1993 gear and control gear for voltage not exceeding 1000 Volts.

23) IS:13947-PartIII -1993 : Air-break isolators for Voltage not exceeding 1000 Volts

24) IS:8623-1993 : Factory built assemblies of switch gears and control gears for voltage up to and including 1000 Volts A.C. and 1200 Volts D.C.

25) IS: 11353-1985 : Marking and arrangement of switch gear bus bars main connectors and auxiliary wiring.

26) IS: 13947 PART-1 : Cubical Boards.

27) IS: 8084-1976 : Insulated Busbar rating.

28) IS: 2675-1983 : Enclosed distribution fuse boards and cutouts for Voltage not exceeding 1000 Volts.

29) IS: 8828-1995 : Miniature Circuit Breaker.

30) IS: 9926-1981 : Fuse wire used in rewirable type electric fuses up to 650 Volts.

31) IS:1554-Part -1988 : PVC insulated electric cables Heavy duty.

32) IS:3961-PartII&IV-1967 Recommended current rating for cables.

33) IS: 8130-1984 : Copper conductor in insulated cables and cores .

34) IS:8130-1984 : Conductor for insulated electric cables and flexible cords.

35) IS: 3975-1999 : Low Carbon Galvanized Steel Wires, FormedWires and Tapes for Armouring of Cables - Specification

36) IS: 5831-1984 : PVC insulation and sheath of electric cables.

37) IS: 8130-1984 : Aluminum conductor for insulated cables.

38) IS: 11955-1987 : Recommended current rating for Cable.

39) IS: 732-1989 : Code of practice for electrical wiring installation system Voltage not exceeding 650 Volts.

40) IS: 1646-1997 : Code of practice for fire safety of Buildings (general) electrical installation.

41) IS: 9537-1981 : Rigid steel conduits for electrical wiring.

42) IS: 2667-1988 : Fittings for rigid steel conduits for electrical wiring.

43) IS: 3480-1966 : Flexible steel conduit for electrical wiring.

44) IS: 3837-1976 Accessories for rigid steel conduits for electrical wiring.

45) IS: 694-1990 : PVC insulated cables (wires).

46) IS:9537-PartIII-1983: Installation of Rigid non-metallic conduits for electrical wiring.

47) IS: 6946-1973 : Flexible (playable) nonmetallic conduits for Electrical installation.

48) IS: 1293-2005 : Plugs and sockets upto 250V.

49) IS: 8130-1984 : Conductors for insulated electrical cables and flexible codes.

50) IS: 9537-1980 : Specification for conduit for electrical installation.

51) IS: 3419-1988 : Accessories for non-metallic conduits for electrical wiring.

52) IS: 3854-1997 : Switches.

53) IS: 6538-1971 : Plugs.

54) IS:13585-PartI-1998 : Shunt Capacitors for power systems upto 650V.

55) IS: 13703 : Low voltage fuse and links up to 1000 volts.

56) IS: 1913-1978 :General and safety requirement for lighting fittings.

57) IS: 1944-1981 : Code of practice for lighting public thorough fares.

58) IS:3528-1966 : Waterproof electric lighting fittings.

59) IS: 3553-1966 : Water tight electric lighting fitting.

60) IS: 1239-PartI-2004: Mild Steel tubular and other wrought steel pipe fitting.

61) IS:10322-PartV-1987: Luminaries for street light.

62) IS:13703-Part III-1993 : HRC fuses having rupturing capacity Voltage uo o 1000V

63) IS: 2312-1967 : Exhaust Fan.

64) IS: 374-1979 : Class I Ceiling Fan.

65) IS: 7098 (Part I, II, III) -1988 : XLPE armoured Cables upto 1000V

NOTE: All codes and standards means the latest where not specified otherwise the installation shall generally follow the Indian Standard codes of practice or relevant British Standard Codes of Practice in the absence of corresponding Indian Standards.

PLEASE FOLLOW:

a. Indian Electricity Act of 1910 and rules issued there under revised up to date.
b. Regulations for electrical equipment in building issued by The Bombay Regional Council of insurance Association of India.

TECHNICAL SPECIFICATIONS FOR ELV SERVICES

SUMMARY PAGE

ELV WORKS through specelsied SI to be engaged by main civil contractor after approval of the University and credential as per the CPWD guidelines.

General: All the material shall must confirm the good working condition as per the local weather/temperature and environmental condition. The product quality must confirm the seismic zone-IV. Before supply of the material lost type test certificate issued by the NABL/NABL accredited laboratory not earlier than 3 years must be submitted for Pre-Dispatch Inspection(s).

TECHNICAL SPECIFICATION

1. DATA & TELECOM – PASSIVE CABLING INFRASTRUCTURE – CAT6A CABLE & COMPONENTS, FIBER OPTICS CABLE & COMPONENTS

SCOPE OF WORK

- Complete installation shall be done in accordance with installation practices for a well structured cabling system, using components from a single OEM to ensure consistent and assured performance. The structured cabling distribution network shall serve as a vehicle for transport of data, video and voice telephony signals over a common network throughout the network.

- Devices and services that shall run on the passive network shall include, but not limited to, the following:

a.) Wired LAN access
b.) Wireless LAN access
c.) Voice communications servers and IP/SIP end-points
d.) IP-based CCTV/Surveillance Cameras
e.) Access Control Controllers
f.) DDC controllers for IBMS
g.) PLCs, FRTUs and HMI/MMI etc. for SCADA
h.) Various devices and controllers for AV system
i.) Video-conferencing equipment

- Cabling installation for data and voice communications shall originate at networking racks and terminate at IOs terminated at wall.

- Installation, termination and identification of wiring between station outlets and networking distribution rack(s)and networking distribution rack(s) and main rack (s), shall be considered part of the system integrator's work.

- All cables and terminations shall be tested @500 MHz identified, labelled and documented at all locations.

- system entirely operational for its intended use, by addition of components specific to its make/model even if not specifically mentioned in the BoQ without any additional cost.

- System integrator shall provide Ethernet cabling connectivity for all other services, utilities and systems (such as, but not limited to – HVAC, Electrical, Plumbing, Lift Panels and any other such) besides those already forming

part of ELV (CCTV, FAS, ACS, Data and Telecom) upto the device location as indicated by the respective utility contractor, e.g., DDCs, PLCs, FRTUs and other such. The respective utility contractor shall indicate the location of their devices and rack where the cabling is to be terminated.

Supported Applications, but not limited to:

- Ethernet Applications – wired Ethernet and wireless as per IEEE 802.11a/b/g/n/ac
- IEEE 802.3af Data Terminal Equipment (DTE) Power via Media Dependent Interface (MDI)
- Telecom – BRI, PRI and Digital Subscriber Loop (DSL) Applications
- Voice, Video and ISDN Applications

References & Standards, but not limited to:

- TIA / EIA
- International Electro technical Commission (IEC)
- European Committee for Electro technical Standardization (CENELEC)
- American National Standards Institute (ANSI)
- Institution of Electrical and Electronics Engineers (IEEE)
- Wherever there is reference to multiple standards and/codes, the ones most recent and most stringent shall apply.

It shall be the responsibility of the system integrator and OEM manufacturer to ensure that:

- The Passive Components of structured cabling distribution network will be free from manufacturing defects in material and workmanship under normal and proper use.
- All Passive Components in the structured cabling distribution network shall meet or exceed the relevant component specification of the EIA/TIA 568-B and EIA/TIA 568-C.2 series and ISO/IEC 11801: 2002 standards; or later version as applicable at the time of installation.
- The structured cabling distribution network compliant channels will meet or exceed the Guaranteed Channel Performance as per relevant standards in the structured cabling distribution network Performance Specifications in effect at the time of installation.
- The site will be duly certified by OEM for a period of 25 years from the date of issuance of the registration certificate or installation, whichever is earlier, for which they shall submit detailed performance test reports for every IO installed.

- The CAT6A SCS must be tested by an accredited 3rd Party test facility to the following standards: ANSI/TIA 568-C.2: Category 6A Channel – 4 connector
- Category 6A System shall meet and exceed the transmission requirements of ANSI/TIA-568-C.2, ISO/IEC 11801 Class EA and support 4PPoE as per IEEE 802.3bt (Type 4)
- The specifications for items in this section, applies to the following:
- F/UTP CAT6Acable and associated components such as Patch Panels, IOs/RJ45 Jacks,
- Patch Cords
- UTP CAT6 cable and associated components such as Patch Panels, IOs/RJ45 Jacks, Patch Cords
- Single-Mode fiber optic cable and associated components such as distribution shelves,
- LIUs, pigtails and patch cords
- Networking Racks – for termination of networking cables
- Installation:
- The final branch connections with single pair cables in conduits and the maximum number of cables in each conduit shall be as follows :
-

Conduit Diameter Inch	**Conduit Diameter mm**	**Max. No. of cables**
1”	25	2 Nos. Of F/UTP CAT6Acables
11/2”	40	4 Nos. Of F/UTP CAT6Acables

1.1 F/UTP CAT6ACABLING SYSTEM

- The CAT6A SCS must be tested by an accredited 3rd Party test facility to the following standards: ANSI/TIA 568-C.2: Category 6A Channel – 4 connector
- Category 6A System shall meet and exceed the transmission requirements of ANSI/TIA-568-C.2, ISO/IEC 11801 Class EA and

support 4PPoE as per IEEE 802.3bt (Type 4)
The specifications for items in this section, applies

No.	Description	Specification
1	Following common specifications shall apply to all F/UTP CAT6Astandards based structured cabling components, i.e., Cable, Patch Panel, IOs& Patch Cords. All components of the structured cabling system shall be from the same OEM manufacturer.	
i	Standards Compliance	F/UTP cabling system, conforming to ANSI/TIA/EIA 568-C.2 CAT6A Cabling system, ISO/IEC 11801 2nd edition, EN-50173-1. The cabling system components must be UL listed or equivalent
ii	Warranty	Performance characteristics shall be provided alongwith the bids and actual tests conducted at site after installation and commissioning for the following parameters: Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel. 25-years' systems performance guaranty shall be provided and site shall be certified for guarantied performance by the OEM/manufacturer along with actual test results conducted at site. The cable shall be tested for minimum guaranteed performance as per standards at 500MHzoperation minimum.
iii	OEM Requirement	All passive cabling must be from same OEM (UTP, F/UTP and Fiber)
1.1	**F/UTP CAT6A**	
i	Standards Compliance	As per 1.i) above
ii	Conductors	23 AWG solid bare copper
iii	Construction and mechanical details	Polyethylene insulation, LSZH jacket.
iv	Operating temperature	-20 Deg. C to +60 Deg. C
v	Delay Skew	Not exceeding 45 ns / 100m
vi	Performance Characteristics	Attenuation, Pair-to-pair and PS NEXT, ELFEXT and PSELFEXT, Return Loss, ACR and PS ACR for 4-connector channel, to be submitted with bid
1.2	**F/UTP CAT6AI/O Jack**	
i	Standards Compliance	As per 1.i) above, UL Listed

ii	Performance Characteristics	ETL Verified 4-Connector Channel to ISO/IEC 11801 AMD 1 Class EA, along with channel illustration, and parts numbers to be submitted along with the bid
1.3	**F/UTP CAT6APATCH PANEL**	
i	Standards Compliance	As per 1.i) above
ii	Ports	24 Ports loaded with shuttered or keystone Jacks
iii	Port arrangement	Individually replaceable jacks or keystone
iv	Height	1 U (1.75 inches)
v	Panel	Fully powder coated
vi	Approvals	UL listed
vii	Termination Pattern	TIA / EIA 568 A and B;
viii	Performance Characteristics	ETL Verified 4-Connector Channel to ISO/IEC 11801 AMD 1 Class EA, along with channel illustration, and parts numbers to be submitted along with the bid
1.4	**F/UTP CAT6APATCH CORDS**	
i	Standards Compliance	As per 1.i) above
ii	Conductor	24-26 AWG, multi-stranded copper, UL Listed
iii	Length	Pre-terminated (Factory Crimped) 1 Meter, 2 Meter, 3 Meter options in different colours
1.5	**Face Plates**	
i	Type	1-port, 2 -port or 4-port, White Face plate
ii	Materials	ABS / UL 94 V-0
iii	No. Of Ports	One/ Two / Four

F/UTP CAT6A CABLE LAYING PROCEDURE:

1. The containment system for F/UTP CAT6A cabling shall consist of PVC conduits and multi-compartment raceways. PVC conduits shall be dedicated for all IT/ELV related cabling. Wherever multi-compartment raceways are to be used, the F/UTP cabling for IT/ELV shall be laid in one of the dedicated compartments.
2. An axial spacing of 50 mm (minimum) shall be maintained between power and network cable.
3. If crossing each other, they should be at Right angles. These cables have to be properly tagged & labelled
4. TIA/EIA-569/609 standards have to be followed, while cable laying, considering the conduit fill in ratio, No. of bends, bending radius.
5. Exposed F/UTP cables in horizontal runs are not acceptable.
6. F/UTP cables bunched together with electrical distribution cables or other ELV cables such as fire detection, pubic address and IBMS signal/communication cables are not acceptable.

7. Proper color coding for I/O identification, has to be followed for field termination. The patch panels & patch cords are supposed to be color coded/Tagged/ identified with stickers (e.g. Blue for data, Yellow for Voice, Violet for IP Surveillance, & Green for Wi- Fi (Stickers on patch panels).
8. Proper earthing/grounding arrangement shall be provided by the ELV System Integrator.
9. Sharp bends such as at 90 degrees are to be avoided – the integrator shall follow OEM guidelines for maintaining bending radii.
10. Cable shall be neatly bundled and dressed to their respective panels or blocks. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack.
11. Each cable shall be clearly labelled on the cable jacket behind the patch panel at a location that can be viewed clearly without removing the bundle support ties. Cables shall be properly marked and distinctively coloured for ease of identification.

1.2 FIBER OPTIC CABLE AND COMPONENTS

SPECIFICATIONS OF SINGLE MODE FIBER OPTIC CABLING SYSTEM:

i	Type	Single mode OS2 fiber cabling system and all its components; must be from a single OEM (Cables + Components)
ii	Networks Speeds Supported	1Gbps, 10Gbps and 40Gbps
iii	Standard Compliance	ITU-T G.652A, B, C & D, IEC - 60793-2-50, TIA/EIA 568-C.3
Iv	Performance Testing	Fiber-channel compliance to ANSI/TIA568 -C.0 forOS2
V	Warranty	25-year syestems warranty from OEM including OTDR test reports; Warranty to cover bandwidth of the specified and installed cabling system

Losses @ 1310nm frequency	< = 0.34 dB/Km
Losses @1550nm frequency	< = 0.22 dB/Km
Losses @ 1380nm frequency	< = 0.31 dB/Km

SPECIFICATIONS FOR SINGLE MODE OPTICAL FIBER CABLE:		
i	Cable Type	6 / 12 / 24 / 48 core, Single Mode, Armored, Loose-unitube for 6 and 12 core , Gel filled&Multi tube construction cable for 24 and 48 core ; typical 6 cores per

		tube for 24 and 48 core cable
ii	Fiber Type	Single Mode, 9 / 125
iii	Fiber core must be	As per Telecordia GR20, ITU-T G652D, IEC-60793-2-50, TIA/EIA 492- CAAB
iv	No of cores	6 / 12 / 24 / 48 core -ISO 11801 -OS2
v	Armor	Corrugated steel tape armor
vi	Cable Construction Type	Loose tube corrugated steel tape armored cable, provided with FRP or equivalent non-metallic central strength member
vii	Outer Jacket Construction	High density polyethylene, anti - termite, anti - rodent suitable for direct burial application. Jacket must be UV stabilized
viii	Losses @ 1310nm frequency	< = 0.34 dB/Km
ix	Losses @1550nm frequency	< = 0.22 dB/Km
x	Operating Temperature	-20 deg C to + 60 deg C
xi	Cable / Component	All fiber cables and components must be from a single OEM (Including F/UTP CAT6ACabling System)
xii	Testing Parameters	Must pass the following : -IEC794-1-E1, IEC794-1-E2, IEC794-1-E3, IEC794-1-E4, EIA-455-104, IEC794-1-E7, IEC794-1-E10, IEC794-1-E11, IEC794-1-F5 or equivalent tests
xiii	Multi-channel capability	The fiber cable must have been designed to provide optimum performance from 1265nm to 1625nm making it suitable for 16 – channel Course Wavelength Division Multiplexing (CWDM) applications
SPECIFICATIONS FOR CONNECTORS:		
i	Connector Type	SC or LC-Style, Duplex
ii	Operating temperature	-20 deg C to + 50 deg C
iii	Durability	(500 Matting's): < 0.2 dB Max
iv	Ferrules	Pre-radius Ceramic Zirconia Ferrule. Bayonet Coupling: 2.5 mm Zirconia Ferrule
v	Attenuation	Not more than 0.75 dB per mated pair
vi	Parameters / standard	Meets or exceeds ITU specifications

SPECIFICATIONS FOR PIGTAILS (SINGLEMODE):	
Type	LC style, SM OS2, Simplex, 1 meter, compliant to ITU-G652.D
Operating temperature	-20 deg C to + 50 deg C
Durability	(500 Matting's): < 0.2 dB Max

Ferrules		Pre-radius ceramic zirconia ferrule. Bayonet coupling: 2.5 mm zirconia ferrule
Attenuation		Not more than 0.75 dB per mated pair
Parameters / standard		Meets or exceeds ITU specifications UL Listed or equivalent
SPECIFICATIONS FOR FIBER OPTIC CABLE PATCHCORDS:		
i	Cable type	LC-LCstyle, SM OS2, available as either 1.6mm or 3mm duplex patch cord. Compliance to ITU-G652.D
ii	Fiber type	Single mode 9/125 micron primary coated buffers
iii	No of cores	2 cable construction type PVC outer jacket
iv	Outside Diameter	1.6mm x 3.0mm (Simplex) or 1.6mm x 3.3mm(Duplex)
v	Operating Temperature	-20 deg C to + 60 deg C
SPECIFICATIONS FOR 19" RACK MOUNTED FIBER OPTIC PATCH PANELS		
Fiber optic patch panel		19-inch, rack mounted fiber optic patch panel
Height		1U
Number of fiber cores		6/12/24/48 core configurations
Number of OSP (outdoor) cables for termination		Minimum 2
Grounding		2 Nos. of earthing lugs
Cable Management rings		Front and rear cable management rings
Adapter plates		6/12/24/48/96 Port adapter plates with each plate loaded with single- mode couplers, as applicable
Construction		Complete Aluminium alloy or CRCA housing, fully powder coated, minimum 1.6mm thick.
Splice tray		Shall be included in LIU
SPECIFICATIONS FOR ADAPTOR PLATES & ADAPTORS (SINGLEMODE):		
Fiber Optic adapter plate		6-port, SC or LC style
Attenuation		Max of 0.75 dB per mated pair
Adapters		Available in Simplex and Duplex types
Durability		< 0.2 dB max (1000 Mattings)
Standard		Compliant as per EIA/TIA 568-B and ISO/IES 11080

SPECIFICATIONS FOR EXTERNAL FIBER OPTIC ENCLOSURE:		
i	No of fiber core terminations	6/12/24/48 ports
ii	Features	Easy and fast-to-fix for fiber cable termination,IP-68 Rated
iii		Easy to re-enter, it should not require re-entry kits
v		Fiber optic splice tray must be designed in snap in lock & easily fixable.
Vi		Must meets fire codes and industry standards
vii		Should prevent cable sheath movement with

		temperature changes

FO CABLE LAYING GUIDELINES:

1. Outdoor FO cables shall be buried at a depth of 1200 mm by digging the soil (soft soil as well as hard soil); digging of soil shall be within the scope of ELV contractor; it shall be responsibility of ELV contractor to remake the soil after digging.

2. Where FO cable needs to travel below a road section, the FO cable shall be pulled or laid in pre-laid/existing RCC Hume pipes.

3. While laying FO cables, excessive sharp bends shall be avoided – as a guideline a bending radius of not less than 15 x cable diameter shall be maintained, however, integrator shall follow the OEM's cable laying guideline for the same wherever they are available.

4. Spare cable loop having length of approx. 20 meter shall be left spare inside the manhole chamber for any future jointing, maintenance and extension of branches.

5. The concrete FO route markers shall be specified after every 200m and wherever bends or turns are there in FO route.

6. Each Indoor & Outdoor OS2 Single mode "loose tube" of fiber cable should be properly labeled & marked at all Man holes/ Traps/ Shafts/ LIU end.

1.2 19"WALL MOUNTED NETWORKING ENCLOSURES (6U TO 15U USABLE HEIGHTS)

- Construction shall be single section welded robust with ventilation holes on the sides and top & bottom covers with provision to mount 2 fans
- Top/ Bottom covers and side panels shall be of sheet steel, powder coated
- Vertical 19" metric panel mounts and door trims shall be of sheet steel and powder coated
- The top and bottom covers shall be provided with four cut outs on top and bottom cover for cable entry and round cuts shall be edge protected with rubber grommets
- Two pairs of 19" equipment mounting angles with mounting holes conforming to IEC 297-3
- Toughened glass front lockable door
- Wall mounted 19" Networking rack shall be available in various heights
- Cooling shall be achieved with the help of two fans, 90 CFM capacity each, mounted on top

- Power shall be provided in form 19" rack mountable power strip which shall consist of minimum four 5/15A power sockets. Power strip shall be provided with 20A MCB
- Cantilever shelf – at least one front mounting 1U cantilever shelf shall be provided with depth of 250 mm or more
- 1U vertical cable managers on a/r (as required basis) for dressing of cables for 24 ports patch panel, 24 ports switch
- Hardware Pack / Rack mounting accessories and hardware – as required
- Horizontal managers on A/R basis for ensuring neat and aesthetically clean installation
- Cabinet material – cabinet shall be made of 16 Gauge (1.5mm) thick cold rolled steel sheets or thicker
- Finish – cabinet shall be black or grey epoxy powder-coated of durable quality
- Load carrying capacity – min. 25 kg load of equipment should be mountable
- Product must be UL listed and certified for use in Information Technology or Communication Equipment
- EIA standard pattern design with 12-24 tapped holes (EIA-310-E compliant)
- Dimensions – 6U to 15U usable height, 600mm (W), 450mm(D)

1.3 19" FLOOR STANDING NETWORKING ENCLOSURES (22U TO 42U USABLE HEIGHTS)

- Frame of sturdy frame section construction, consisting of 9 x folded rolled hollow frame section punched in 25mm DIN pitch pattern. All profile edges are radiused. The corners are stiffened with welded zinc die-cast corner connectors, Front and rear perforated door. Top cover with cable entry and Bottom open. 42 U 19" L type angle Front & Rear on 6 x punched section. Cabinet color should be Black and light grey
- The Thickness of the CRCA sheets used for Doors is 1.5mm and for Side Panels is 1.5mm
- Fully adjustable 19" equipment mounting angles
- The cabinet design confirming to DIN 41494 or EIA 310D standards
- Top and Bottom Covers and Side panels shall be of sheet steel and Primary Dip Coat

= 20-30 Microns Power Coat = 80-120 Microns

- Vertical 19" metric panel mounts and door trims shall be of sheet steel and powder coated

- The Top cover with min. 4 cut out of diameter 100mm or more for cable entry. Bottom cover with 4 cut out of diameter 100mm or more for cable entry. All cut outs blanked with plastic caps

- Perforation - for full / split perforated doors the style should be" Honeycomb" type of perforation for maximum air circulation and stiffness. Doors should have min. 75% perforation for better air circulation

- Cabinet shall be capable of dismantling and reassemble at the site

- Locks options – options shall be available such as slam lock - common key or unique key, Swing handle lock, Digital Keypad operated locks, Biometric locks

- Side panels – must contain slam latches for locking purpose and option of providing slam locks, or screw fitted for removal, if required

- Two pairs of 19" Equipment mounting angles with mounting holes conforming to IEC 2973

- Front glass door made of toughened glass, tinted with easily detachable hinges
- Two pairs of slotted vertical cable channel shall be provided at front and back for managing cables

- Lockable industrial grade castors with foot brakes

- Rack shall be supplied with 4 x 90 CFM fans at top

- Rack shall be supplied with equipment mounting hardware in pack of 20s such as mounting nuts and screws either 12-24 or M6 type as applicable

- Minimum 2 nos. of 8 x 5/15 Amps power supply sockets, 2 nos. of vertical cable managers and 2 no. of 19" 1U size horizontal cable managers

- Finish – cabinet shall be black or grey epoxy powder-coated of durable quality. The Powder coating of the racks is as per Nano coated, electro-dip coat primed to 20 microns, and power coated with texture polyester with 80 to 120 microns for long lasting paint against corrosion

- Product must be UL listed and certified for use in Information Technology or Communication Equipment

- EIA standard pattern design with 12-24 tapped holes (EIA-310-E compliant) or EIA standard pattern design with 3/8" (9.5mm) square punches for Cage Nuts for mounting

2. ACTIVE COMPONENTS - NETWORKING SWITCH SPECIFICATIONS

DESCRIPTION & DESIGN

- Campus networking infrastructure is a high performance design that factors

important parameters such as aggressive use of IT and e-Learning in education, scalability and reliability.

- Key considerations for network are – gigabit connectivity to each user from the nearest distribution rack to various users/departments/devices in a topology consisting of core switches at central server room followed by the distribution and edge/access switches.

- The network shall have a mix of components for supporting PoE+ as well as non-PoE devices.

- A robust fiber optics based backbone is being provided. It shall be based on ring topology using single mode fiber optics cable. The vendor shall ensure that the networking switches shall be populated with the necessary transceivers for achieving this design objective.

- Several applications are proposed to run on this network – IP-based voice communications supporting voice-data-video, network based cameras and storage, integrated audio-video, video conferencing, interactive learning, integrated building management systems and important services integration such as fire detection.

- The integrators shall propose and supply enterprise class networking switches only.

2.1. TYPE-2 EDGE SWITCH (ACCESS SWITCH)

A Layer 2, 24 x 10/100/1000Base-Tx Ports, PoE+, minimum 4 dedicated SFP Ports. All 28 ports should be active simultaneously

Switch Architecture

- The switch should have 24 X 10/100/1000 Base-Tx ports; all ports shall be 802.3at-compliant PoE+ capable, with the switch capable of providing minimum 350 Watts of PoE power budget.
- The switch should also support PoE as per 802.3af on all ports.
- Switch should have 24 Nos. 10 Base-T/100Base-Tx/1000Base-Tx auto-sensing ports complying to IEEE 802.3, IEEE 802.3at, IEEE 802.3u and 802.3ab standard, supporting half duplex mode, full duplex mode and auto-negotiation on each port.
- Switch should have minimum 4 dedicated
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate.
- Switch should support auto switch replacement in an existing stack with the new switch without any configuration for joining the stack
- Switch should support link aggregation across multiple switches in a stack.
- Switch should support both IPv4 and IPv6 – Switch should support features like Neighbour Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS over IPv6
- Switch should have non-blocking switching throughput of minimum

52Gbps.
- Switch should have forwarding rate of minimum 35Mpps.
- Switch should be IPv6-Ready from Day 1
- Switch should have the capabilities to stack upto 8 switches with dedicated stacking port/ virtual chassis from day 1 and with minimum stacking bandwidth of 80Gbps

B Layer 2 Features

- IEEE 802.1Q VLAN tagging
- 802. 1Q VLAN on all ports with support for minimum 255 VLANs.
- Support for minimum 16k MAC addresses.
- Spanning Tree Protocol as per IEEE 802.1d.
- Multiple Spanning-Tree Protocol as per IEEE 802.1s.
- Rapid Spanning-Tree Protocol as per IEEE 802.1w.
- Self-learning of unicast & multicast MAC addresses per switch port.
- Jumbo frames up to 9000 bytes.
- Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.

C Quality of Service (QOS) Features

- Switch should support classification and scheduling as per IEEE 802.1P on all ports.
- Switch should support four queues per port.
- Switch should support QoS configuration on per switch port basis.
- Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic).

D Security Features

- Switch should support MAC Address based Filters / Access Control Lists (ACLs) on all switch ports.
- Switch should support Port based Filters / ACLs.
- Switch should support RADIUS and TACACS+ for access restriction and authentication.
- Secure Shell (SSH) Protocol, HTTP and DoS protection.
- ARP spoofing, DHCP snooping etc.
- Switch should support static ARP, Proxy ARP, UDP forwarding and IP sourceguard.

E Management Features

- The switch should support CLI as well as web-based Management.
- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.
- Switch should support all the standard MIBs (MIB-I & II).
- Switch should support TELNET and SSH Version-2 for Command Line Management.
- Switch should support 4 groups of embedded RMON (history, statistics,

alarm and events).

- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers.
- Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3 functions, VLAN, STP, Security, QoS should not require rebooting of the switch.
- Switch should have comprehensive debugging features required for software & hardware fault diagnosis.
- Switch should support multiple privilege levels to provide different levels of access.
- Switch should support SNTP (Network Time Protocol).
- Switch should support FTP/TFTP for software upgrade.
- Switch support multiple configuration file & backup configuration file.

2.2. TYPE-2 EDGE SWITCH (ACCESS SWITCH)

F Layer 2, 24 x 10/100/1000Base-Tx Ports, Non-PoE, minimum 4 dedicated SFP Ports. All 28 ports should be active simultaneously

Switch Architecture

- The switch should have 24 X 10/100/1000 Base-Tx ports;
- Switch should have 24 Nos. 10 Base-T/100Base-Tx/1000Base-Tx auto-sensing ports complying to IEEE 802.3, IEEE 802.3at, IEEE 802.3u and 802.3ab standard, supporting half duplex mode, full duplex mode and auto-negotiation on each port.
- Switch should have minimum 4 dedicated
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate.
- Switch should support auto switch replacement in an existing stack with the new switch without any configuration for joining the stack
- Switch should support link aggregation across multiple switches in a stack.
- Switch should support both IPv4 and IPv6 – Switch should support features like Neighbour Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS over IPv6
- Switch should have non-blocking switching throughput of minimum 52Gbps.
- Switch should have forwarding rate of minimum 35Mpps.
- Switch should be IPv6-Ready from Day 1
- Switch should have the capabilities to stack upto 8 switches with dedicated stacking port/ virtual chassis from day 1 and with minimum stacking bandwidth of 80Gbps

G Layer 2 Features

- IEEE 802.1Q VLAN tagging
- 802. 1Q VLAN on all ports with support for minimum 255 VLANs.
- Support for minimum 16k MAC addresses.
- Spanning Tree Protocol as per IEEE 802.1d.
- Multiple Spanning-Tree Protocol as per IEEE 802.1s.
- Rapid Spanning-Tree Protocol as per IEEE 802.1w.
- Self-learning of unicast & multicast MAC addresses per switch port.
- Jumbo frames up to 9000 bytes.
- Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.

H Quality of Service (QOS) Features

- Switch should support classification and scheduling as per IEEE 802.1P on all ports.
- Switch should support four queues per port.

- Switch should support QoS configuration on per switch port basis.
- Switch should provide traffic shaping and rate limiting features (for egress as well as ingress traffic).

I Security Features

- Switch should support MAC Address based Filters / Access Control Lists (ACLs) on all switch ports.
- Switch should support Port based Filters / ACLs.
- Switch should support RADIUS and TACACS+ for access restriction and authentication.
- Secure Shell (SSH) Protocol, HTTP and DoS protection.
- ARP spoofing, DHCP snooping etc.
- Switch should support static ARP, Proxy ARP, UDP forwarding and IP sourceguard.

J Management Features

- The switch should support CLI as well as web-based Management.
- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3.
- Switch should support all the standard MIBs (MIB-I & II).
- Switch should support TELNET and SSH Version-2 for Command Line Management.
- Switch should support 4 groups of embedded RMON (history, statistics, alarm and events).
- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers.
- Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3 functions, VLAN, STP, Security, QoS should not require rebooting of the switch.
- Switch should have comprehensive debugging features required for software & hardware fault diagnosis.
- Switch should support multiple privilege levels to provide different levels of access.
- Switch should support SNTP (Network Time Protocol).
- Switch should support FTP/TFTP for software upgrade.
- Switch support multiple configuration file & backup configuration file.

2.3. TYPE-3 BLOCK/CLUSTER DISTRIBUTION SWITCH

K Layer 3, 24 x 1G SFP Ports, 4 x 10G SFP+ Ports, Redundant Power Supply, Redundant Fan, Full Advanced L3 Features

Switch Architecture

- The switch should have at least 24Nos. 1G Base- SFP ports
- The switch should have at least 4 Nos. 10G - SFP+ ports
- The switching fabric for all the LAN ports shall be non-blocking and each port shall run at wire-speed / line-rate. Switching fabric capacity of the switch should be capable to run all the ports at line-rate

- The switch should support both IPv4 and IPv6 – Switch should support features like Neighbor Discovery, Syslog, Telnet, SSH, Web GUI, SNMP, NTP, DNS, RADIUS overIPv6
- The switch should have non-blocking switching bandwidth of minimum 128Gbps
- The switch should have forwarding rate of minimum 80Mpps
- The switch shall be supplied with at least one redundant power supply
- The switch shall be supplied with at least one redundant fan
- The switch should be IPv6 Ready from day 1

L Supported Layer 2 Features

- IEEE 802.1Q VLAN tagging
- 802. 1Q VLAN on all ports with support for minimum 1000 VLANs
- Support for minimum 32K MAC addresses
- Spanning Tree Protocol as per IEEE 802.1d
- Multiple Spanning-Tree Protocol as per IEEE 802.1s
- Rapid Spanning-Tree Protocol as per IEEE 802.1w
- Jumbo frames up to 9000 bytes
- Link Aggregation Control Protocol (LACP) as per IEEE 802.3ad.
- QoS Prioritization as per IEEE 802.1p
- User Authentication as per IEEE 802.1x

M Supported Layer 3 Features

- The Layer 3 switch should support full Layer 3 features like PIM-DM/, PIM-SM, RIPv1/v2, OSPF, PBR, ECMP, BGP and VRRP; it shall be supplied with all requisite licences for implementing Layer 3 capabilities
- The Layer 3 Switch should support for full IPv6 features like RIPng, MLD v1/v2, OSPFv3, VRRPv3 and IPv6 management
- The Distribution switch should support virtualization routing and forwarding
- Inter-VLAN IP routing for full layer 3 routing between two or more VLANs
- IP unicast routing protocols (static, RIPv1/v2 & OSPF)
- Virtual Router Redundancy Protocol (VRRP) as per RFC 3768 or equivalent
- Switch should support IGMP v1/v2/v3 as well as IGMP v1/v2/v3 snooping or Proxy
- Switch should support up to 512 multicast groups/entries
- Inter-VLAN IP routing for full layer 3 routing between two or more VLANs

N Security Features:

- Switch should support MAC Address based Filters / Access Control Lists (ACLs) on all switch ports
- Switch should support Port based Filters / ACLs
- Switch should support RADIUS and TACACS+ for access restriction and authentication
- Secure Shell (SSH) Protocol, HTTP and DoS protection
- IP Route Filtering, ARP spoofing, DHCP snooping
- Switch should support static ARP, Proxy ARP, UDP forwarding and IP source-guard

O Management Features

- The switch should support CLI based or Web-based Management, via a console port

- Switch should be SNMP manageable with support for SNMP Version 1, 2 and 3
- Switch should support all the standard MIBs (MIB-I& II)
- Switch should support TELNET and SSH Version-2 for Command Line Management
- Switch should support 4 groups of embedded RMON (history, statistics, alarm and events)
- Switch should support System & Event logging functions as well as forwarding of these logs to multiple syslog servers
- Switch should support on-line software reconfiguration to implement changes without rebooting. Any changes in the configuration of switches related to Layer-2 & 3functions, VLAN, STP, Security, QoS should not require rebooting of the switch
- Switch should have comprehensive debugging features required for software &hardware fault diagnosis
- Switch should support multiple privilege levels to provide different levels of access
- Switch should support SNTP (Network Time Protocol)
- Switch should support FTP/TFTP for software upgrade
- Switch support multiple configuration file & backup configuration file

2.3.1. ACCESS POINT

- Dual Radio, with 802.11a/n/ac (5 GHz) and 802.11g/n (2.4 GHz) concurrent operation
- 4X4:3Multiple Input / Multiple Output (MIMO) Wave 2 access point
- Internal/external antennas for 2.4Ghz and 5Ghz operations with one 10/100/1000 Base-Tx auto-sensing (RJ45) PoE+ port
- AP must have two radios (2.4GHz or 5GHz)
- Maximum Associated Users: 240 (120 per radio)
- AP must have two ethernet ports for link aggregation
- Power Supply: via an 802.3at POE+ switch port or OEM supplied Power Injector
- Access point should be 802.11ac Wave 2 from day 1
- IEEE 802.3 10-BASE-T, IEEE 802.3u 100BASE-TX, 1000BASE-T, IEEE 802.3ab 1000BASE-T
- AP must include OEM supplied mounting brackets and accessories for various mounting options such as ceiling, wall or rooftop

P Security:

- WPA
- IEEE 802.11i WPA2
- RFC 2246 TLS protocol version 1.0
- RFC 3280 Internet X.509 PKI certificate and CRL profile
- RFC 4346 TLS protocol version 1.1/1.0

Q Encryption:

- TKIP-MIC: RC4 40 bit, 104 bit and 128 bit, SSL & TLS: RC4 128-bit
- PHY data rates up to 1.8Gbps per AP
- Support for band steering, client load balancing, LLDP
- Should support 802.1X authentication
- Should support centralized configuration and management and reporting
- Solution should have Bonjour Support for supporting Apple devices
- Should support Wi-Fi Alliance Protected Access 1.0 (WPA) and 2.0 (WPA2).

2.3.2. ROOM BASED ACCESS POINT

R

S/N	Performance Specification / Parameter
1	Access Points proposed must include radios for 2.4 GHz and 5 GHz with 802.11ac Wave 2 with ceiling mount options.
2	Access point must support 802.11ac (2x2) Wave 2.
3	WI-FI STANDARDS: 2.4 Ghz: IEEE 802.11b/g/n, 5 Ghz: IEEE 802.11a/n/ac
4	WIRELESS SECURITY WPA2-TKIP/AES Personal, WPA-TKIP/AES Personal, WPA2-Enterprise (802.1x/EAP),WPA-Enterprise (802.1x/EAP),Open
5	ANTENNA TYPE: 4 x internal omni-directional antennas
6	ETHERNET: 1 x 10/100/1000 Base-T with PoE In (802.3af/at) port 3 x 10/100/1000 Base-T ports 2 x RJ45 Based Pass Through (Input and Output) ports Further details mentioned herein below:
7	1 x 10/100/1000 Base-T with PoE In (802.3af/at) port 3 x 10/100/1000 Base-T ports 2 x RJ45 Based Pass Through (Input and Output) ports 1x 10/100/1000 BASE-T Ethernet (RJ45) (Uplink on the back) 1x 10/100/1000 BASE-T Ethernet (RJ45) with 802.3af Power over Ethernet output 2x 10/100/1000 BASE-T Ethernet (RJ45) outputs 1x Passthrough port (non-managed). 1x 10/100/1000 BASE-T Ethernet (RJ45) (Uplink on the back) 1x 10/100/1000 BASE-T Ethernet (RJ45) with 802.3af Power over Ethernet output 2x 10/100/1000 BASE-T Ethernet (RJ45) outputs 1x Passthrough port (non-managed). It is a revised description The description proposed model is present in MR36H which already announce EOS from December 26.

WLC Specifications-

S.No	Category	Specifications	***Compliance Yes/No (Approval before supply)***
		Wireless controller should support 250 AP and 5000 clients from day 1 and can be upgraded to 500 AP support with 10000 clients without any hardware change.	
	Hardware	The control shall support deployment flexibility without compromising any features	
		The controller shall support min 5 Gbps tunnelling capacity and shall be upgradable to 10 gbps.	
		The controller shall support 2x 10G/Multigigabit fiber uplink.	
		Wireless Controller shall support link aggregation and load sharing between Access Point to WLC links	
		The controller shall support hardware encrypted data plane between Access Point and Controller	
		The controller shall be proposed with complete feature set including licensed feature	
	High Availability	High Availablilty mode shall support controller inline data plane mode as well as local switching mode and Mesh mode	
		High Availability mode shall allow geographically dispersed installation between Controllers	
		The controller failover shall not trigger client de-authication and re-association	
		The controller shall support hot WLC software patching for fixing bugs	
		The controller shall support hot AP software patching for fixing bugs	
		The contrroller shall support new AP hardware without need for upgrading entire controller software.	
		The controller shall support rolling AP upgrade	

		The controller shall support rolling AP upgrade wihtout need for clustering	
		The redundant Controller shall sync Access Point and Client Status, including DHCP IP lease status	
	Software	Access Point shall be able to proactively distributes Client connection before and after association	
		and tracking client condition in real time using data packet RSSI	
		The controller shall support standard-based, secure AP-Controller data&control protocol like CAPWAP. protocol that has known vulnerability like PAPI cannot be used.	
		The controller shall support Inter-Controller Wireless Roaming	
		The controller shall maintains per-user Application usage and shall be able to export it for network analytic.	
		The controller shall support Multi Languages options from embedded GUI Management	
		The controller shall provide per-Client Connection Scoring and provide reasoning of Client Connection Score	
		The controller shall support Cellular offload using IPv6 tunneling to Mobile Core network	
	RF management	The controller shall be able to support multiple RF Management profile per group of APs, including Transmit Power Control	
		and Dynamic Channel Assignment on both 2.4GHz and 5Ghz	
		The controller shall be able to identify and avoid interferers with network performance impact analysis report	
		The controller shall support optimized, automatic channel width (20~160Mhz) selection over 5GHz, 802.11ac	
	Mesh	Mesh AP nodes shall provide quick convergence and fast failover to new root mesh node	

		Mesh Backhaul interface shall support full duplex operation using wired daisy chaining	
		Mesh AP shall support fast roaming for Wired-client through wired-to-wireless bridge client	
	Application Recognition and Control	The controller shall support per-user and per-WLAN based application recognition and control that throttle usage by rate-limiting	
		The controller application recognition technology shall support exporting to 3rd party compatible format, such as NetFlow v9	
		The controller shall provide policy-based mDNS gateway including chromecast gateway	
		The contorller shall support new application signatures without upgrading controller software	
	BYOD & Security	The controller shall provide Device Profiling using mutlple profiling methods to reduce false-detection	
		The system shall provide secure onboarding service for both employee and guest based on standard-based security protocol	
		Proposed system shall not use public cloud as user data repository	
		The controller shall be able to embedded custom web portal page (HTML) to fully customize user experience without additional cost or extra box	
		The controller shall provide rule-based rogue classification and automatically run rogue mitigation action	
		The controller shall be able to detect employee device connection to Rogue Access Point and contain it automactically. It should also support protection from Honeypot or Evil twin.	
		The controller shall support Content Security using DNS integration, Web Classification shall be fully customizable	
		The system shall support control plane encryption on both IPv4 and IPv6	

		The Controller's image upgrade shall be done through secure, encrytped transport	
		The controller shall be able to provide unique pre-shared keys to the devices that do not support the 802.1x security protocol	
		The controller shall support Identity PSK for on boarding	
		The controller shall support identification & mitiogation of threas inside encrypted traffic	
	Network	The controller shall support mapping of specific VLANs to single SSID, depending on Access Point location and user	
	Configuration	The controller shall support automatic VLAN assignment per SSID to load-balance user connection.	
		assigned VLAN pool shall be same as number of available VLAN in the system	
		The controller shall support embedded best practice configuration profile and setup	
		The controller shall support packet fragmentation between Access Point and controller communication	

3. VIDEO SURVEILLANCE SYSTEM

GENERAL

- The Surveillance System components must be TCP/IP based components working on the same backbone network as the Data Network (LAN).
- Surveillance system must be scalable in terms of equipment (no. of cameras), storage capacity and licenses.
- True open platform functionality is an essential aspect of this specification; cameras from different OEMs must be able to integrate seamlessly with the specified 3rd party VMS software platforms without any loss of features and functionality. Similarly, supplied VMS software platforms must also be able to integrate with a variety of cameras from different manufacturers in future.
- For better saving on storage and bandwidth the compression used shall be

H.264 high profile for all types of cameras and devices. H.264 high profile shall be a common requirement for all cameras and devices irrespective of whether mentioned in individual sub-sections or not or if mentioned otherwise.

- All cameras shall be vandal resistant as per IK10 rating.
- All cameras shall be ONVIF Profile S compliant
- Cameras shall have a wide dynamic range of between 85 to 95dB (for Fixed Box/CS-Mount and Indoor Dome/Mini-dome models and between 120 to 130dB (for indoor/outdoor PTZ models)for ensuring good image performance in varying light conditions.
- **"All cameras shall be UL listed/certified"**

3.1. FULL HIGH DEFINITION, TRUE DAY/NIGHT, INDOOR NETWORK RAPID PTZCAMERA

GENERAL REQUIREMENTS:

- The camera shall be a Full HD Rapid Dome PTZ camera supporting triple streaming of codecs; simultaneously generating and transmitting JPEG/MJPEG and two independent H.264High Profile video streams different in resolutions and frame rates.
- The camera shall have a 1/3" type CMOS/CCD/MOS sensor of approx. 2.0 Megapixels and have a True day/night capability.
- The camera shall be capable of 360 degree pan rotation and a minimum tilt range of 0° to 180°, designed for ceiling mount operation.
- The camera shall incorporate a built-in 30X optical, auto-focus zoom lens, and shall have 12X digital zoom capability with 360X total zoom capability.
- The camera shall be able to automatically sequence through the preset positions in programmable sequence, i.e., preset tours.
- The camera shall produce a high quality picture with a minimum illumination of 0.4 lux in color mode or 0.02 lux in B/W mode at F1.6 or better. It shall offer IR cut filter that switches on/off to enhance low-light sensitivity during B/W mode.
- The camera shall be equipped with an intelligent automatic backlight compensation capability, mask settings and level adjustment capabilities to compensate for backlight by masking out brighter areas.
- The camera shall have feature to transform shadows and dark areas into natural and crisp images in real time.
- The camera shall support automatic tracing white balance adjustment capability.
- The camera shall have light control mode to select the operating environment, i.e., indoor or outdoor.
- The camera shall have a 2D and 3D noise reduction capability for reducing AGC noise to provide clear images without motion blur.
- The network interface shall be an 8-pin RJ-45 connector, 10Base-T/100Base-TX Ethernet. Both IPv6 and IPv4 shall be supported.
- The camera shall support JPEG/MJPEG and H.264 high profile compression. The minimum resolution for each codec shall be 1920 x 1080
- The camera shall be capable of generating HTML code for the video image, allowing for easy web page integration.

- The camera shall be capable of supporting up to five (05) users simultaneously over the network.

- The camera shall have the capability to stream JPEG/MJPEG and H.264 high profile video in TCP protocol H.264 in UDP (unicast/multicast) protocol.

- The camera shall incorporate a built-in algorithm for intelligent motion detection capability. The camera shall offer this feature with minimum four configurable areas per scene and ten sensitivity levels adjustments.

- The camera shall have 2-way audio features, i.e., the camera shall have built-in audio input and output jacks and be capable of transmitting and receiving full duplex audio stream on the same Ethernet connection as the video. The audio shall be encoded using the G.726 or equivalent ADPCM standard.

- The camera shall support the following network protocols: TCP/IP, UDP/IP, HTTP, HTTPS, RTSP, RTP, RTP/RTCP, FTP, SMTP, DHCP, DNS, DDNS, NTP, SNMP, UPnP

- The camera shall support HTTPS client authentication.

- The camera shall be compliant with the industry standard ONVIF (Open Network Video Interface Forum) specification with Profile S compliance.

- The camera shall have user configurable port settings.

- The camera shall have an email (SMTP) notification capability and shall support scheduled transfer of image data via FTP to an FTP server.

- The camera shall have privacy zone masking for blocking out unwanted or prohibited areas within the video image to protect privacy.

- The camera software should include IP Setup (including group camera management) program, Firmware Upgrade Tool, Privacy Masking Tool. The software shall be supplied with the camera as a standard accessory.

- The minimum electronic shutter setting shall be 1 second, and a maximum of 1/20,000 sec.

- The camera shall have minimum 2 external I/O Terminals for external alarms and/or controls
- The camera shall be capable of limiting bandwidth from 64 kbps to 8 Mbps in H.264 mode while also being able to operate without bandwidth limitation in JPEG format.

- The camera shall be capable of automatically transmitting alarm images transfer via FTP file transfer and/or e-mail. In addition the network camera shall support scheduled transfer of image information via FTP to an FTP server.

- Terminal inputs, video motion detection alarms, and alarm commands shall be able to trigger actions such as memory recording, FTP file transfer, e-mail

notification, alarm indications on web browser, alarm terminal output, and alarm command.

- The camera shall have a local storage capability via a memory card slot which can support up to 64GB memory card that can cache images in the event of a network failure. The camera shall also support manual/alarm recording to the optional memory card. The camera shall provide notification of the remaining capacity of the memory card.

CAMERA LENS SPECIFICATIONS:

- The camera shall have an integrated minimum 30X auto-focus zoom lens.

- Focal length shall be 4.3 mm (+/- 10%) to 129 mm (+/- 10%) with field of view coverage of 2.4° (+/- 10%) to 63.5° (+/- 10%).

- The aperture range for the lens shall be F1.6 to F4.7 (+/- 10%).

VIDEO-ELECTRICAL REQUIREMENTS:

- The camera input power shall be PoE+ or optionally AC/DC 24V which shall be included in supply, if necessary.

AUDIO REQUIREMENTS:

- The camera shall support bi-directional audio, using G.726 or equivalent 16KHz sampling standards such as AAC.
- It shall support audio modes such as - OFF or Mic (Line) input or Audio output or Interactive (Half duplex) or Interactive (Full duplex)

- The camera shall have mini-jack connectors accessible via pigtail to support external microphone and active speakers.

MECHANICAL REQUIREMENTS:

- The camera shall have 360° endless pan rotation and 0° to 180° tilt range. The unit shall be designed for ceiling mount operation.

- The camera shall have pan/tilt speeds of 300° per second in presets

- The camera shall have onehundred (100) user defined presets.

- The camera shall be vandal resistant with IK10 rating or IEC 62262 compliance.

- The camera shall have inbuilt dehumidification/defog feature to remove moisture.

3.2. FULL HIGH DEFINITION, TRUE DAY/NIGHT, OUTDOOR NET WORK RAPID PTZ CAMERA

GENERAL REQUIREMENTS:

- The camera shall be a Full HD Rapid Dome PTZ camera supporting triple streaming code simultaneously generating and transmitting JPEG/MJPEG and two independent H.264 High Profile video streams different in resolutions and frame rates.

- The camera shall have a 1/3" type CMOS/CCD/MOS sensor of approx. 2.0 Megapixels and have a True day/night capability.

- The camera shall be capable of 360 degree pan rotation and a minimum tilt range of 0° to 180°, designed for ceiling mount operation.

- The camera shall incorporate a built-in 30X optical, auto-focus zoom lens, and shall have 12X digital zoom capability.

- The camera shall be able to automatically sequence through the preset positions in programmable sequence, i.e., preset tours.

- The camera shall produce a high quality picture with a minimum illumination of 0.6 lux in color mode or 0.07 lux in B/W mode at F1.6 or better. It shall offer IR cut filter that switches on/off to enhance low-light sensitivity during B/W mode.

- The camera shall be equipped with an intelligent auto backlight compensation capability, mask settings and level adjustment capabilities to compensate for backlight by masking out brighter areas.

- The camera shall have feature to transform shadows and dark areas into natural and crisp images in real time.

- The camera shall support automatic tracing white balance adjustment capability.

- The camera shall be capable of limiting bandwidth from 64 kbps to 8 Mbps in H.264 mode while also being able to operate without bandwidth limitation in JPEG format.

- The camera shall be capable of automatically transmitting alarm images transfer via FTP file transfer and/or e-mail. In addition the network camera shall support scheduled transfer of image information via FTP to an FTP server.

- Terminal inputs, video motion detection alarms, and alarm commands shall be able to trigger actions such as memory recording, FTP file transfer, e-mail notification, alarm indications on web browser, alarm terminal output, and alarm command.

- The camera shall have a local storage capability via a memory card slot which

can support up to 64GB memory card that can cache images in the event of a network failure. The camera shall also support manual/alarm recording to the optional memory card. The camera shall provide notification of the remaining capacity of the memory card.

- The camera shall have built-in motion detection capability.

CAMERA LENS SPECIFICATIONS:

- The camera shall have an integrated minimum 30X auto-focus zoom lens.
- Focal length shall be 4.3 mm (+/- 10%) to 129 mm (+/- 10%) with field of view coverage of 2.4° (+/- 10%) to 63.5° (+/- 10%).
- The aperture range for the lens shall be F1.6 to F4.7 (+/- 10%).

VIDEO-ELECTRICAL REQUIREMENTS:

- The camera input power shall be PoE+ or optionally AC/DC 24V which shall be included in supply, if necessary.
- Power consumption SHOULD be minimum confirming the required features.

S AUDIO REQUIREMENTS:

- The camera shall support bi-directional audio, using G.726 or equivalent 16KHz sampling standards such as AAC.
- It shall support audio modes such as - OFF or Mic (Line) input or Audio output or Interactive (Half duplex) or Interactive (Full duplex)
- The camera shall have mini-jack connectors accessible via pigtail to support external microphone and active speakers.

T MECHANICAL REQUIREMENTS:

- The camera shall have 360° endless pan rotation and 0° to 180° tilt range. The unit shall be designed for ceiling mount operation.
- The camera shall have maximum pan/tilt speeds of 350° per second in presets.
- The camera shall have onehundred (100) user defined presets.
- The camera shall be vandal resistant with IK10 rating or IEC 62262 compliance.
- The camera shall have inbuilt dehumidification/defog feature to remove moisture from the camera.
- The camera shall be outdoor rated having IP66 rating for ingress protection.

3.3. FULL HIGH DEFINITION, TRUE DAY/NIGHT, MINI DOME NETWORK CAMERA (3-8mm)

GENERAL REQUIREMENTS:

- The camera shall be a Full HD dome network camera supporting three codecs, JPEG/MJPEG and 2 nos. H.264 high profile, any two of which can be used simultaneously. The camera shall utilize a 1/3" type CCD/MOS/CMOS sensor of approx.

2.0 Megapixels and have a true day/night capability.

- The camera shall be ONVIF Profile S compliant.

- The camera shall have an IK10 rated vandal-proof housing and shall comply with IEC 62262, IEC 60068-2-75 test standard for impact resistance.

- The camera shall support JPEG/MJPEG format and H.264 high profile compression. The camera shall be able to select the high quality mode in JPEG/MJPEG 1920x 1080 at minimum 25fps. The camera shall also be able to support full HD mode of 1920 x 1080 in H.264 compression mode with 30fps.

- The camera shall provide minimum 3 streams, namely, 1 x JPEG/MJPEG and 2 x H.264 High Profile.
- The camera shall incorporate a built-in web server, so that astandard web browser such as Microsoft Internet Explorer. Mozilla Firefox or Google Chrome can be used to access the camera without need for special viewer software.

- The camera shall have an advanced function which will allow the camera image to be viewed in JPEG format without using any plug-ins and thus allowing HTML code for the video image to be generated, allowing for easy web page integration.

- The camera shall be capable of supporting up to five (05)users simultaneously over the network.

- The camera shall have light control mode to select the operating environment, i.e., indoor or outdoor.

- The camera shall have a 2D and 3D noise reduction capability for reducing AGC noise to provide clear images without motion blur.

- The network interface shall be an 8-pin RJ-45 connector, 10Base-T/100Base-TX Ethernet. Both IPv6 and IPv4 shall be supported.

- The camera shall have built-in motion detection capability.

- The camera shall support the following Network protocols: TCP/IP, UDP/IP, HTTP, RTSP, RTP, RTP/RTCP, FTP, SMTP, DHCP, DNS, DDNS, NTP, and SNMP.

- The camera shall support HTTPS client authentication.

- The camera shall have user configurable port settings.

- The camera shall have an integral 3 to 9 mm p-iris type vari-focal lens with remote zoom and focus.

- The camera shall be Power over Ethernet (PoE) capable, compliant to the IEEE 802.3af standard.

- The camera shall have privacy zone masking for blocking out unwanted or prohibited areas within the video image to protect privacy

- The camera software should include IP Setup (including group camera management) program, Firmware Upgrade Tool, Privacy Masking Tool. The software shall be supplied with the camera as a standard accessory.

- The minimum electronic shutter setting shall be 1 second, and a maximum of 1/40,000 sec.

- The camera shall be capable of limiting the bandwidth from 64 kbps to 8 Mbps in MPEG-4 or H.264 high profile, and from 0.5 Mbps to an unlimited bandwidth in JPEG.

- The camera shall be capable of automatically transmitting alarm images transfer via FTP file transfer and/or e-mail. In addition the network camera shall support scheduled transfer of image information via FTP to an FTP server.

- The camera shall feature a body-based automatic back focus mechanismfor automatic and remote back focus adjustment by way of hardware button or software based control.

U <u>CAMERA LENS SPECIFICATIONS:</u>

- Focal length shall be 3 to 8 mm with field of view coverage of approximately 90° to 34°

V <u>VIDEO-ELECTRICAL REQUIREMENTS:</u>

- The camera input power shall be PoE 802.3af compliant source.

- The camera shall operate at a minimum scene illumination of: 0.3 lux in colour and 0.065 lux in B/W mode, 0 lux with IR.

- The IR range shall be upto 20 mtrs

- The camera shall have multiple ON/OFF/Selectable AGC levels which can be set from the settings menu.

W <u>MECHANICAL REQUIREMENTS:</u>

- The camera shall have compliance to IEC 60529 standard. Also, it shall have IK10 rated vandal resistant body for reliability.

3.4. FULL HIGH DEFINITION, OUTDOOR FIXED CS-MOUNT/

BOX / BULLET CAMERA GENERAL REQUIREMENTS:

- The camera shall be a Full HD fixed-type CS-mount network camera supporting three codecs – 1 x JPEG/MJPEG and 2 x H.264 high profile streams. Camera shall have a 1/3" type CMOS/MOS sensor and have a resolution of approx. 2.0 MP and have a True day/night capability.

- The camera shall be ONVIF Profile S compliant.

- The camera shall support JPEG/MJPEG and H.264 high profile compression. The camera shall be able to select the high quality mode in JPEG 1920 x 1080 at minimum 25fps. The camera shall also be able to support full HD mode of 1920X1080 in H.264 compression mode with 30fps. The camera shall support JPEG and H.264 high profile compression
- The network interface shall be an 8-pin RJ-45 connector, 10Base-T/100Base-TX Ethernet. Both IPv6 and IPv4 shall be supported.

- The camera shall incorporate a built-in web server, so that a standard web browser such as Microsoft Internet Explorer. Mozilla Firefox or Google Chrome can be used to access the camera without need for special viewer software.
- The camera shall be capable of supporting up to five (05)users simultaneously over the network.

- The camera shall have built-in motion detection capability.
- The camera shall support the following Network protocols: TCP/IP, UDP/IP, HTTP, HTTPS, RTSP, RTP, RTP/RTCP, FTP, SMTP, DHCP, DNS, DDNS, NTP, SNMP, UPnP, IGMP, ICMP, ARP

- The camera shall have both FTP client and server capabilities.

- The camera shall have user configurable port settings.

- The camera shall have a CS-mount 2MP IR corrected type 5-50mm vari-focal lens.

- The camera shall be Power over Ethernet capable, compliant to the 802.3af standard.

- The camera shall have privacy zone masking for blocking out unwanted or prohibited areas within the video image to protect privacy.

- The camera shall have the capability for Camera ID as well as Date/Time data to be superimposed on the video image.

- The camera shall have light control mode to select the operating environment, i.e., indoor or outdoor.
- The camera shall have a 2D and 3D noise reduction capability for reducing AGC noise to provide clear images without motion blur.

- The camera shall be capable of automatically transmitting alarm images transfer via FTP file transfer and/or e-mail. In addition the network camera

shall support scheduled transfer of image information via FTP to an FTP server.

- The minimum electronic shutter setting shall be 1second, and a maximum of 1/40,000 sec.
- The camera shall be capable limiting the bandwidth from 64 kbps to 8192 kbps in H.264 high profile and an unlimited bandwidth in JPEG.
- The camera shall support multi-casting and unicasting

X CAMERA LENS SPECIFICATIONS

- The camera shall have a CS-mount DC auto-iris type vari-focal lens - Focal length shall be 5- 50mm.
- The aperture range for the lens shall be F1.2 to F1.9.

Y VIDEO- ELECTRICAL REQUIREMENTS

- The camera input power shall be PoE 802.3af compliant source.
- The camera shall operate at a minimum scene illumination of: 0.3 lux in colour and 0.06 lux in B/W mode.
- The camera shall have multiple ON/OFF/Selectable AGC levels which can be set from the settings menu.

Z MECHANICAL REQUIREMENTS

- The camera shall have a CS type camera lens mount.
- The camera lens supplied with the camera shall be IR corrected lens supplied by the camera OEM or other reputed makes of lens such as Tamaron or Fujinon or equivalent and having focal length 5-50mm, F1.2 to F1.9, DC auto-iris type vari-focal lens.
- The camera shall be installed in a vandal resistant IK10 rated housing.
- The camera shall be outdoor rated and having IP66 rating for ingress protection.

3.5. VIDEO MANAGEMENT SOFTWARE (VMS)

- The application must be able to support multiple brands of surveillance cameras at the same time.
- In order to ensure an openness of the system the VMS application provider shall be different than the camera make.
- The VMS shall support SDK (Software Development Kit) integration for integrating third party systems.

- The VMS shall support ONVIF or PSI alliance – industry standards for the interface of IP-based physical security products.

- The VMS shall allow the direct configuration of IP camera device with no requirement to directly connect via web page of IP camera or encoder to configure parameters such as Discovery on IP network and set IP Address, Frame Rate, Resolution, Motion Detection (within camera or server based), Bit Rate, Key frame interval, Digital I/O, Audio Inputs/Outputs, Ability to update firmware of IP camera or encoder. Any configuration changes do not require these services to be restarted.

- The VMS shall be compatible with both 32-bit and 64-bit operating systems including clients working on Windows 7 or later and server operating systems version Windows Server 2003/2008 or later.

- The VMS shall be based on a true open architecture that shall allow for use of non- proprietary workstation and server hardware, non-proprietary network infrastructure and non-proprietary storage.

- The VMS shall offer a complete and scalable video surveillance solution which allows cameras to be added on a unit-by-unit basis.

- All video streams supplied from analog cameras or IP cameras shall be digitally encoded in H.264 or better compression formats and recorded simultaneously in real time.

- The VMS shall support configuration of individually configurable multiple streams for Live & Recording. This functionality shall also support configuration of each camera stream separately. Altering the setting of one camera shall not affect the recording & display settings of other cameras.

- The VMS shall be able to use multiple CCTV keyboards to operate the entire set of cameras throughout the system, including cameras of various manufacturers' brands, including their PTZ functionalities.

- The VMS shall be able to retrieve and set the current position of PTZ cameras with presets.

- The VMS shall consist of a role-based architecture, with each server hosting one or more roles, typical roles or functions such as the following:

- The system shall be managed by a Central Database Role that would contain all the system information and component configuration.

- Database Management Role to authenticate users and give access to the system based on predefined user access rights or privileges, security partition settings, configuration of camera units, access control units, PTZ functionalities, camera sequences and recording schedules.

- Video Recording Role for managing cameras and encoders under its control and archiving video.

- Routing Role for routing video and audio streams across the networks from

the source to destination.

- Health Monitoring Role for monitoring and logging health events and warnings from the various client applications, roles, and services. It shall also log events within the Windows Event Log, generating reports on health statistics and health history.

- Surveillance User Interface shall be provided for monitoring of video from the cameras, transactions from access control and the events & alarms. The interface shall also facilitate recording of the video.

- A User Interface for controlling of Pan Tilt & Zoom functionality and pre-sets of PTZ cameras besides other functions such as - control of iris and focus of the camera, perform digital zooming on the live as well as playback video.

- The User Interface shall allow administrators and operators with appropriate privileges to monitor the VMS system, run reports, and manage alarms.

    - The User Interface shall support following to enhance usability and operator efficiency such as:

        - Use of transparent overlays that can display multiple data in a seamless fashion.
        - Display tile menus and quick commands.
        - Consolidated and consistent workflows.
        - Tile menus and quick commands easily accessible within every display tile of the user workspace.

    - The User Interface shall have task for investigation of video bookmark, smart motion search, archive reports, audit trails and activity reporting.

    - The user shall have full control over the user workspace through a variety of user- selectable customization options. Administrators shall also be able to limit what users and operators can modify in their work space through privileges.

    - Once customized, the user shall be able to save his/her workspace.

    - The user workspace shall be accessible by a specific user from any client application on the network.

    - Display tile patterns shall be customizable.

    - Facility shall be available for event or alarm lists to be displayed on any part of the screen, from a portion of the screen up-to the entire screen, and shall be resizable by the user. The length of event or alarm lists shall be user-defined. Scroll bars shall enable the user to navigate through lengthy lists of events and alarms.

    - The User Interface shall support multiple display tile patterns,e.g., 1 display tile(1x1 matrix),16tiles(8x8matrix)and multiple additional variations.

- The User Interface shall support as many monitors as the PC video adapters and Windows Operating System are capable of accepting.

- Shall support live video monitoring on each and every display tile within a task in the user's workspace.

- The operator shall be able to drag and drop a camera into a display tile for live viewing.

- The operator shall be able to start/stop recording on any camera in the system, which is configured to allow manual recording, by clicking on a single button.

- The operator shall be able to switch one or more video tile to switch for instant replay. This operation shall not affect live monitoring of other cameras.

- Users shall be able to take snapshots of live video and be able to save or print the snapshots.

- The user shall be able to view the same camera multiple times in different tiles.

- A Server Monitoring Service shall be installed on all PCs/servers running with VMS platform. In the event of a malfunction or failure, the Server Monitoring Service shall restart the failed service. As a last resort, the Server Monitoring Service shall reboot the server/PC if it is unable to restart the service.

- The platform shall support the Alarm Management functionality. The User shall have the ability to acknowledge alarms, create an incident upon alarm acknowledgement, and put an alarm to snooze. The user shall able to spontaneously trigger alarms based on something he or she sees in the system.

- The Surveillance User interface's video playback capabilities shall include:

  - Audio and video play back of any time span.

  - Video play back on each and every display tile.

  - Allowing operators to switch to instant replay of the video for any archiving camera with the simple click of button.

  - Allowing the operator to select between instant synch of all video streams in play back mode allowing operators to view events from multiple angles or across several camera fields, or non-synchronous playback.

  - Allowing the operator to simultaneously view the same camera in multiple tiles at different time intervals.

- Allowing the operator to control the play back with:
    - Pause
    - Lock Speed
    - Forward and Reverse Playback at:1x,2x,4x,6x,8x,10x,20x,40x (at least up to 40x)
    - Forward and Reverse Play back frame by frame
    - Slow Forward and Reverse Playbackat:1x/8x,1/4x,1/3x,1/2x.
    - Loop play back between two time markers
- Displaying a single timeline, or optionally one timeline for each selected video stream, with which the operator can navigate through the video sequence by simply clicking on any point in the timeline.
- Displaying the level of motion at any point on a timeline.
- Allowing to query archived video using various search criteria, including but not limited to, time, date, camera, and area, among others.
- Providing a tool to search video and associated audio on user-defined events or motion parameters.
- Allowing operators to define an area of the video field in which to search for motion as well as define the amount of motion that shall trigger search results in order to retrieve all archived video streams which contain motion which meets the search parameters. There shall be a graphical timeline where the time of each search hit shall be indicated.
- Supporting digital zoom on play back video streams.
- Providing still image export to PNG, JPEG, GIF, and BMP format with Date and Time stamp and Camera Name on the image (snapshot).
- Providing tools to export video on various media such as a DVD.
- Allowing operators to load previously exported video files from their computer or network.

- The VMS shall permit the user to select multiple entities to be monitored from the Surveillance User Interface.
- The User Interface shall support the ability to manually track a moving target with the single click of a button.
- Visual tracking shall be available with both live and recorded video.

- The user interface monitoring client shall able to take control of other client station based on the privilege level and control the tile of the other client like a video wall application.

CONFIGURATION USER INTERFACE

- The Configuration User Interface shall allow the administrator or users with appropriate privileges to change video configuration.

- It shall provide the ability to change video quality, bandwidth and frame rate parameters on a per camera (stream)basis for both live and recorded video.

- It shall provide the ability to configure brightness, contrast and hue settings for each camera on the same.

- The Configuration user interface shall provide the capability to enable & change audio parameters, audio recording serial port configuration, I/O configuration on camera device units.

- The Configuration User Interface shall provide the ability to set recording schedules and modes for each individual camera, e.g.,:

  - Continuous
  - On motion and Manual
  - Manual only
  - Disabled

- The Configuration User Interface shall support the creation of schedules to which any of the following functional aspects can be attached:

  - Video quality(for each video stream per camera)
  - Recording(for each camera)
  - Motion detection(for each detection zone per camera)
  - Brightness, Contrast, Hue(for each camera)
  - Camera sequence execution

- The configuration User Interface shall support creation of unlimited recording schedules and assign any camera to any schedules.

- The Configuration User Interface shall provide the capability to set a pan-tilt-zoom protocol to a specific camera device serial port and allow mixing domes of various manufacturers within a system.

ARCHIVING

- The Archiver (Recording role) shall use an event and time stamp database for advanced search of audio/video archives. This database shall be Microsoft SQL 2008 or SQL 2012 or later

- The Archiver shall digitally sign the recorded video.

- The Archiver shall offer a plug and play type hardware discovery

service with the following functionalities:

- The Archiver shall have the capacity to configure the key frame intervalin seconds or number of frames.
- The Archiver shall support configuration of pre-alarm and post-alarm recording option that can be set between one second and 5 minutes on a per camera basis.
- The Archiver shall support minimum 300 cameras or 300 Mbps of recording throughput whichever comes first in case the network is end to end multicast.
- The Archiver shall supportsoftware level motion detection.
- Software level motion detection shall able to divide camera field of view in 5 detection zone for setting up individual motion setting in each zone and trigger an event for each zone separately.
- The Archiver shall be able to communicate with camera using 128bits SSL encryption and HTTPS secure protocol.
- The Archiver shall be able to receive multicast UDP streams directly from the camera.
- For network topologies that restrict the camera from sending multicast UDP streams, the Archiver shall redirect audio/video streams to active viewing clients on the network using multicast UDP.
- The Archiver shall be able to redirect audio/video stream to active viewing clients on the network using unicast UDP or TCP.
- The user interface of the monitoring station shall support dynamically switching the live stream from – High Resolution, Low Resolution & Live (normal).
- The Archiver shall allow configuration of retention period for archiving video for pre- set number of days. It shall also delete oldest video data if the disk is full before the retention time occurs.
- The Archiver shall allow important video sequences to be protected against normal disk clean-up routines.
- The Archiver shall keep a log and compile statistics on disk space usage.
- The Archiver shall have the capacity to down-sample video streams for storage saving purposes.

FAILOVER AND STANDBY FUNCTIONALITY

- The Standby Directory Role shall take over the responsibility of system management in case the primary directory fails. The fail over shall occur in less than 1 minute. No action from the user shall be required.

- This functionality shall be achievable without using the windows clustering.
- The Standby Archiver shall act as replacement of Archiver role on hot standby in case the primary Archiver role is unavailable. Failover shall occur in less than 1 minute. No action from the user shall be required.
- Failover Archiver shall take over for – server failure, storage failure, manually shift the Archiver Role to standby Archiver to perform maintenance activity on primary server.
- It shall be possible for a single Standby Archiver Server to act as the Standby for one or multiple Archiver roles.
- It shall be possible for any Archiver role in the system to be designated as another's stand by and vice-versa.
- The Standby Archiver shall have the ability to act as a Redundant Archiver and maintain an exact copy of everything recorded by the default Archiver, i.e., audio/video archives, events and bookmarks.
- Redundancy shall be configured on a camera by camera basis.
- The Redundant Archiver shall use a multicast video stream from the camera and shall not require an additional connection to any camera.

UNIFIED WEBCLIENT

- Web client shall be supported for video &access control.
- The Web client shall be a thin client with no download required other than an internet web browser or standard web browser plug-ins.
- The Web client shall be platform independent and run within Microsoft Internet Explorer, Firefox, Safari, and Google Chrome.

SMART PHONE AND TABLET APPS

- The VMS shall support mobile apps for various popular smart phones and tablets, including e.g., Apple iOS based devices and Android based devices
- It shall support monitoring of live camera, receive alarm push notifications, save snapshots locally on device or control PTZ.

3.1. VIDEO SURVEILLANCE STORAGE

Configuration & Specification for Storage System for Video Surveillance & Recordings on a 24 Hrs x 30Days Basis

1. High Availability

- The proposed solution should be a storage system configured with dual, redundant controllers.
- Each controller must have Intel Sandy Bridge Quad core CPU per controller or equivalent.
- The proposed solution should be based on real time optimized operating system and should not be a general purpose OS.
- The proposed solution should support online Microcode / OS upgrades.
- Must provide five 9's availability (99.999%)

2. Investment Protection

- The proposed storage should be non-disruptively upgraded to 10G Ethernet, FC and FCoE protocols in future and managed by the same storage management software.

- Storage system quoted by the OEM should be in the Leaders Quadrant in the latest Gartner Magic Quadrant for Midrange and High End Modular Storage Arrays Report.

3. RAM, Scalability and HDD Support

- The controllers should have a minimum 30GB cache spread across dual controllers.
- The proposed solution should be scalable to more than 110 drives in the same storage array without the need for upgrading the controllers.

4. Host Connectivity and Storage Backend Disk Connectivity

- The offered storage shall be supplied with at least 8nos x 1G iSCSI Ports across dual controllers for host connectivity.
- The array proposed should have a minimum of 4nos x 6Gbps 2.0 SAS backend architecture.

5. Total Aggregate Bandwidth

- The Proposed storage disk should ensure a minimum total aggregate bandwidth of 2500Mbps on a 90% write &10% read application environment.

6. RAID Support

- All RAID types should be industry standard RAID and solution to be configured with RAID5 protection.
- For every 30 disks, 1 no disk should be configured as Global hot spare.

7. Management

- The proposed solution should support a browser based built in management. It should have SNMP support. (Traps, e-mail, MIB II)

8. Current Required Protocols

- The proposed solution must support and be configured for FC &iSCSI protocols.

9. Storage Capacity Requirements

- The proposed storage array should be configured with Minimum 150TB usable capacity using SATA/NL-SAS Drives. The usable capacity is defined as the net storage capacity available for the application stack, after deducting the penalties imposed by storage infrastructure requirements, disk and array formatting, RAID penalties, host OS and file system formatting including overheads or any other penalties which eat away usable disk space. Drives offered for the above capacity shall be of the highest capacity offered by the vendor.

- The same storage system should support 50% extra growth in terms of performance and capacity for future expansion without any controller upgrade.

10. Regulatory Model

- The device should have the following certifications - FCC Class A or CE Mark for immunity against electromagnetic emissions.

11. Safety and Quality Standards

- The device should have the following quality and safety standard certifications - CAN/ CSAC22.2-60950/UL60950.

3.6. SERVERS AND CLIENTS FOR VIDEO SURVEILLANCE SYSTEM

- Server Hardware - Industry standard Intel based platform, rack mountable, redundancy architecture for critical hardware components, licensed Microsoft Server Operating system as per VMS OEM and requisite user licenses, licensed application suites, Processor: 2 x Quad Core Intel® Xeon® 5150, 2.66 GHz, 4 MB Cache, 1333 MHz FSB or better or as per CCTV/VMS OEM, min. 8 GB of RAM, 500 GB storage or more, additional hard drive(s) for video storage, 1360 x 768 or higher screen resolution, 10/100/1000 Ethernet Network Interface Card, DVD ROM Drive.

- Client Hardware - Industry standard Intel based platform, rack mountable, licensed Microsoft Operating system and requisite user licenses, licensed application suites. Intel Core i7 2600 @ 3.4 GHz or higher, min. 8 GB RAM DDR3, 500 GB SATA II hard drive for OS and VMS applications, NVidia GTX 570 or DirectX VA 2.0 compatible card with 1 GB of RAM, 1600 x 1200 or

higher screen resolution , 10/100/1000 Mbps Ethernet Network Interface Card, min. 16x DVD+/- RW Drive.

- Required Operating Systems:

- For Client PCs: Microsoft® Windows 10 or higher Professional or Ultimate 32- bit/64-bit
- For Server:» Microsoft® Windows Server® 2012 Standard Edition 64-bit » Microsoft® Windows Server® 2012 Enterprise Edition 64-bit, or later as per VMS OEM requirements

- Browser Requirements» Internet Explorer 6, 7 or 8 (for Web Clients), latest versions of Mozilla Firefox and Google Chrome

3.7. 5-PORT INDUSTRIAL PoE+ SWITCH WITH 2-PORT POPULATED MINI GBIC SFP PORTS:

Interface :

1. Fiber Ports: 2 x 100BaseFX ports (single mode, LC connector)
2. RJ45 Ports: 3 x 10/100BaseT(X) auto negotiation speed, Full/Half duplex mode, and auto MDI/MDI-X connection
3. PoE Pin out: V, V, V+, V+ for pin 1, 2, 3, 6 (End span, MDI-X Alternative A)
4. LED Indicators: PWR1, PWR2, 10/100M, PoE
5. Alarm Contact: 2 relay outputs with current carrying capacity of 1 A @ 24 VDC

Power Requirements (Unit shall be provided with required power supply)

1. Input Voltage: 24/48 VDC (20 to 60 VDC), redundant inputs
2. Input Current: Max 7.5 A @ 24 VDC (shall support up to 4 ports at 30W per Po E port)
3. Overload Current Protection: Yes
4. Connection: removable 4-contact terminal blocks
5. Reverse Polarity Protection: Yes

Physical Characteristics

1. Housing: Metal, IP30 protection
2. Installation: DIN-Rail mounting, wall mounting

Standards

1. IEEE 802.3at for Power-over-Ethernet+
2. IEEE 802.3 for 10BaseT
3. IEEE 802.3u for 100BaseT(X)
4. IEEE 802.3x for Flow Control

Standards & Certifications

1. UL 508
2. UL 60950-1
3. CSA C22.2 No. 60950-1
4. EN 60950-1

Environmental Limits

1. Operating temperature 0 to 60°C (32 to 140°F) minimum. And upto-40 to 75°C (-40 to 167°F)
2. Storage Temperature -40 to 85°C (-40 to 185°F)
3. Ambient Relative Humidity 5 to 95% (non-condensing)

MANUFACTURER'S AUTHORIZATION (MAF)

AA MAF Letter Format (On OEM Letter head with seal)

Date: _____
To,
<<< NAME OF CLIENT/ORGANIZATION>>
_____
_____

Subject: Manufacturer's Authorization Certificate

Tender Ref.: << PLEASE SPECIFY SPECIFIC TENDER REF.NO.>>

Dear Sirs,

This is with reference to the above mentioned Tender.

We hereby authorize <<NAME AND ADDRESS OF INTEGRATOR>> to offer our range of product in their tender bids. Being authorized <<NAME AND ADDRESS OF INTEGRATOR>> may make techno- commercial and commercial proposal for this tender.

Upon being awarded the work <<NAME AND ADDRESS OF INTEGRATOR>> are authorized to install and commission our range of products falling under <<SECTION/PRODUCT CATEGORY>> of this tender.

We as Original Electronic Manufacturers will provide all the techno-commercial and service support necessary to <<NAME AND ADDRESS OF INTEGRATOR>>for this project during the commissioning phase of the equipments and until hand-over.

We also confirm that the items would be serviceable during the warranty period of 12 months and for at least five years thereafter.

Thanking and assuring best of our services at all times.

Yours faithfully (Seal & Signature)

TECHNICAL SPECIFICATIONS FOR FIRE FIHTING SERVICES

SUMMERY PAGE FIRE FIGHTING

TECHNICAL SPECIFICATIONS

1.0 SCOPE OF WORK:

Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely installation of Hose reel, fire extinguisher as required for all floor as per the drawings and specified here in after or given in the Bill of Quantities.

Without restricting to the generality of the foregoing, the fire safety system shall include the following: -

For Cluster A, B, C, D, E & F

a) M.S. (H) piping, hose reel & accessories

b) Fire Extinguishers

c) Pump House & Accessories

d) Signages

e) Suction, Delivery & header pipe, fittings, flanges & valves.

f) Fire Safety Certificate after completion of work (Fire NOC), if required

2.0 PIPE WORK:

2.1 GENERAL REQUIREMENT:

All the materials shall be of ISI mark, best quality conforming to the specifications and subject to the approval of the Client or his representative. If so directed, materials shall be tested in an approved testing laboratory & the contractor shall produce the test certificate in original to the Engineer-in-charge & the entire charges for original as well as repeated tests shall be borne by the Contractor.

Before welding, the pipe faces shall be cleared & then shall be welded conforming to IS: 9595 – 1980. The electrodes used for welding shall comply with IS: 814. The laying of welded pipe shall also comply to IS 5822 – 1986. The welding joints shall be tested in accordance to IS: 3600, Part 1973.

Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by **suitable clamps or supports as mentioned in IS code.** Only approved type of anchor fasteners shall be used for RCC ceiling and walls.

Valve and other apparatus shall be so located that they are easily accessible for operations, repairs and maintenance.

2.2 PIPE AND FITTINGS:

All pipes shall be conforming to IS:1239-1990 (M.S. Heavy class) welded joints as specified by the Client's Representative.

Pipes (exposed) shall be given one primary coat of Zinc chromate with two coat of compatible epoxy paint give an even look (Fire red, shade No. 536 as per IS: 5).

All black steel pipes under floors or below ground shall be provided with protection against corrosion by

application of 100/ 150 mm wide and 4mm thick layer of PYPKOTE/ MAKPOLYKOTE (IS:10221) over the pipe, as per manufacturer's specifications Checking with holiday testing machine. Excavation of soft soil including back filling, compacting, watering up to 1.3M depth.

All fittings 50mm & below 50 shall be forged fitting.

All fittings above 50mm shall be butt welded.

All piping laid shall be as follows:

Pipe Size	Material	Joints & Fittings	Sealing Material
Up to 50mm	E.R.W., M.S. pipe Heavy Class IS:1239	Forged Fittings Raised face Slip-on Flanges	3mm, 3-ply Rubber insertion
65mm to 150mm	E.R.W.,M.S. Pipe Heavy Class IS:1239	Butt welded Fittings Raised face Slip-on Flanges	3mm, 3-ply Rubber insertion

200mm to 300mm	E.R.W., M.S. pipe Heavy Class IS:3589 (Minimum 6.3mm thk.)	Welded Raised face Slip-on Flanges	3mm, 3-ply Rubber insertion

Pipes shall be provided with electrical resistance welding. Jointing shall be butt welded between pipe and pipe and fittings.

Joints between C.I. and M.S. / G.I. pipes shall be made by provided a suitable flanged tail or sockets piece and M.S. flanges on the M.S./G.I pipe shall have appropriate number of holes and shall be fastened with nuts, bolts and 1.5mm thick compressed asbestos gaskets.

Tee off connections shall be through reducing tees. Drilling and tapping of the main walls of the main pipe shall not be allowed.

All equipment and valve connections shall be through welded flanges.

All welded piping is subjected to the approval of the Client's Representative and sufficient number of flanges and unions shall be provided.

Tender drawings indicate schematically the size and location of pipes. The Contractor on the award of the work, shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain valves and all pipe support, structural supports. He must keep in view the specific openings in buildings and other structures through which pipes are designed to pass. Drawings to be got approved from Local Fire Authorities.

Contractor shall submit the Hydraulic calculation for the system in accordance with Fire Authority By Laws.

Piping shall be properly supported on or suspended from stand clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchors, clamps and hangers, and be responsible for their structural sufficiency.

Pipe supports shall be of steel, adjustable for height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials a gasket shall be provided in between. Spacing of pipe supports shall not exceed as per relevant IS Code.

Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars steel structural supports attached to pipe and with a 15 mm thick rubber pad or any resilient material. Where pipes pass

through the roof floor, suitable flashing shall be provided to prevent water leakage. Risers shall have a suitable clean out at the lowest point and air vent at the highest point. The Contractor shall coordinate with structural.

Pipe sleeves, 50 mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with fireproof materials like putty, fire seal etc.

Piping work shall be carried out in a workmen like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation and coordination with other agencies work so that particular area work shall be carried out in one stretch.

Piping layout shall take due care for expansion and contraction in pipes.

Using screwed fittings shall be accurately cut to the required sizes and thread in accordance with IS:554 and burrs removed before lying. Wherever reducers are to be made, eccentric reducers shall be used.

2.3 PROCEDURE FOR PYPKOTE / COATEK APPLICATION FOR UNDER GROUND PIPES

Surface Preparation - The pipe surface shall be cleaned by a wire brush.

Application of Primer - Pypkote / Coatek primer is to be applied on pipes immediately after cleaning. This is to prevent any further accumulation of rust on the pipe. This is a cold applied primer and is applied by brush.

Application of Pypkote / Coatek 4 mm Tape - After the primer is applied on the pipe, it is allowed to dry for about 30 min. till it becomes touch dry. Before adhering the tape to the pipe, it is advisable to gently heat the primer coated pipe by a run of LPG torch. Remove the bottom polyethylene from the tape & then heat bottom surface of the tape by LPG torch or any heat source & start wrapping the tape to the pipe by heating the primer coated pipe & by removing the bottom polyethylene from the tape before wrapping better adhesion between the tape & pipe is obtained. Overlaps are maintained with a minimum of 12.5 mm.

Tape coating of weld joints - The tape is applied over the weld joints after the necessary welding & testing methods of the joints is completed. The procedure for application of tape shall be the same as bare pipe procedure. Overlaps on each side of the weld joints shall be 50 mm.

A final coat of White wash with water based cement paint is done immediately over the entire coated pipe. Holiday Testing Before lowering the pipes in the trenches and before back filling the trenches the holiday test is to done at min. 20 KV. Defective area shall cleaned and re wrapped as per above.

Painting

Two coat of Zinc chromate Primer with two coats of First quality Synthetic Enamel paint of approved brand and shade.

Contractor shall do Zinc Phosphate primer, epoxy based, followed by 2 coats of Enamel paint. Please note enamel paint application to be done after min 1 hour & max 24 hrs, after application of Zinc phosphate primer. Time interval after application of Zinc phosphate & application of 1st coat of enamel should be min 1hour & max 24 hrs; so that the Zinc phosphate does not loose it's etching characteristics. The interval will be 5 to 6 hrs between application of 1st coat enamel paint & 2nd coat enamel paint.

Paint shall be of approved quality and shade. Where directed by the Owner's site representative pipes shall be painted in accordance with approved pipe colour code.

Painting shall be expertly applied; the paint shall not over run on surfaces not requiring painting such as walls, surfaces etc. Nuts and bolts shall be painted black, while valves shall be painted blue.

3.0 VALVES

3.1 NON-RETURN VALVE:

Check valves / non-Return valve shall normally be used in all water services. Check Valve / Non return valves shall be provided as required or as shown in the drawings and conform to the following specifications:

- Type: Dual Plate wafer check valve
- Body material: CI IS 210 Gr. Fg. 200
- Rating: PN 16
- Seat: EPDM Rubber lining
- Disc: Ductile iron
- Trim: Spring & Trim SS 304
- End connection: Wafer type suitable for clamping between flanges as per ASME B 16.5 Class-150
- Test Pressure: Body 21 Bar, Seat 14 Bar

3.2 C.I. SLUICE VALVES:

The contractor shall provide cast iron sluice valves as per below mentioned details. Valves should be provided with companion flange & require

accessories.

- Type: Sluice valve
- Rating: PN 16
- Body material: IS-210 Gr. FG-200 Cast Iron, Bolted Bonnet Inside screw non rising stem
- Seat: Renewable
- Wedge: Solid wedge
- Stem: Cu-Alloy, Stem SS (12 Cr. 12)
- Standard: IS:14846
- End Details: Flanges as per IS 1538 F/F Drilled
- Test Pressure: Body 24 Bar, Seat 16 Bar

3.3 BUTTERFLY VALVES:

The valve shall be wafer type. They shall be designed to fit with/without gaskets, the watertight seal being obtained by EPDM seat projection at the faces compressed between the flanges. The valves shall be supplied inclusive of flanges and high tensile steel bolts of dimensions recommended by suppliers of valves. The valves shall comply with following specification.

- Type: Wafer type
- Pressure rating: PN 16
- Body Material: IS-210 Gr. FG-200 Cast Iron
- Type of disc: CF8 Stainless Steel
- Seat material: EPDM
- Operation: hand Lever
- Stem: Stainless Steel 12 Cr. 12
- Standard: IS:13095
- End Details: Flanges as per BS-10 Table D/E ANSI B 16.1 CI-125
- Test Pressure: Body 24 Bar, Seat 18 Bar

3.4 AIR RELEASE VALVE:

- Material: Brass
- Pressure Rating: PN 16
- Maximum working temperature: 100°C
- Adopter / Body / Disc Assm / Cover / Cap: Brass
- Float: Plastic
- Size: 25mm dia.

3.5 BALL VALVES

Ball valves shall be provided with each Hose reel, air release valve & wherever required for drain purpose as

mentioned in BOQ/ Drawing.

- Pressure /Class / Rating: PN-25
- Body Material: Forged Brass
- Seat: Renewable P.T.F.E. Seat
- Ball: Brass (Nickle Plated)
- Stem: Machined Brass Nickle Plated
- Body Test Pressure: 40kg/cm²
- Working Pressure: 25kg/cm²

3.6 INSTALLATION:

- Valve shall be installing in a manner that allows future removal and service of the valve.
- Packing and gasket shall not contain asbestos.
- The valve shall be of the same size as the pipe to which they are installing.
- Valve above 150mm diameter shall be self-locking warm gear type waterproof and protory lubricated.
- Provide chain operator's w/chain cleats on all valves more than 2.4 meter above floor.

4.0 HOSE REEL:

Contractor shall provide First Aid Hose Reel as mentioned in BOQ & drawing with painting, anchor fastener, bolts & nuts etc. complete as required by Local Fire Authority as per below mentioned technical details.

- Hose reel drum – IS:884
- Type – Swinging type
- Material – M.S.
- Hose – Textile reinforce Type-2, as per IS:12585
- Working pressure – 25kg/cm²
- Length – 20mm bore x 30mtr long.
- Shut of nozzle – 8mm, S.S.

5.0 FIRE BRIGADE INLET CONNECTIONS:

Fire Brigade inlet connection shall be provided for Fire Tender. It should be installed at a point near the

entry to the premises where a fire service vehicle can approach easily & feed water in system line as well as

in underground water tank.

C.I. 2-way fire brigade inlet with isolation / check valve shall be installed and connected with system Line.

C.I. 4-way fire brigade inlet with isolation valve shall be installed and connected with water tank.

SG Iron Draw out connection with isolation valve shall be installed and connected with water tank.

6.0 FIRE EXTINGUISHERS

Contractor shall provide Fire extinguishers as per BOQ, specifications and drawings.

Fire extinguishers shall conform to the following Indian Standard specifications and shall be with BIS approved stamp as revised and amended up to date.

a) Co2 4.5 kg Fire Extinguisher:

Co2 type Fire Extinguisher 4.5Kgs. Capacity, made from seamless cylinder, confirming to IS: 7285 and CCOE approved, fitted with Discharge hose and

horn and wheel type valve with initial Charge complete extinguisher confirming to IS: 15683:2018 specification.

- Discharge valve- wheel type (conforming to IS: 3224) ISI marked
- Body- MS seamless pipe 4 mm thick conforming to IS: 7285, ISI marked
- Syphon tube - aluminium conforming to IS: 733
- Discharge horn - non-conductor of electricity like polythene Fiber glass
- Co2 gas - as per IS: 15222
- Hose - braided rubber hose having 180 kgf/cm² working pressure 1 meter length
- Painting – P.O red conforming to IS: 5, shade no. 538
- Test pressure of body - 250 kgf/cm²
- Operating temp. -30ºc - + 60ºc

b) ABC 6 kg Fire Extinguisher:

ABC Stored Pressure type Fire Extinguisher 6 Kgs. capacity bearing ISI Mark for Fighting ABC Class of Fire. The Extinguisher will be Manufactured Confirming to BIS: 15683:2006.

- Body 1.5 mm thick mild steel
- Valve with below mentioned additional facilities
  a) In built NRV on valve to cross check internal pressure.
  b) Operating temperature marking on valve.
  c) Automatic safety release valve.
  d) non-returnable valve
  e) CE approved valve
- Powder - dry chemical powder as per IS: 4308 (mono ammonium phosphate 90%)
- Painting – P.O red conforming to IS: 5, shade no. 538
- Hose - braided PVC having bursting pressure 50 kgf/cm²
- Anti-corrosive treatment
  a) Shot blasting
  b) Epoxy powder coating outside
- Jet length – 4 meters
- Operating temp. -30ºc - + 60ºc

Fire extinguishers shall be installed as per Indian Standard Code of practice for selection, installation and maintenance of portable first aid appliances IS:2190-1979.

Hand appliances shall be installed in readily accessible locations with the Appliance brackets fixed to wall by suitable anchor fasteners.

Each appliance shall be provided with an inspection, testing, change of charge and other relevant data.

All appliances shall be fixed in a true workman like manner truly vertical and at current locations.

7.0 FIRE PUMPS:

7.1 SCOPE:

Contractor shall furnish all labour, for installation testing and commissioning of complete fire pumping system. In general, the item of works shall include but not limited to the following:

a) 1 no. of Main Pump - Electrically operated pump

b) 1 no. of Standby Pump – Diesel Engine operated pump

c) 1 no. of Jockey Pump - Electrically operated pump

d) Complete electrical system, Panel for pumps.

7.2 MAIN PUMP (ELECTRIC DRIVEN):

Contractor shall provide and install electrically operated fire pumps of capacity and head indicated in the Drawings/Bill of Quantities.

Pumping sets shall be split casing pump.

Pumps shall be capable of giving a discharge of not less than 150 % of the rated discharge at a head of not less than 65% of the rated head. The shut off head shall be within 120% of rated head.

2280 lpm – 88m head

MOC: Casing CI – Impeller Bronze – Shaft SS410, Mechanical seal

Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages.

The pump casing shall be designed to withstand 1.5 times the working pressure.

7.3 MOTORS FOR ELECTRIC DRIVEN PUMPS:

7.3.1 MOTOR:

The motor (IE2) shall be TEFC squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. System.

Degree of protection shall be IP 55. The class of insulation shall be F. Temperature rise limit up to class 'B', duty 'S1' The synchronous speed shall be 1500RPM as specified.

The motor shall be rated for continuous duty and shall have a horsepower rating necessary to drive the pump at 150% of its rated discharge with at least 65% rated head. The motor shall conform to I.S. 325 - 1978.

7.3.2 MOTOR STARTER:

The motor starter shall be soft type conforming to IS: 1822 - 1967. The unit shall include suitable current transformer and ammeter of suitable range on one line to indicate the current. The starter shall not incorporate under voltage no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system.

7.4 JOCKEY PUMP (ELECTRIC DRIVEN):

Contractor shall provide and install electrically operated fire pumps of capacity and head indicated in the Drawings/Bill of Quantities.

Pumping sets shall be horizontal End suction centrifugal pump.

180 lpm – 88m head

MOC: Casing CI – Impeller Bronze – Shaft SS410, Mechanical seal

Bearing of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water.

The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages.

The pump casing shall be designed to withstand 1.5 times the working pressure.

7.5 MOTOR FOR ELECTRIC DRIVEN PUMP:

7.5.1 MOTOR:

The motor (IE2) shall be TEFC squirrel cage A.C. induction type suitable for operation on 415 volts 3 phase 50 Hz. System.

Degree of protection shall be IP 55. The class of insulation shall be F. Temperature rise limit up to class 'B', duty 'S1' The synchronous speed shall be 2900RPM as specified.

The motor shall be rated for continuous duty and shall have a horsepower rating necessary to drive the pump at 150% of its rated discharge with at least 65% rated head. The motor shall conform to I.S. 325 - 1978.

7.5.2 MOTOR STARTER:

The motor starter shall be soft type conforming to IS: 1822 - 1967. The unit shall include suitable current transformer and ammeter of suitable range

on one line to indicate the current. The starter shall not incorporate under voltage no voltage trip overload or SPP.

The starter assembly shall be suitably integrated in the power and control panel for the wet riser system.

7.6 DIESEL ENGINE:

7.6.1 ENVIRONMENTAL CONDITIONS:

The engine shall be required to operate under the conditions of environment as specified the place of installation.

7.6.2 ENGINE RATING:

The engine shall be cold starting type without the necessity of preliminary heating of the engine cylinders or combustion chamber (for example, by wicks, cartridge, heater plugs etc.). The engine shall be multi cylinder / vertical 4 stroke cycle, water cooled, diesel engine, developing suitable HP at the operating speed specified to drive the fire pump. Continuous capacity available for the load shall be exclusive of the power requirement of auxiliaries of the diesel engine, and after correction for altitude, ambient temperature and humidity for the specified environmental conditions. This shall be at least 20% greater than the maximum HP required to drive the pump at its duty point. It shall also be capable of driving the pump at 150% of the rated discharge at 65% of rated head. The engine shall be capable of continuous non-stop operation for 8 hours and at least 3000 hours of operation before major overhaul. The engine shall have 10% overload capacity for one hour in any period of 12 hours continuous run. Engine rpm shall be 2300.

The engine shall accept full load within 15 seconds from the receipt of signal to start. The diesel engine shall conform to BS 649/IS 1601/IS 10002, all amended up to date.

7.6.3 ENGINE ACCESSORIES:

The engine shall be complete with the following accessories: -

a) Fly wheel dynamically balanced.

b) Direct coupling for pump and coupling guard.

c) Radiator with hoses, fan, water pump, drive arrangement and guard.

d) Corrosion Resister.

e) Air cleaner, oil bath type / dry type.

f) Fuel service tank support, semi-rotary pump and fuel oil filter with necessary pipe work.

g) Pump for lubricating oil and Lub. oil filter.

h) Elect. starting battery (2 x 12 v).

i) Exhaust silencer with necessary pipe work.

j) Governor.

k) Instrument panel housing all the gauges, including Tachometer, hour meter and starting switch with key (for manual starting).

l) Necessary safety controls.

m) Winterization arrangement, where specified.

7.6.4 COOLING SYSTEM:

The engine cooling system shall be radiator water cooled system. The radiator assembly shall be mounted on the common bed plate. The radiator fan shall be driven off the engine as its auxiliary with a multiple fan belt. When half the belts are broken, the remaining belts shall be capable of driving the fan. Cooling water shall be circulated by means of an auxiliary pump of suitable capacity driven by the engine in a closed circuit.

7.6.5 FUEL SYSTEM:

The fuel shall be gravity fed from the engine fuel tank to the engine driven fuel pump. The engine fuel tank shall be mounted either over or adjacent to the engine itself or suitably wall mounted on brackets at a height not less than 60 cm above the fuel injection pump. The fuel filter shall be suitably located to permit easy servicing.

All fuel tubing to the engine shall be with copper, with flexible hose connections where required. Plastic tubing shall not be permitted.

The fuel tank shall be of welded steel construction relevant to Indian or foreign standard for mild steel drums (IS 2552) and of capacity sufficient to allow the engine to run on full load for at least **4 hours**. The tank shall be complete with necessary floor mounted supports, level indicator (protected against mechanical injury) inlet, outlet, overflow connections and drain plug and piping to the engine fuel tank. The outlet should be so located as to avoid entry of any sediment into the fuel line to the engine.

A semi rotary hand pump for filling the daily service tank together with hose pipe 5 mtr. long with a foot valve etc. shall also form part of the scope of work or as specified in Bill of Quantities.

7.6.6 LUBRICATING OIL SYSTEM:

Forced feed Lub. oil system shall be employed for positive lubrication. Necessary Lub. oil filters shall be provided, located suitably for convenient servicing.

7.6.7 STARTING SYSTEM:

The starting system shall comprise necessary batteries (2x12v), 24 volts starter motor of adequate capacity and axle type gear to match with the toothed ring on the fly wheel. By metallic relay protection to protect starting motor from excessively long cranking runs suitably integrated with engine protection system shall be included within the scope of the work.

The capacity of the battery shall be suitable for meeting the needs of the starting system.

The battery capacity shall be adequate for 10 consecutive starts without recharging with cold engine under full compression.

The scope shall cover all cabling, terminals, initial charging etc.

7.6.8 EXHAUST SYSTEM:

The exhaust system shall be complete with silencer suitable for outdoor installation, and silencer piping including bends and accessories needed for a run of 5 meter from the engine manifold. (Adjustment rates for extra lengths shall also be given). The total back pressure shall not exceed the engine manufacturer's recommendation. The exhaust piping shall be suitably lagged.

7.6.9 ENGINE SHUT DOWN MECHANISM:

This shall be manually operated and shall return automatically to the starting position after use.

7.6.10 GOVERNING SYSTEM:

The engine shall be provided with an adjustable governor to control the engine speed within 5% of its rated speed under all conditions of load up to full load. The governor shall be set to maintain rated pump speed at maximum pump load.

7.6.11 ENGINE INSTRUMENTATION:

Engine instrumentation shall include the following: -

a) Lub. Oil pressure gauge.

b) Lub. Oil temperature gauge.

c) Water pressure gauge.

d) Water temperature gauge.

e) Tachometer.

f) Hour meter.

The instrumentation panel shall be suitably resident mounted on the engine.

7.6.12 ENGINE PROTECTION DEVICES:

Following engine protection and automatic shutdown facilities shall be provided: -

a) Low lub. oil pressure.

b) High cooling water temperature.

c) High lub. oil temperature.

d) Over speed shut down.

7.6.13 PIPE WORK:

All pipelines with fittings and accessories required shall be provided for fuel oil, lub. oil and exhaust system, copper piping of adequate sizes shall be used for lub. oil and fuel oil. M.S./G.I. piping will be permitted for exhaust.

7.6.14 ANTI VIBRATION MOUNTING:

Suitable vibration mounting duly approved by engineer-in-charge shall be employed for mounting the unit so as to minimize transmission of vibration to the structure. The isolation efficiency achievable shall be clearly indicated.

7.6.15 BATTERY CHARGER:

Necessary float and boost charger shall be incorporated in the control section of the power and control panel, to keep the battery under trim condition. Voltmeter to indicate the state of charge of the batteries shall be provided.

7.7 CONTROL PANEL:

7.7.1 CUBICAL PANEL:

Contractor shall supply, install, testing & commissioning of Pump control panel with required cables, cable trays & accessories.

- **1 No. Panel for below mentioned pumps**

- **1 no. Of Electric Motor Driven Main Pump**

- **1 no. Diesel Engine Driven Standby Pump**

- **1 no. Electric Driven Jockey Pump**

The main switch board cubicle panel shall be of floor mounted type, totally enclosed, dust and vermin proof made from 2.0 mm CRCA sheet of suitable size duly painted with Powder Coated as per IS code / local fire department's requirement.

The cubical shall comprise of the followings:

- Incoming main M.C.C.B unit of required capacity.
- Outgoing M.C.C.Bs one for each motor.
- Copper busbar of suitable capacity.
- Fully Automatic "**SOFT TYPE** " starter suitable for the motor H.P. with Push Buttons and ON/OFF indicating light one for each motor for all pumps.
- Single phasing preventers one for each motor.
- Ampere meters - one for each motor complete with CTs.

- Voltmeter on incoming main with rotary selector switch to read voltage between phase to

Neutral and phase to phase.

- Three neon phase indicating lamps.
- Rotary switch for manual/auto operation.
- All color coded internal and inter-connecting wiring from incoming main to bus bar, switch board panel

and power/control cables from switch board cubicle to motors, engine and batteries etc. complete in all

respect.

- 7Tank Chemical treatment
- Outer Structure: - 2.0mm MS CRCA Sheet & Load Bearing Members: - 2.0mm MS CRCA Sheet
- Front Door &Cover: - 2.0mm MS CRCA Sheet
- Internal Partition: - 2.0mm MS CRCA Sheet
- Mounting Plate: - 2.0mm MS CRCA Sheet
- Gland Plate: - 2.0mm MS CRCA Sheet
- Danger notice board must be located at control panel.
- Ip protection – IP 42

All switchgears and accessories shall be approved make to relevant IS codes and to the satisfaction of ENGINEER-IN-CHARGE and rating of all equipment must match the KW of motors included. All electrical work to be carried out as per IS standard and CPWD rules/specifications.

7.7.2 EARTHING:

There shall be two independent earthing stations at least 3 meters away from the pump room. Each earth electrode shall consist of GI earth plate 600mmx600mmx6mm thick including accessories and masonry enclosure with cover plate having locking arrangement. All electrical apparatus, cable boxes and sheath/armour clamps shall be connected to the main bar by means of branch earth connection of 25mm x 5mm copper strip. All joints in the main bar and between main bar and branch bars shall have the lapping surface properly tinned to prevent oxidation. The joints shall be riveted and sheathed. The main earthing strip shall be 25 x 5mm copper in 40mm dia G.I. pipe from earth electrode as required.

Earth plates shall be buried in a pit 1.2 x 1.2m at minimum depth of 3 meters below ground. The connections between main bar shall be made by means of these 10 mm studs and fixed at 100mm centers. The pit shall be filled with coke breeze, rock salt and loose soil. A G. I pipe of 29mm dia with performations on the periphery shall be placed vertically over the plates to reach ground level or watering.

A brick masonry man hole 30x30x30cms size shall be provided to surround the pipe for inspection. A bolted removable link connecting main bar outside the pit portion leading to the plates shall be accommodated in this manhole for testing.

Earthing shall be done complete as per NBC / CPWD / IS specifications.

7.7.3 CABLING:

All cables from switch board panel to the motors shall be PVC insulated FRLS and PVC sheathed FRLS armoured aluminum conductor power cables of 650/1100 V grade conforming to IS:1553. The cables of required size shall be suitable for laying on surface of wall or in flooring with suitable clamps. Necessary cable trays shall deemed to be included in this item as per site requirements.

The termination shall be with brass compression glands suitable for PVC sheathed armored aluminium conductor cable of 1.1 KV "A' grade of the required size.

Refer electrical tender for further detailing & make list.

8.0 AIR VESSEL FOR FIRE PUMPS:

Provide air vessel from 8mm M.S. sheet with dished ends and suitable supporting legs, with required necessary valves and connection with required accessories.

The vessel shall be 450mm x 2000mm dia, suitable for working pressure 8.8 kg/cm², Hydro test at 13.2 kg/cm², Joint efficiency 0.85, Radiography longitudinal seam 100%, Circumferential seam 10% spot.

9.0 PRESSURE GAUGE:

Contractor shall provide 150 mm dia Pressure Gauge at each pump delivery line & common delivery header or as per standard practice.

- Range - 0 - 15 Kg / cm²
- Bourdon material – Nonferrous – AISI – 316
- Case & Bezel - Cast Aluminium Stove enameled Black weatherproof Case with inner screwed bezel of ABS plastics and Case and Bezel made of AISI 304/316.
- Glycerin filled, screwed, nipple, isolation valve, U-type stainless steel siphon tube and complete with necessary as required.

10.0 PRESSURE SWITCH:

Contractor shall provide Pressure Switches for automation of fire pumps.

- Cover - ABS, plastic
- Switch contacts – SPDT
- Ingress protection – IP 67

11.0 STRAINER:

Contractor shall provide strainer at water tank suction side as per drawing / BOQ with required accessories.

- Material - Cast Iron IS 210 Gr. FG 200
- Trim - S.S. Screen/SS 304 having 1.2mm perforation
- End Details: Flanges as per BS 10 Table E
- Body Test Pressure: 21 kg/cm²

12.0 SIGNAGES:

12.1 AUTOGLO GR Self Maintain Photoluminescent SWGS Signages in 1 mm thick Rigid Sheet ARS 10000

>Strong Self Adhesive.

>Life: 10- 15 Years

>Weatherproof

The sign can easily be cleansed with a dry cloth or with a cloth humidified with water (without detergents), Self-Extinguishing, The Sign does not contain any radioactive substances In toxic terms the product is considered as safe, Non Peelable, Non Scratchable, Non Breakable, Silk Screen Printed:

High quality paint with UV resistance, As Per PSPA Class - A / DIN 67510 Part 2 / 60 Minutes / > 700 mcdl with High photoluminescent luminous intensity Certified By Government Of India Lab For A Glow Period > 24 Hrs. DRDO & ARAI Certified for All require QC test to Confirm As per the IS 9457-2005, IS 12349 (To be approved by EIC) the color Should be

RED/GREEN/BLUE/YELLOW with Graphics Symbol in White approved by Local Director of Fire and Emergency services.

a) Fire Equipment: size: 100 X 300mm

13.0 TESTING OF THE SYSTEM:

All piping shall be tested to hydrostatic test pressure of **13.2 Kg/Cm²** for 2 hours. All leaks and defects in joints revealed during the testing shall be rectified to the satisfaction of the Client's Representative.

Piping required subsequent to the above pressure test shall be re-tested in the same manner.

System may be tested in sections and such sections shall be securely capped.

The Client's Representative shall be notified well in advance by the Contractor of his intention to test a section of piping and all testing shall be witnessed by the Client's Representative.

The Contractor shall make sure that proper noiseless circulation of fluid is achieved through the system concerned. If proper circulation is not achieved due to air bound connections, the Contractor shall rectify the defective connections. He shall bear all the expenses for carrying out the above rectification including the tarring-up and re-finishing of floors, walls etc. as required.

The Contractor shall provide all materials, tools, equipment, instruments, services and labor required to perform the test, and shall ensure that the plant room and other areas are cleaned up and spill over water is removed.

The Contractor shall give the pressure test of head for hydrant at ground level and also for hydrant at terrace level.

All air shall be trapped from the pipeline through hydrants, Hose Reel& air valves. Each section of the pipe shall be slowly filled with the water & allow to stand the water for few hours with the ends closed.

Flushing of underground connections: Underground mains and lead-in connections to system risers shall be flushed before connections made to piping in order remove foreign materials which may have entered the underground during the course of installation. For hydrant system the flushing operation shall be continued until water is clear.

14.0 COMMISSIONING OF SYSTEM:

Before commissioning, the entire system shall be flushed to ensure that any earth /foreign matters which might have entered during installation are taken out. For this, pump may be operated, and valves opened at different locations.

As soon as the work is complete, the system shall be commissioned and made available for use. Requirement of firefighting installations is equally important during occupation of the building. If the building is to be occupied in part, firefighting system of building completed shall Commissioned by isolating the system of under construction portion of the building.

The firefighting system shall be maintained and manned from the very first day of its Commissioning.

Any defects noticed during the warranty period shall be promptly attended by the Contractor and availability of the system at all time is to be ensured.

15.0 ACCEPTANCE TEST:

At the time of taking over, the hydrant system shall fulfil the following acceptance tests: -

Starting up of the pressure suction (Jockey Pump): The pressure switch shall be set at 7.8 kg/cm^2 at the lower limit and 8.8 kg/cm^2 at the upper limit. The system drain shall be opened to cause a drop in the pressure. The Pump shall start as soon as the pressure gauge needle falls down to 7.8 kg/cm^2. The pump shall also stop automatically when the system has been pressurized again up to required pressure (8.8 kg/cm^2).

All these tests mentioned above shall be repeated after one-hour interval. The result of all the tests shall be identical again. After the system has satisfactorily withstood the above tests, it can be taken over from the contractor.

16.0 START-UP / SYSTEM TESTING:

It will be the responsibility of the tendered to cause interim/stage inspection by the CFO during execution of the work as and when so called for by the Employer / Architect and shall carry out any rectification / modification as may be suggested by the State Fire Officer (CFO).

Soon after the work is completed, the contractor shall inform the CFO in writing with a copy to the Architect / Employer for getting the complete system including all sub system and instrumentation, control etc. thoroughly inspected and tested for satisfactory performance. After satisfactory

completion of tests of the systems by the CFO the contractor shall be required to submit in built drawings on tracing cloth to the Architect which have been so approved.

The contractor shall also be responsible for getting the system and equipment tested and approved by other Statutory Authorities like the Area Fire Officer or the State Fire Services as may be required.

17.0 HANDING OVER:

All commissioning and testing shall be done by the Contractor to the complete satisfaction of the Engineer-in-Charge / Consultants, and the job handed over to the Client. Contractor shall also hand over to the Client all maintenance and operation manuals and all items as per the terms of the contract.

A. CODES & STANDARDS

Sr. No.	Code	Description
A	**INDIAN STANDARD (IS)**	
1	IS 325	Induction motors - 3 – phase
2	IS:636	Fabric Reinforced Rubber Lined Hose
3	IS:844	First Aid Hose Reel
4	IS 900	Installation and Maintenance of Induction Motor
5	IS:903	Fire Hose Delivery Couplings, Branch Pipe, Nozzles And Nozzle Spanner
6	IS:908	Fire Hydrant stand post
7	IS:909	Underground fire hydrant sluice valve type
8	IS:1239	Steel Tubes & Fittings - up to 150 mm (Part I & II)
9	IS:2190	Selection, installation and maintenance of First aid fire extinguishers.
10	IS:2871	Specification for branch pipe, universal, for firefighting purposes
11	IS:3589	Steel Tubes - above 150 mm
12	IS:3844	Installation and maintenance of internal Fire hydrants and hose reel on premises
13	IS:5132	First Aid Fire Hose

14	IS:5290	Landing valves
15	IS:5312	Check Valves
16	IS:10211	Anti-corrosion treatment for underground pipes
17	IS:13095	Butterfly valves
18	IS: 14846	Sluice valves
19	IS:15301	Installation and Maintenance of Fire Fighting Pumps
20	IS:15105	Design and Installation of Fixed Automatic Sprinkler Fire Extinguishing Systems
21	IS:15683	Portable fire extinguishers - Performance and construction
B	**National Building Code (NBC)**	

TECHNICAL SPECIFICATIONS FOR HVAC SERVICES

SUMMERY PAGE HVAC WORKS

a) DESIGN BRIEF

Executive Summary

The design approach taken to compliment the "Net Positive" concept for overall campus. The approach for designing HVAC system shall mainly focussing toward environment issues, energy conservation, safety & ease of maintenance. New technological changes towards the sustainable & energy efficient design shall be implemented to optimize the use of active & passive system. The key strategies for achieving the same shall be as follows:

1. Water Cooled VRV

Considering the water availability at site, an energy conscious Water cooled VRV has been proposed for the residential parcel. The system is capable to do the individual energy metering for each indoor. For hostel block, each room shall have individual indoor unit with common outdoor VRV unit placed at terrace of each block in a cluster which in turn rejecting the heat to common cooling tower of the cluster. The same concept has been designed for faculty apartment where the VRV outdoor of individual flat is connected to common cooling tower of individual apartment block whereas the faculty bungalow have the same concept with having single common cooling tower placed in landscape area.

Design Approach:

The approach for designing HVAC system shall mainly focussing toward environment issues, energy conservation, safety & ease of maintenance. New technological changes towards the sustainable & energy efficient design shall be implemented to optimize the use of active & passive system. The key strategies for achieving the same shall be as follows:

1. Water Cooled VRV

Codes & Standard:

The system design shall be carried out based on the latest edition of international code & standard which are as follows:

1. ASHRAE (American Society of Heating, Refrigeration & Air-conditioning Engineers)
2. ISHRAE (Indian Society of Heating, Refrigeration & Air-conditioning Engineers)
3. National Building Code of India (NBC)
4. ECBC (Energy Conservation Building Code)

Input Data

Based on the architectural inputs on the building envelop, following are the input data considered in the designing of HVAC system:

Ambient Condition: Since the meteorological data of Nalanda, Rajgir is not available, we have consider "Gaya" as the base station for ambient design (Temperature & Relative humidity).

Season	Dry Bulb Temp	Wet Bulb Temp	Relative Humidity
Summer	112.3 °F (44.6 °C)	73.9 °F (23.3 °C)	15.8 %
Monsoon	92.1 °F (33.4 °C)	84.5 °F (29.2 °C)	73.4 %
Winter	40.9 °F (5.0 °C)	39.9 °F (4.4 °C)	92.1 %

Indoor Space Condition: Considering the ASHRAE 55 Standard & human comfort, indoor space condition considered as follows:

Season	Dry Bulb Temp	Wet Bulb Temp	Relative Humidity
All Area except Campus Inn & International Centre	77.0 ± 3.6°F (25.0 ±2.0°C)	-	Not more than 65%
Campus Inn & International Centre	72.0 ± 3.6°F (22.0 ±2.0°C)	-	Not more than 65%

Fresh Air: Referring to ASHRAE 62.1, fresh air in the indoor space shall be provided to maintain healthy indoor air quality. Broadly, following selection criteria shall be adopted:

1. Hostel Room – 5 CFM/ person + 0.06 CFM/ sq. ft.

Lighting load: Referring to ASHRAE 90.1 & ECBC, the lighting load for indoor spaces is as follows:

1. 0.7 W/ft^2 for Hostel Room
2. 0.7 W/m^2 for Corridor

Occupancy: Occupancy in different area had been considered based on the architectural inputs/ furniture layout. In few areas where architectural inputs/ furniture layouts are not available, the design had considered as per ASHRAE 62.1

1. Hostel Room – 57 sq. ft. per person

U value: The U value had been calculated on the basis of architecture/ civil inputs. Following are the U value considered:

Component	Building	Composition	U-Value
Window	Student Hostel	Single Glazed Glass **(SGG Clear Cosmos ET125)**	0.669 Btu/hr. ft^2 °F
			SHGC - 0.29 (Recessed window 0.25 & shaded 0.20)
Wall	Student Hostel	Brick -47cm	0.184 Btu/hr. ft^2 °F
Roof		As per construction details	0.072 Btu/hr. ft^2 °F
Ceiling & Floor		As per construction details	0.48 Btu/hr. ft^2 °F
Wall Partition		As per construction details	0.40 Btu/hr. ft^2°F
Glass Partition		As per construction details	0.58 Btu/hr. ft^2°F

Component		Direction	Summer	Monsoon
Solar Heat Gain (Btu/hr. ft^2)	Glass	East	12	11
		West	160	165
		South	12	13
		North	33	11
		South East	12	11
		South West	73	127
		North East	12	11
		North West	144	100
	Ceiling	-	32	12
	Roof	-	59	45
	Partition Wall	-	32	12
Equivalent Temp. Difference	Exposed Wall	East	36	22
		West	50	36
		South	50	36
		North	34	20
		South East	42	28
		South West	56	42
		North East	36	22
		North West	36	22
		Shared	34	20

Equipment Load: As per the electrical team input, the equipment load in offices are considered as 1.1 W/sq. ft.

Other Assumptions: In addition to the above captioned assumptions, the design includes following assumptions to conclude the design:

1) Winter heating had been considered for all conditioned spaces as confirmed by Client.
2) Hostel Block – air conditioning in only rooms & common room in cluster had been considered.
3) Academic calendar available at NU website had been considered for identifying the load profile.

MASTER SUMMARY SHEET											
Sr.	Application Area	Block	Revised Load								
No.		Name	Unit Type	Area	Cooling Load	Heating Load	Airflow	Total	Total	Total Winter Heating Load	Total
								Area	Cooling Load		Airflow
				Sq. ft.	TR	kW	CFM	Sq. ft.	TR	kW	CFM
		Student Hostel	Hostel PhD Hostel Married	2,62,544	1332	2873.76	735650.57				

1. DX TYPE HI-WALL SPLIT UNIT

A. Scope:

The scope of this section comprises of the supply, installation, testing & commissioning of DX Type Hi-wall Split Unit.

B. Condensing unit

The compressor(s) shall be hermetically or semi-hermetically sealed or scroll and designed for continuous operation even at high ambient temperatures of 46°C. The condenser shall be air cooled, made of Cu. tubes with extended aluminium fins. Cabinets shall be fabricated out of heavy gauge steel, properly formed for close fit and structural rigidity. All access panels shall be so constructed as to be quickly and easily removable. All outside surface shall be finished with powder coating for protection against humid weather. The condenser fans shall be directly driven and designed to achieve low condensing temperatures & operate continuously and silently.

C. Evaporating unit

The cooling coils shall be made of Copper Tubing having extended aluminium fins. The tubes shall be mechanically expanded for positive bonding between tubes and fins. The cooling coils circuit shall be fed with liquid refrigerant through the expansion devise and distributor. The blower shall be statically and dynamically

balanced and designed for silent operation at required airflow rates against required static pressure. The filters shall be washable synthetic media type arranged for convenient cleaning and replacement. The drain pan shall be fabricated out of heavy sheet steel, insulated with 1/4" expanded polyethylene sheet. The casing shall be of heavy gauge G.I., duly powder coated for weather protection.

NOTE: ALL OUT-DOOR UNITS SHALL BE MOUNTED ON EXTENDED BALCONY TYPE M.S. ANGLE FRAME STRUCTURE. THE M.S. ANGLE FRAME STRUCTURE SHALL BE MADE AVAILABLE TO VENDER BY CLIENT.

D. Controls and interlocking

Electrically / electronically operated controls (Remote) should have provided with all components, auxiliary relays, capacitors including wiring for controls and interlocking.

Minimum features such as Airflow/ String display/ preset/ Temperature/ Operation mode display/ Programming time display. All displays should be liquid crystal which gives accurate status in letters, numbers and motion.

E. Drain piping

Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping shall be made of 1.1/4" dia / 2" dia rigid PVC pipe of 6 Kg/Sq. cm. pressure rating with water tight threaded connections, leading from the room unit to a suitable drain point. Complete drain piping shall be made leak proof & water tight by means of precise installation & the use of leak proof sealant / adhesives. Insulation of drain piping by 9 mm thick Nitrile Rubber.

b) ELECTRICAL WORK

1. AS PER CPWD SPECIFICATION

CLAUSE NO.	DESCRIPTION

13.1 SCOPE

This chapter covers the requirements for the electrical works associated with heating, air conditioning, ventilation and cold room applications, namely, switch boards, power cabling, control wiring, earthing, p.f. capacitors and remote control-cum-indicating panels. Electric motors are not covered here, as these are covered as part of the respective equipment specifications.

13.2 GENERAL

i) Unless otherwise specified in the tender specifications, all equipments and materials for electrical works shall be suitable for continuous operations on 415 V / 240 V + 10%(3 phase/single phase), 50 Hz. AC system. Where the use of high voltage equipments is specified in particular works, all the respective equipments shall be suitable for continuous operation on such specified high voltage.

ii) All electrical works shall be carried out complying with the Indian Electricity Rules, 1956 as amended to date.

iii) All parts of electrical works shall be carried out as per appropriate CPWD General specifications for Electrical works, namely, Part I (Internal) 2013, Part II (External) 1994 work, and Part IV (Sub-station), 2013 all as amended to date.

iv) All materials and components used shall conform to the relevant IS specifications amended to date.

13.3 SWITCH BOARDS

i) The main switch board in the A.C. plant room shall be floor mounted, free standing cubical type and shall be factory built fabricated by one of the reputed switch board manufacturer. It shall be suitable for termination of the incoming cable(s)/ bus trunking from top/ bottom. The switchboards in air handling unit (AHU) rooms shall be wall mounted, or floor

mounted as feasible at site and as approved by the Engineer-in- charge, but they shall be cubical design, unless otherwise specified and open able from front.

ii) The capacity of switch gear, starters etc. shall be suitable for the requirements of loads fed/controlled. Starting currents shall be duly considered in case of motor loads.

iii) Switch fuse units shall be used up to and including 63 A and fuse switch units shall be used for 100 A and above. ACB shall be used for 630 A and above ratings.

iv) All switch fuses/fuse switches dis-connector switches shall be of AC 23 duty as per IS: 4064-1978 as amended up to date. They shall be complete with suitable HRC cartridge type fuses.

v) Switch boards controlling motors shall house starters for motors, unless otherwise specified. Independent single phasing preventors for each such starter shall be provided. The starter and SPP shall be located adjacent to the controlling switch gear.

vi) One-volt meter with selector switch, a set of indicating lamps and fuses for voltmeter and lamps shall be provided at each switchboard. One ammeter with CTS, and selector switch shall be provided with each motor starter. Instruments shall be flush mounted with the panel and have a glass index not higher than 1.5. The instruments and accessories shall be provided whether or not specifically indicated in the tender specifications.

vii) The fabrication of switchboard shall be taken up only after the drawings for the fabrication of the same are approved by the Engineer-in-charge.

viii) Switchboards shall be fabricated as per specifications indicated in sub- para above.

ix) The layout of bus bars and cable alleys shall be designed for convenient connections and inter-connections with the various switchgear. Connections from individual compartments to cable alleys shall be such as not to shut down healthy circuits in the event of maintenance work becoming necessary on a defective circuit.

x) Care shall be taken to provide adequate clearances between phase bus bars as well as between phase bus bars, neutral and earth.

xi) Where terminations are done on the bus bars by drilling holes therein, extra cross section shall be provided for the bus bars. Alternatively, terminations may be made by clamping.

xii) Provision shall be made for proper termination of cables at the switchboards such that there is no strain either on the cables, or on the terminators. Cables connected to the upper tiers shall be duly clamped within the switchboard.

xiii) Identification labels shall be provided against each switchgear and starter compartment, using plastic engraved labels.

xiv) Metallic danger board conforming to relevant IS shall be fixed on each electrical switchboard.

xv) Switchboard housing only isolators near cooling towers shall be housed in weather proof enclosure. The mounting arrangement shall be as approved by the Engineer-in-Charge to suit the site conditions.

13.4 POWER CABLING

i) Unless otherwise specified, the power cables shall be XLPE insulated, PVC outer sheathed aluminium conductor, armoured cables rated for 1100 V grade. The power cables shall be of 2 core for single phase, 4 core for sizes up to and including 25 sq.mm, 3-1/2 core for sizes higher than 25 sq.mm for 3 phase. Where high voltage equipments are to be fed, the cables shall be rated for continuous operation at the voltages to suit the same.

ii) Power cables shall be of sizes as indicated in the tender specifications. In all other cases, the sizes shall be as approved by the Engineer-in- Charge, after taking into consideration the load, the length of cabling and the type of load.

iii) Cables shall be laid in suitable metallic trays suspended from ceiling, or mounted on walls, or laid directly in ground or clamped on structures, as may be required. Cable ducts shall not be provided in plant rooms. Cable trays shall be fabricated from slotted angle/solid angles to make ladder type cable tray, designed with adequate dimensions for proper heat dissipation and also access to the cables. Alternatively, cable trays may be of steel sheet with adequate structural strength and rigidity, with necessary ventilation holes therein. In both the cases, necessary supports and suspenders shall be provided by the Air- conditioning Contractor as required.

iv) Cable laying work shall be carried out in accordance with 13.4 (iii) above. The scope of work for the Air-conditioning Contractor shall include making trenches in ground and refilling as required, but excludes any masonry trenches for the cable work.

13.5 CONTROL WIRING

i) Control wiring in the plant rooms and AHU rooms shall be done using ISI marked PVC insulated and PVC sheathed, 1.5 sq.mm copper conductor, 250 V grade, cables drawn in ISI marked steel or PVC conduits. Alternatively, armoured multi-core copper conductor cables may also be used for the purpose. The control cables interconnecting the plant room and the AHU rooms shall be of multi-core armoured type only, and suitable for laying direct in ground.

ii) The number and size of the control cables shall be such as to suit the control system design adopted by the Air-conditioning Contractor.

iii) ISI marked steel conduit pipes, wherever used, shall be of gauge not less than 1.6 mm thick for conduits up to 32 mm dia and not less than 2.0 mm thick for higher sizes. All conduit accessories shall be threaded type with substantial wall thickness.

iv) Control cables shall be of adequate cross section to restrict the voltage drop.

v) In the case of control wires drawn through steel conduits, the wire drawing capacity of conduits as specified under the CPWD General Specifications for Electrical Works (Part I) 1994 shall not be exceeded.

vi) Runs of control wires within the switchboard shall be neatly bunched and suitably supported/clamped. Means shall be provided for easy identification of the control wires.

vii) Control wiring shall correspond to the circuitry/sequence of operations and interlocks approved by Engineer-in-Charge.

viii) In cold storage involving temperatures below zero deg. C, polythene cables shall be used instead of PVC cables.

13.6 EARTHING

i) Provision of earth electrodes and the type of earthing shall be as specified in the tender specifications.

ii) The earth work shall be carried out in conformity with CPWD Specifications for Electrical works (Part-I), Internal 1994.

iii) Metallic body of all medium voltage equipments and switch boards shall be connected by separate and distinct earth conductors to the earth stations of the installations; looping of such body earth conductors is acceptable from one equipment, or switch board to another.

iv) G.I. plate earthing shall be provided for PTAC plants and reciprocating central AC plants up to 100 TR capacity. Above 100 TR reciprocating units and centrifugal/ screw chilling units copper plate earthing shall be provided.

v) The size of earth conductors for body earthing of equipments shall be as under: -

Motors up to and including 10 HP rating	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire
12.5 HP to 40 HP	2 Nos. 4 mm dia copper wire/ 2 nos. 6mm dia GI wire
50 HP to 75 HP	2 Nos. 6 mm dia copper wire/ 2 nos. 25x3mm GI strip
Above 75 HP	2Nos. 25mm x 3mm copper strip/ 2 nos. 25x6mm GI strip
Switch boards with incoming rating Upto 100 A	2 Nos. 3 mm dia copper wire/ 2 nos. 4mm dia GI wire 125
A to 200 A rating	2 Nos. 6mm dia copper wire/ 2 nos. 25x3mm GI strip
Above 200 A rating	2 Nos. 25mm x 3mm copper strip/ 2 nos. 25x6 mm GI strip

vi) Armouring of cables shall be connected to the body of the equipments/switch board at both the ends. Compression type glands shall be used for all such terminations in the case of PVC cables.

13.7 POWER FACTOR CAPACITORS

i) PF capacitors shall be provided for all motor loads of 5 HP and above. These capacitors shall come into circuit when the respective motor load is switched on. For this purpose, necessary interconnections between the capacitors and the motors/starters shall be included in the scope of work of the Air-conditioning Contractor.

ii) The power capacitors shall be of such value as to improve the PF to 0.90 lagging when the motor is running at full load. In the case of large size motors, the capacitors may be made in

suitable banks so that the required bank(s) of capacitors may be switched under partial load conditions. Such operations of individual banks shall be automatic.

iii) Where the PF capacitors are provided in banks, each bank shall be controlled by suitably rated switch gear with HRC fuses.

iv) The capacitor banks and the controlling switchgear may be fabricated in independent cubical or may form part of the switchboard in the installations. In the latter case, the capacitors are permitted to be mounted on the switchboard, if so desired.

13.8 REMOTE CONTROL CUM INDICATING PANEL

i) The remote control cum indicating panel shall be provided in the plant room. This panel shall have necessary push buttons for on and off controls and status indication of all electric motors except for small motors as of humidifiers of AHUs and FCUs. However , if BMS system is provided , remote control-cum- indicating panel shall not be required.

ii) In view of (i) above, push buttons need not be provided as part of the starters in the switch boards, except of the AHU blower motors. In the case of the AHU blower motors, push buttons shall be provided as part of the starters for local on and off operations.

iii) Back indication to show the status of operation of all the motors (except small motors as in humidifiers of AHUs and FCUs) and also of the electric strip heaters (AHU wise) shall be provided.

iv) Panel shall be fabricated from 1.6 mm thick steel sheet. This shall be of freestanding floor mounting type design. This shall be complete with necessary termination arrangements, multicore cables, tag blocks, control transformer, designation plastic labels, double earth studs etc. as required.

13.9 MOTOR STARTER

i) The motor starter shall conform to IS: 1822 —Motor starters of voltage not exceeding 1000 volts‖ and shall be air insulated and suitable for 415 volts, + 10%, 50 Hz., 3 phase AC supply. Enclosures shall have protection of IP 42 for Indoor applications and IP 55 for outdoor applications.

ii) Starter for the motor shall be direct on line (D.O.L) for motors up to and including 7.5 H.P. rating and automatic star-delta close transition type for motors of higher ratings unless otherwise specified in the tender specifications. Starters shall be rated for intermittent duty. Starting current should not exceed two times the full load current.

iii) Reciprocating chiller shall be fitted with part winding starter and housed in chiller panel.

iv) The starter shall be mounted on the main electrical control panel/ unit mounted/ self-mounted as specified.

v) Each starter shall be provided with the following protections: -

a) Thermal overload on all the three phases with adjustable settings,

b) Under voltage protection, and

c) Independent single phasing preventor. (current sensing type)

vi) Adequate number of extra NO/ NC contacts for interlocks, indicating lamps etc. shall be provided on the starter/ contactor.

13.10 PAINTING

All panels shall be supplied with the manufacturer's standard finish painting or as indicated in the Schedule of Work.

13.11 MOTOR EFFICIENCY

i) All permanently wired poly-phase motors of 0.375 kW or more serving the building and expected to operate more than 1500 hours per year and all permanently wired poly phase motors of 50 kW or more serving the building and expected to operate more than 500 hours per year shall have a

minimum acceptable nominal full load motor efficiency not less than IE3 class as per IS 12615 for Energy Efficient motors.

ii) Motors of horsepower differing from those listed in the table shall have efficiency greater than that of the listed kW motor. See Annexure N.

iii) Motor horsepower ratings shall not exceed 20% of the calculated maximum load.

iv) Motor nameplates shall list the nominal full load motor efficiencies and the full load power factor.

v) Motor users should insist on proper rewinding practices for rewound motors. If the proper rewinding practices cannot be assured, the damaged motor should be replaced with a new, efficient one rather than suffer the significant efficiency penalty associated with typical rewind practices.

vi) Certificates shall be obtained and kept on record indicating the motor efficiency. Whenever a motor is rewound, appropriate measures shall be taken so that the core characteristic s of the motor is not lost due to thermal and mechanical stress during removal of damaged parts .After rewinding, a new efficiency test shall be performed and similar records shall be maintained.

vii) Motors should be installed with soft start energy savers and Variable Speed drives based on the application required.

1.0 TECHNICAL SPECIFICATIONS (LT CABLES)

1.0 GENERAL

1.1 The work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. Electrical Installation work shall also be in conformity with National Electrical Code with up to date amendments. All Electrical work shall be carried out in accordance with the provision of Indian Electricity Act 1910 & Indian Electricity Rules 1956 amended up to date. The work

shall also conform to Indian Standard Code of Practice for the type of work involved. It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. All Electrical works shall be carried out as per following CPWD general Specifications for Electrical Works.

Part I - Internal Work - 2014.

1.2 Wherever this Tender Specifications call for a higher standard of material and or workmanship than those required by any of the above mentioned regulations and specifications then the particular specifications given here under shall take precedence over the said regulations and standards.

1.3 The work shall be executed and measured as per the dimensions given in the Bill of Quantities**.** Drawings, Designs, Specifications etc. The abbreviations used shall mean as under:-

	-	Inch (25.4mm)
	-	Foot (12 inches or 30.48 cms)
Sq. ft.	-	Square Feet
Sq.Mt (M^2)	-	Square Metre.
Cu. Ft.	-	Cubic Feet.
Cum (M^3)	-	Cubic Metre.
Kg.	-	Kilograms (Equivalent to 1000 gms)
T.(M.T.)	-	Tonne (Equivalent to 1000 Kgs.)
No.	-	Numbers.
Cm.	-	Centimetre.
M or R.M.	-	Metre or Running Metre.

2.0 SPECIFICATION FOR MAIN LT PANELS:

2.1 APPLICABLE CODES & STANDARDS

The design, manufacturing process and performance of the MV panel boards and all the equipment & instruments incorporated in the same shall comply with the latest Indian Standards issued by B.I.S. as follows:

BRIEF DESCRIPTION	REFERENCE STAND
Main Panel / D.G. sych. Panel / APFC panel	IEC 61439
Switch gear General Requirements	IS :13947-1993/IEC 61439-2
Factory Built Assemblies of Switch gear and Control gear and bus bar trunking	IS : 8623 (Part I & Part II)
Miniature Circuit Breaker	IS : 8828
HRC Cartridge fuse	IS : 9224 (Part 2)
Current Transformers	IS : 2705
Indicating Instruments	IS : 1248
Busbar Connections and Accessories	IS : 5578, 11353
Code of Practice for Phosphating Iron & Steel	IS : 6005
PVC insulated wires	IS : 694

Note: -The above are minimum standards expected. The technical specifications to follow and those given in schedule of quantities, if found to be more stringent as compared to those listed above, then the more stringent specifications shall prevail.

2.2 CONSTRUCTIONAL FEATURES

i The MV Panel shall be modular in design. There shall be welding only in the main frame of the panel. The frame shall be assembled with bolts and Nuts. The profiles used in the assembly of the panel shall be restricted to only two designs. Each profile should have holes of standard size punched at standard pitch throughout the length of the profile. This facilitates the joining of vertical and members with bolts and Nuts. The joining of these

members shall be dust and vermin proof and for this Neoprene Rubber is to be used.

ii Doors shall be with concealed hinges and flush type locks. All doors shall be earthed to the profile by a yellow green 2.5 Sq. mm. wire lugged at both ends.

iii All switchgears shall be mounted on clamps and fixtures such that there shall be flexibility for adjustments in X and Y axis. All partitions shall be made out of CRCA sheets. These partitions shall not be used for load bearing of switchgears. The profiles and doors shall be of 2 mm thick CRCA sheet and powder coated to RAL 7032. The partitions shall be of 1.6 mm CRCA sheet as specified above.

iv Modular type MV Panel to assemble low voltage switchgear and copper busbar arrangement. The switch handle shall be interlocked such that the door of enclosure cannot be opened unless the switch is in OFF position, however, mechanical interlock defeat mechanism has to be provided. All MCCB's / Switches only operating knob / handle shall only be visible other portion should be covered by suitable sheet. All rear doors shall be of hinged type with locking arrangement. Detachable bottom plates shall be provided at the cable compartments and terminal chamber. Liberal space shall be provided in the cable compartment as well as switch compartment to facilitate termination of cables. Provision shall be made for clamping the cables in the cable compartment.

v The panel shall have easily-removable and interchangeable sections. All service shall be capable of being performed with access from the front plus and a choice of any one side or rear for installation flexibility. To ensure grounding integrity and for static protection and EMI/RFI shielding, the removable exterior panels shall be grounded to the frame by way of stranded copper wire. Hinged doors shall provide access to the main input circuit breaker, and to all output switchgears.

vi. The unit shall be naturally convection-cooled. No fans for forced-air cooling system shall be used. The convection cooling method shall allow continuous full-load operation without activation of over-temperature

circuits. Copper bus bars, sized in accordance with the NEC shall withstand 90°C minimum. Both for reliability and Heat rejection shall be through screened protective sides, which prohibits entry of foreign material.

vii The busbar sizes should not be less than 120% of the rated current in amps & it should be so selected that the temperature should not rise 50 C above ambient. Copper busbar shall be supported with high quality non-hygroscopic insulating material. Separate busbar compartment provided on the sides housing three phase and neutral busbar should have front bolted cover, side busbar chamber shall have standardized dimension of 300 mm. The rating of the neutral busbar shall be 100% of that of phase busbar wherever required. The bus bar shall be of ETP grade Copper.

viii Power terminal blocks or bus-bar or bus-bar extensions shall be provided for each input and output feeders as per the switchgear rating and a parity-sized insulated ground conductor. All the outputs of 63A TPN & below shall be terminated to a Bus bar type terminal connector at the rear side of the panel using C-rail. All the live parts of the terminations shall be provided with shrouding by transparent perplex sheet of not less than 4 mm thick. The accessories for proper fixing of the CT's shall be provided.

ix The frame shall be configured to accept future field augmentation of additional cubicle sections.

x The panel shall be supplied along with base plinth of 100 mm. height for each modular section and shall be made of C – channel of 6mm Thick.

xi The panel shall be powder coated with Structure finish. The colour of the panel shall be siemens grey (color code IS:952) and block color to the plinth.

xii Minimum surface area & depth of the panels shall be as specified in schedule of quantities. Dimension can increase as per GA drawings of Manufacturer.

xiii Totally Type Tested Assembly as per IEC 61439

The rated peak withstand current Ipk will be equal to or higher than the peak value of the prospective short-circuit current

The breaking capacity and current limitation characteristic (I^2t, Ipk) of the specified short circuit protective device shall be stated by the ASSEMBLY manufacturer

The internal installation and wiring is carried out in accordance with the devices and components Manufacturers' instructions

The rated diversity factor is the per unit value of the rated current, assigned by the ASSEMBLY manufacturer, to which outgoing circuits of an ASSEMBLY can be continuously and simultaneously loaded taking into account the mutual thermal influences. Rated diversity factor can be stated:

- for groups of circuits;
- for the whole ASSEMBLY.

The rated diversity factor multiplied by the rated current of the circuits shall be equal to or higher than the assumed loading of the outgoing circuits. The assumed loading of outgoing circuits shall be addressed by the relevant ASSEMBLY standard.

The ambient air temperature does not exceed +40 °C and its average over a period of 24 h does not exceed +35 °C. The lower limit of the ambient air temperature is –5 °C.

Other characteristics as per IEC 61439

The following characteristics shall be declared:

a) Additional requirements depending on the specific service conditions of a functional unit

(E.g. type of coordination, overload characteristics);

b) Pollution degree (see 3.6.9);

c) Types of system earthing for which the ASSEMBLY is designed;

d) Indoor and/or outdoor installation (see 3.5.1 and 3.5.2);

e) Stationary or movable (see 3.5.3 and 3.5.4);

f) Degree of protection;

g) Intended for use by skilled or ordinary persons (see 3.7.12 and 3.7.14);

h) Electromagnetic compatibility (EMC) classification (see Annex J);

i) Special service conditions, if applicable (see 7.2);

j) External design (see 3.3);

k) Mechanical impact protection, if applicable (see 8.2.1);

l) The type of construction – fixed or removable parts (see 8.5.1 and 8.5.2.);

m) The nature of short-circuit protective device(s) (see 9.3.2);

n) Measures for protection against electric shock

2.3 AIR CIRCUIT BREAKERS (A.C.B.)

1. The ACBs shall comprise single units of Three / Four pole construction as per the single line diagram, having a rupturing capacity of 50kA at 415V AC for 1 second and shall be provided with door interlock. All ACB Should have single frame size for all ratings.

2. The ACB shall be type tested & certified for compliance to IS13947 from Indian testing authorities – CPRI, ERDA

3. For all ratings, the ACB shall have uniform panel cut-out, preferably on left or right side of the panel for allowing maximum utilization of panel space.

4. For safety of users, interlock should be provided between breaker operating mechanism & the arc chutes to prevent closing in case the arc chutes are not properly secured.

5. Draw out breakers should not close unless in distinct Service/Test/Isolated positions.

6. All current carrying parts shall be silver plated.

7. For ease of maintenance, it should preferably be possible to replace jaw contacts & cradle terminals without disturbing the bus bar links.

8. It should be possible to know the control voltage ratings for all electrical accessories without opening the panel door.

9. Circuit breaker should provide an electrical indication when all pre-requisites for closing the breaker are fulfilled.
10. A padlocking arrangement shall be provided to prevent unauthorized racking operation.
11. An interlock should be provided to prevent racking operation with panel door open.
12. It should not be possible to rack out the breaker, unless a persistent OFF command is maintained.
13. It shall not be possible to commence racking operation, with breaker ON. Additionally, it should not be possible to close the breaker during racking operation, even by a remote closing command.
14. For Draw-out breakers, an arrangement shall be provided to prevent rating mismatch between breaker and cradle.
15. The ACBs shall be CE marked.
16. The insulation material used shall conform to Glow wire test as per IEC 60695.
17. It should be possible to lock the breaker in OFF condition, by way of a key interlock.
18. The breaker as supplied should meet IP42 protection.
19. The breaker should be able to accommodate Aluminium termination as specified in IS13947 – Part 2. Any accessories required to achieve the same shall be considered in the watt-loss data specified by the manufacturer.
20. Any changes in the bus bar& dropper orientation/layout in the panel shall not call for any rework on the cradle/breaker.
21. Withstand capacity shall not be lower than Icu, at least for the maximum short- time delay setting provided on the protection releases.
22. It should be possible to convert a manually spring changed breaker to motorized spring charged breaker, on site.

23. The opening time for ACB shall not exceed 40 ms at any current level.
24. The ACB shall provide electrical and mechanical anti-pumping.
25. Remote tripping device (Shunt release) should be able to trip the ACB, even at voltages as low as 10%.
26. Under Voltage and closing releases should not consume power in latched condition (when not required to operate the breaker).
27. Inspection of main contacts should be possible without using any tools.
28. Every control connection should be uniquely identified for standardization and electrical interchangeability at site.
29. It should be possible to access racking handle & carry out setting of the release from the front & without opening the panel door.
30. ACB Shall be supplied with Spreaders as standard part of Breaker. No extra cost shall be paid for the same.
31. All ACBs shall have Ics=Icu=Icw for 1Sec
32. Rated impulse withstand voltage shall be 12KV for all ACBs

Protection Release

1. The breaker should be equipped with micro-controller based release, offering overload (50% to 100%), short circuit (400% to 100% of rated current) and earth fault protection with settable time delays for all protections.
2. The release should be able to communicate on MODBUS RTU protocol using RS485 port.
3. The release shall be equipped with thermal memory and Users should be able to selectively enable the feature.
4. The release should provide local LED indication for identification of type of fault, without requiring using external power supply. All ACB should have display of Voltage, current and energy parameters along with 10 trip fault history for O/L, S/C, E/F with time stamping. The fault indication

should be available for a period of at least 60 hours, after tripping in the absence of main supply or battery back-up.

5. The release should provide separate electrical fault indication.
6. Critical functions like Earth Fault and Zone Selective Interlocking should be in-built and should not be provided through add-on devices.
7. The release should provide local indication of actual %age loading at any instant.
8. The release should be able to provide protection for 50% and 100% Neutral rating.
9. On-Line change of settings should be possible.
10. It should be possible to carry out testing of release without tripping the breaker.
11. The release shall meet the EMI / EMC requirements
12. Earth Fault Protection should have adjustable current setting 20% to 100% of ACB rated current.

2.5 LOAD MANAGER/MULTIFUNCTION METER

13. The load manager shall be of 3 phase, 4 wire type and shall provide true RMS measurements of following parameters:

- Voltage – Line to Line & Average, Line to Neutral & Average, Neutral to Earth
- Current – Phase currents & Average, Neutral current
- Phase angles of Vr, Vy, Vb, Ir, Iy, Ib
- All parameters of Power for each Phase and Total
- All parameters of Energy – kVAh, kWh, kVARh
- Frequency of Supply

14. They shall be complete with the following functions:

- History log of Hi-lo profile with minimum 4 peaks and minimum 4 lows for Voltage, Current, Frequency, Power factor and all other parameters of power with Day, Date and Time of Occurrence.
- Shall have RS-485 Communication port.

- Meter should have LCD Display with IEC 62053-21/22 compliance with 64 sampling rate, percentage THD and individual Harmonics of upto 31st level.

2.6 MOULDED CASE CIRCUIT BREAKERS

1. The MCCBs shall comprise single units of triple pole/four pole construction as specified, shall be rated for 415 V AC.
2. All live parts shall be totally enclosed and shrouded with a heat resistant moulded insulating material housing. Operating mechanism shall be quick make, quick break and trip free type.
3. The MCCB shall be provided with the following features in microprocessor release:

a) Inverse-time-current tripping characteristics under sustained overload.

b) Instantaneous tripping on short circuit

4. MCCBs shall have positive isolation current limiting, load line reversibility
5. The rated service breaking capacity (Ics) shall not be less than the ultimate short circuit breaking capacity (I cs = I cu)
6. Variable Thermal setting shall be provided in all MCCB s with thermal magnetic Release.
7. All circuit breaker of 250 amps and below rating shall be provided with thermal magnetic release& circuit breakers above 250 amps rating shall be provided with Microprocessor based release with thermal memory.
8. All incomer MCCBs having earth fault release should be provided with fault differentiation of over current (OC& SC) and earth fault on release or panel door.
9. All MCCBs shall be provided with rotary handles and links for which nothing extra shall be paid.

2.7 CURRENT TRANSFORMERS

1. Current transformers shall be of the Cast Resin Type.

2. Current transformers shall not be directly mounted on the buses. Current transformers on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.
3. All current transformers shall be earthed through a separate earth link.

2.8 INDICATING INSTRUMENTS AND METERS

1. Digital electrical indicating instruments shall be of minimum 96 mm square size and should have red coloured readout and 1" display height.

2.9 CABLE TERMINATIONS

Suitable double compression type, brass cable glands with check nuts, rubber sealing ring and brass washers mounted on a removable gland plate shall be provided to support all cables entering the switchgear. Cable Termination will be measured under separate item in the schedule of quantities.

2.10 INTERNAL WIRING

Wiring inside the panel shall be carried out with 660/1100 V grade, single core, PVC insulated, stranded copper conductor wires. Minimum size of conductor for power circuits is 2.5 sq. mm. Not more than two connections shall be made on any one terminal. All internal wiring shall be properly ferruled at the both termination. All control cables shall be terminated with crimping types lugs with coloured PVC shrouds and shall have identification labels.

2.11 TERMINAL BLOCKS

1. Terminal blocks shall be of heavy duty and comprising of finely threaded pairs of brass studs of at least 6 mm diameter, links between each pair of studs, washers, nuts and locknuts. The studs shall be securely locked within the mounting base to prevent their turning. Insulated barriers shall be provided between adjacent terminals.

2. Terminals shall be shrouded. Terminal blocks shall be adequately rated to carry the current of the associated circuit. Minimum rating of the terminal block shall be 10 A.

2.12 BATTERY & BATTERY CHARGER

A set of 24V DC power supply shall be provided for PLC Main L.T. Panel (Essential Supply). DC Power supply shall be sealed maintenance free batteries of 65 AH capacity. Suitable battery chargers shall also be provided to charge the battery to perform during mains failure.

2.13 CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main L.T. Panel to suit the number; type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

2.14 LOAD MANAGEMENT WITH PLC [FOR ONLY MAIN LT PANEL (ES)]

Load Management through PLC to achieve auto opening and closing of incomer breakers, bus coupler switching of essential panel , interlocking providing signal to AMF Panel for load status and AMF shall give command to DG Set to auto start / auto stop depending upon load status and requirement etc. and necessary hardware and software required to perform the operation shall be provided by the contractor including all control wiring and rates for the same shall deemed to be included in the quoted rate of the panel.

2.15 LABELS

2.15.1 Labels shall be provided for Feeder designation, feeder equipment no, Compartment designation, panel designation main label. All labels shall comprise white letters on a black background and shall be made of non-rusting metal or 3-ply lamicoid or engraved PVC. Size of lettering shall be 6.0 mm. MV Danger Notice Boards shall also be provided.

2.16 EARTHING

2.16.1 Panel shall be provided with 25 x 5 mm copper earth bus bar running along the entire length of the board. At either end of the earth bus, one clamp type terminal with nuts, bolts and washers shall be provided for bolting the earthing conductor.

2.16.2 Earth bus bars shall be supported at suitable intervals. Positive connection between all the frames of equipment mounted in the switchboard and earth bus bar shall be provided by using insulated copper wires/bare bus bars of cross section equal to that of the bus bar or equal to half the size of circuit load current carrying conductor, whichever is smaller.

2.16.3 All instrument cases shall be connected to the earth bus bar using 660 V grade, single core 2.5 sq.mm stranded, copper conductor.

2.16.4 All non-current carrying metal and hinged doors shall be earthed to the earth bar.

2.17 TESTS

2.17.1 Panel shall be subjected to following tests as per relevant standards:

a) Mechanical operation test.
b) Power frequency H. V. test for 1 minute.
c) Insulation resistance at 500 V D.C. before/after 1 minute H.V. test.

2.18 DRAWINGS AND DATA

2.18.1 As part of the technical bid, the tenderer shall furnish the following data:

a) Schedule of Technical Data completely filled in.
b) Technical literature and catalogues of the equipment being offered.

2.19 TECHNICAL PARTICULARS

2.19.1 FOR MAIN MV PANEL and APFC PANELS

S	DESCRIPTION	PARTICULARS
1	**PANELS**	
1	Rated Voltage Phases & Frequency	415 V, 3 Ph, 4 wire, 50 Hz
1	System Neutral Earthing	Effectively earthed
1	One-minute power frequency voltage a) Power circuit b) Control circuit c) Aux. Circuits connected to sec. of CTs	2500 V 1500 V 2000 V
1	Continuous current rating of busbars under reference ambient temp.	As mentioned in Schedule of Quantities
1	Short circuit current	50 KA for 1 sec (Three phase Symm)
1	Reference ambient temperature	40^0 C
1	Control supply :	

a	DC supply for breaker tripping, closing and DC ckt tapped from DC control bus	30 V DC
b	240VAC control supply for spring motor and panel space heater tapped from 240V AC control bus	240V AC
1	Maximum temperature of busbars& droppers and contacts at continuous current rating under site reference ambient temperature.	90^0 C
1	Colour a) Interior b) Exterior	Approved shade and colour
1	**Moulded case circuit Breakers & A.C.B.s**	
1	Rated Breaking Capacity (kA RMS at 415 V @ 0.25 P.F.)	As mentioned in the schedule of quantities
1	Releases Required a) Overload b) Short circuit c) Under voltage	As mentioned in the schedule of quantities

Feature required

The applications can range from single stand-alone emergency backup power to parallel load sharing of multiple gen-sets in complex

AMF (Automatic Mains Failure) operation

Parallel operation

Master or Slave control capability

Communication ports: Ethernet, RS-485, USB

Protection

Generator: voltage / frequency	59 / 27 / 81O / 81U
Generator: overload, reverse/reduced power	32 / 32R / 32F
Generator: Synch Check	25
Generator: unbalanced load	46
Generator: instantaneous overcurrent	50
Generator: time-overcurrent (IEC 255 compliant)	51 / 51 V
Generator: ground fault (measured ground current)	50G
Generator: power factor	55
Generator: rotation field	
Engine: over speed / under speed	12 / 14
Engine: speed / frequency mismatch	
Engine: D+ auxiliary excitation failure	
Engine: Cylinder temperature	
Mains: voltage / frequency / synch check	59 / 27 / 81O / 81U / 25
Mains: phase shift / rotation field / ROCOF (df/dt)	78

Three-phase true RMS power sensing

Operation modes: AUTO, STOP, MANUAL, and TEST modes

Breaker control: Slip frequency/phase matching synchronization, open/close control, breaker monitoring

Load transfer: open/closed transition, interchange, soft loading/unloading, parallel

Load share and device to device communication

Remote control via interface (Modbus TCP, Modbus RTU) and via discrete/analog inputs for adjusting speed, frequency, voltage, power, reactive power, and power factor set points

Freely configurable PID controllers for various control purposes, such as heating circuit control, water level, fuel level, pressure and/or other process values

Time/Date synchronization over Simple Network Time Protocol (SNTP)

Cylinder head/exhaust temperature monitoring

3.0 CABLES

3.1 L.T. CABLES

3.2.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

3.2.2 MATERIALS

L.T. Cables shall be XLPE insulated and PVC sheathed aluminium conductor armoured power cables conforming to IS: 7098 (Part I)-1988. Cables shall be of 1100volt and with ISI certification mark**.** Conductor of power cables shall be made of electrical purity aluminium conforming to IS 8130-1984. All power cables shall be FR type

3.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonry ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable lying shall be carried out as per CPWD specifications.

3.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

3.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

However, in unavoidable situations heat shrinkable cable joints shall be provided which extra payment shall be paid as per BOQ item.

3.6 **LAYING CABLES IN GROUND**

Cable laying shall be as per IS: 1255-1983 with up to date amendments and as per CPWD Specifications. Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres.

3.9 **LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING**

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/ saddles**.** Care shall be taken to avoid crossing of cable.

3.10 **CABLES ON HANGERS OR RACKS**

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

3.11 LAYING OF CABLES IN PIPE

In locations like road crossing, entry into a building, paved areas etc cables shall be laid in pipes.

The size of pipes shall not be less than 10cm in diameter for a single cable and not less than 15cm for more than one cable.

Pipes for HT and LT cables shall be independent from each other.

Pipes shall be continuous and clear of Debris or concrete before cables are drawn. Sharpe edge shall be smoothened to prevent damage to cable sheathing.

3.12 CABLES TAGS/CABLE ROUTE MARKER

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

3.13 TESTING OF CABLES

Testing of complete cable installation shall be as per clause 2.8.2 and 2.8.3 of CPWD Specifications of Electrical works- part II (External) 1994 amended up to date.

4.0 EARTHING

4.1 GENERAL

Earthing of Substation equipment shall be carried out in conformity with IS 3043-1987, Indian Electricity Rules and CPWD general specification for Electrical works.

4.2 EARTHING OF NON CURRENT CARRYING METAL PARTS OF SUBSTATION EQUIPMENT (BODY EARTHING).

Body earthing of Substation equipment like 11KV VCB Panel Board, Transformer, Main L.T. Panel, Capacitor Panel and DG Sets etc. shall be through a common earth bus formed in the Substation Building. Each

equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth bus by two independent earth conductors. Earthing bus shall be directly connected to number of earth electrodes as shown on drawing. Earthing electrode shall be 600 x 600 x 3mm thick copper plate. Earth bus shall be of 50mm x 6mm copper strip. Connection from each equipment to earth bus shall be with 25mm x 5mm copper strip.

4.3 NEUTRAL EARTHING OF EQUIPMENT

Neutral terminals of Transformers & DG Sets shall be earthed independently. Each neutral terminal shall be earthed with two independent earth electrode. Earth electrode shall be 600 x 600 x 3mm thick copper plate. Earthing conductor shall be 25mm x 5mm copper. Earthing conductor in ground shall be in G.I. pipe whereas inside building shall be on SMC insulator on surface.

4.4 PLATE EARTH ELECTRODE

Earthing shall be provided with copper/G.I plate electrode of following.

i. Copper Plate Electrode. : 600mm x 600mm x 3mm thick

ii. G.I plate Electrode : 600mm x 600mm x 6mm thick

A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A hinged cover of 6 mm thick M S sheet shall be provided at top of chamber. Earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

Earth resistance of < 1Ω shall be achieved at farthest point for normal earthing&<1Ω shall be achieved at farthest point for clean earthing.

Minimum 2 mt. center to center distance between two earth pits.

4.5 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity

immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

For enhancing the earth conductivity, for each type of earth sets, the existing sandy soil around the earth electrode shall be removed and shall be replaced with good earth to obtain desired results for which payment shall be made as per SOQ items.

4.6 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm for 66 KV Grid substation and 5 ohm for earth pit of LT system.