

**EXTERNAL HT SERVICE CONNECTION AND GETTING
APPROVAL FROM CENTRAL ELECTRICITY AUTHORITY AND
PUDUCHERRY ELECTRICAL DEPARTMENT FOR URBAN
HEALTH CENTRE AT KURUSIKUPPAM, JIPMER,
PUDUCHERRY**

**Volume- III
TECHNICAL SPECIFICATION**

Tender No: HLL/IDD/CHN/19-20/031

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**HLL LIFECARE LIMITED
(A GOVT. OF INDIA ENTERPRISE)
JIPMER Campus,
Dhanvantari Nagar,
Puducherry – 605006
Ph : 0413 - 2298295
Web: www.lifecarehll.com**

TECHNICAL SPECIFICATION:

Common Points:

Contractor should submit the shop drawing for all the works within 10 days of receipt of work order / LOA, to the Engineer – in - charge and should get prior approvals before executing any type of works along with coordination layout. The contractor should not deviate from the approved drawing at any point of time, in case of deviation while executing proper authorization should be obtained before proceeding further. Decision of HLL stands final.

The contractor should follow the following procedures:

1. MAR – Material Approval Request (Before procurement of any materials the contractor should submit MAR request along with necessary supporting documents to HITES Engineers and the makes should be as per list of approved makes specified in the tender document. Any materials procured without approval will be rejected at any point of time)

2. Sample Tag – After obtaining MAR, the contractor should submit sample tag along with samples (detailed specification can be submitted instead of samples for materials with high procurement values)

3. MIR – Material Inspection Request – After supplying of materials at site, the contractor should submit MIR request for verification of materials (the materials should be as per approved MAR and sample tag). Items deviating against authorized MIR will be rejected at any point of time.

4. IR – Inspection Request – The contractor should submit Inspection request on day to day basis for inspecting the works carried out.

5. Billing – Billing should be as based on the actuals executed at site and the contractor should submit the bills based on HLL billing format along with supporting documents (Dc copy, bill invoice, MAR, Sample tag, MIR, test reports, etc) for the items claimed in the respective bill. 3 sets of original bill and 2 sets of copy should be submitted.

6. All document formats pertaining to the work should be of HLL formats and the same can be issued on request.

7. 3rd party testes through NABL aggregated labs should be carried out for the necessary items executed at site by the contractor as per the direction of HLL without any additional costs.

8. 5 sets of following documents should be submitted during completion/ handing over of the project

- **As built drawings (Hard & Soft copy),**
- **Inventory list**
- **Warranty certificates**
- **Statutory approvals, if any**
- **Manuals**

9. Spares, keys or any other components related to the equipment/ materials installed should be handed over with a list along with separate tags.

10. Hindrance register should be maintained at site.

11. All the debris, remaining should be cleared from the same and disposed within campus lead not more than 4 KM. And the completion certificate will be issued only after clearing the site and making it good.

12. Installation, Testing & Commissioning report for all the works should be provided as per HLL formats.

Hot work permit:

Hot work permit must be obtained prior to the starting of work from concern department of JIPMER.

Supervision:

Contractor shall depute their team of engineers for the supervision of installation, testing, commissioning & handing over at site of work. List of Engineers along with their bio data should be submitted to project office before commencement of the works. And the team should maintain records of daily progress and report the same to HITES Engineers on regular basis. Prior permission for the works carried should be obtained from HLL. All the Engineers should be available at the site during execution of work until handing over without fail.

1. Mechanical Engineer (HVAC & FPS) -Degree holder – 1 no. with min 5 years' experience or Diploma Holders – 02 no's with min 8 years' experience.

Security & Storage:

The contractor is responsible for storage & security of all the materials, equipment, piping, wiring and all related accessories till the time of handing over to the customer.

Power & Water:

The contractor should make his own arrangement for electricity & water.

Working Hours & Damages of existing property:

As the work is being executed in already constructed building, at mostcare should be taken during execution of works. Damages caused to the existing property should be rectified at own risk and cost with war foot basis. Time Schedule for the works to be carried should be submitted prior to the work.

Labour camp:

Labour camp will not be allowed inside the campus and the contractor should take sole responsibility for workers stay outside the campus. Workers should not use any type of alcohol/smoking related items inside the campus.

Co-ordination with Other Agencies

The contractor shall co-ordinate with all other agencies involved in the building work so that the building work is not hampered due to delay in his work.

Structural Alterations to Buildings

- (i) No structural member in the building shall be damaged/altered, without prior approval from the competent authority through the Engineer-in-charge.
- (ii) Structural provisions like openings, cutouts, if any, provided by the department for the work, shall be used. Where these require modifications, or where fresh provisions are required to be made, such contingent works shall be carried out by the contractor at his cost.
- (iii) All such openings in floors / walls provided by the Department shall be closed by the contractor after installing the cables/ conduits/ rising mains etc. as the case may be, by any suitable means as approved by the Engineer-in-charge without any extra payment.
- (iv) All chases required in connection with the electrical works shall be provided made good by the contractor at his own cost to the original architectural finish of the buildings.

Coordination Layout:

Coordination layout must be submitted along with the shop drawings and approval must be obtained before execution of works.

MAINTENANCE DURING DEFECT LIABILITY PERIOD

Complaints

The contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of charge to the Owner.

TECHNICAL SPECIFICATIONS – ELECTRICAL WORKS

2.3 SPECIAL CONDITIONS FOR ELECTRICAL SERVICES:

a) GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects.

b) The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/ D.G.'s estimator/ approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. The actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from PED & CEA.

The HITES shall have full power regarding the materials or work to be got tested through independent agency at the contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by HITES/ independent agency at his own expenses. The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

2.4 DRAWINGS

i. Tender Drawings:

The tender drawings are meant to give general idea to bidder regarding the nature of scope & works to be executed. Any information/data not shown in tender drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications & terms of the contract. Additional information required by the bidder/tenderer for successful completing the work shall be obtained at his end.

ii. **Shop Drawings:** The contractor shall prepare detailed coordinated electrical shop drawing indicating Single Line Diagram for complete HT/ LT electrical scheme, DG Sets, HT Panel, Transformers, LT Panels, Capacitor Panels, RTCC Panels, PCC Panel, UPS Units, UPS Incoming/ Outgoing panels, Lift Panels, Rising Mains, HT/ LT Cable Schedules, Earth Pit Layout, Earth Strip routes, HT/ LT Cable Routes, etc. with other relevant services and submit to the HITES for approval or the Engineer-in-Charge before commencing the work.

GA Drawings, SLD & Control wiring diagrams, Room trench details for all HT & LT Panels, Capacitor Panels, UPS panels, Floor Electrical Panels, Transformers, DG Sets, UPS Units, Rising Mains etc. shall be prepared & submitted. The shop drawings shall indicate all setting out details and physical dimensions of all equipment/items/ components with wiring and cable details, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings shall not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution. The recommended location/ position of the all equipment as shown on the layout drawings will be adhered to unless stated otherwise.

iii. As-Built Drawings:

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the HITES, required Sets of 'As Built' drawings (in AutoCAD & PDF format) along with soft copy of the executed works incorporating all such changes and modifications during engineering and execution along with Operation and Maintenance Manuals, Warranty & Guarantee Certificates from Original Equipment Manufacturers (OEM), authorized Suppliers & Vendors, as applicable.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthing conductors.
- Layout and particulars of all cables.
- Location and details of Transformers, HT/ LT Panels, Feeder Pillars, capacitor control panels etc.
- UPS panel, and relay panels with description detailed control wiring diagram.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling
- Location of DG Sets, Exhaust and auxiliary equipment with schematic drawings.
- Layout of cable trays with support and their fixing details.
- Location of all earthing station, route and size of all earthing conductor.\

- Layout and particulars of rising mains with fixing details.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the HITES. For all non-specified items, approval of the HITES should be obtained prior to procurement of the same. HITES shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

2.5 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/ equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

2.6 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by HITES's Engineer-in-Charge, only the best quality materials and equipment shall be used.

2.7 GENERAL DETAILS

a) Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

b) Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

c) Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

d) Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specifications / General arrangement, whenever it is not mentioned it shall be as given below:

- Installed out door: IP-55.
- Installed indoor in air-conditioned area: IP-52.
- Installed in covered area: IP-52.
- Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.
- For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

2.8 Rating Plates, Name Plates and Labels

Rating Plates, Name Plates and Labels are to be provided & attached permanently in a conspicuous position to all equipment & items installed in various buildings. A rating plate of non-corrosive material engraved with manufacturer's name, year of manufacture, equipment name, diagram, type or serial number etc. together with details of the loading conditions of equipment. The rating plate of each equipment shall be according to relevant BIS & IEC norms, as applicable.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

2.9 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/ soldering/ brazing material for all copper/ G.I. earthing and essential chemicals etc. which will be required to put the equipment/ scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

2.10 DESIGN IMPROVEMENTS / DEVIATIONS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from HITES will be sought.

If any such agreed upon change is such that it affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

3. QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.
- Qualification data for bidder's key personnel.
- The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- Control of non-conforming items and system for corrective actions.
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring instruments and field activities.
- System for indication and appraisal of inspection status.
- System for quality audits.

- System for authorizing release of manufactured product to the Purchaser.
- System for maintenance of records.
- System for handling storage and delivery.
- A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

3.1. QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment:

- All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.
- Welder and welding operator qualification certificates.
- Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.
- Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.
- Stress relief time temperature charts/oil impregnation time temperature charts.
- Factory test results for testing required as per applicable codes/ mutually agreed quality plan/ standards referred in the technical specification.
- The quality plan with verification of various HITES inspection points as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

4. INSPECTION, TESTING AND INSPECTION CERTIFICATE

- The HITES or duly authorized representative shall have at all reasonable times free access to the Contractor's/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found

unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

- All equipment being supplied shall conform to type tests (if applicable) and shall be subject to routine test in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval (if applicable). The Contractor shall intimate the HITES the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies.
- The Contractor shall give the HITES thirty (30) days written notice of any material being ready for testing (if applicable). Such tests shall be to the Contractor's account. The HITES, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/ inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of HITES and he shall forthwith forward to the HITES duly certified copies of tests in triplicate.
- The HITES shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
- When the factory tests have been completed at the Contractor's or Sub-contractor's works, the HITES shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are

not witnessed by the HITES, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the HITES. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the HITES to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the HITES.

- The contractor shall arrange all necessary tools and testing facilities for inspection purpose including arrangement of air travel (inland as well as abroad), conveyance, lodging, boarding and other miscellaneous expenses etc. HITES shall depute its inspection engineers (2 or more as decided by HITES) after receipt of inspection call from the contractor. All such expenses incurred by the contractor towards inspection of equipment by HITES' inspection engineers shall be borne by the contractor.
- For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by HITES or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.
- The inspection by HITES and issue of Inspection Certificate thereon shall in no way absolve the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
- The HITES will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
- The HITES reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

5. TESTS

5.1. Charging Tests

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the HITES and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

5.2. Commissioning Tests

- The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.
- All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.
- Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.
- The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment.

6. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any

demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. HITES takes no responsibility of the availability of any special packaging/transporting arrangement.

7. PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

8. FINISHING OF METAL SURFACES

8.1. General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

8.2. Hot Dip Galvanizing

- The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.
- The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.
- After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
- The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.
- Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness,
- Uniformity of zinc,
- Adhesion test,
- Mass of zinc coating.

- Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

8.3. Painting

- All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 —Code of practice for phosphating iron and sheetll. All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale

be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

- After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application

of two coats of ready mixed, staving type zinc chromate primer. The first coat may be —flash driedll while the second coat shall be shoved.

- Powder coating/electrostatic painting of approved shade shall be applied.
- The exterior color of the paint shall be as per shade no. 697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in-charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.
- In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for HITES's review and approval.

9. HANDLING, STORING AND INSTALLATION

- In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.
- In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the HITES. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- The Contractor shall submit to the HITES every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- The Contractor shall be fully responsible for the equipment/material until the same is handed over to the HITES in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by HITES, as well as protection of the same against theft, element of nature, corrosion, damages etc.
- The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- The words 'erection' and 'installation' used in the specification are synonymous.
- Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

10. PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

11. DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

12. DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Electrical board Engineer, and the HITES during the period of Contract. The Contractor shall attend such meetings at his own cost at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

13. TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

14. SAFETY CODES & PRECAUTIONS

The Contractor at his own expenses shall arrange for safety provisions as required to comply with the statutory regulations, ISI recommendations and CPWD codes.

The contractor shall provide necessary barriers, warnings, signals and other safety measures to avoid accidents. He shall indemnify HITES against any claims arising out of negligence in this respect.

15. REGULATIONS AND STANDARDS

a.	CPWD General specifications for electrical works	Part-I (Internal) 2013
b.	CPWD General specifications for electrical works	Part-II (External) 1994
c.	CPWD General specifications for electrical works	Part-III (Lifts & Escalators) 2005
d.	CPWD General specifications for electrical works	Part-IV (Substation) 2013
e.	CPWD General specifications for electrical works	Part VII (DG Sets) 2013
f.	Guide for uniform system of marking and identification of conductor and apparatus terminals.	IS 11353 -1985
g.	Low voltage switchgear and control gear assemblies	IS/IEC 61439
h.	Specification for low voltage switchgear and control gear assemblies	IS 8623 (Part -2-1993)
i.	Code of practice for selection, Installation and maintenance of switchgear and control gear.	IS 10118 Part – 1 - 4
i.	PVC insulated (heavy duty) electric cables	IS 1554
	PVC insulated cables for working voltages up to	IS 694

k.	and including 1100V.	
l.	Conduit for electrical installations	IS 9537
m.	Accessories for rigid steel conduits for electrical wiring	IS 3837
n.	Boxes for the enclosure of electrical accessories	IS 14772
o.	General and safety requirements for luminaries	IS 1913
p.	Code of practice for earthing	IS 3043
q.	Electrical accessories – circuit breakers for over current protection for household and similar installations.	IS 8828
r.	Low Voltage switchgear and control gear	IS 13947 Part 1 – 5
s.	Residual current operated Circuit Breakers	IS 12640
t.	Current Transformers	IS 2705
u.	Voltage Transformers	IS 3156
v.	Direct acting indicating analogue electrical measuring instruments and their accessories	IS 1248 part – 1 to 9
w.	Control Switches (switching device for control and auxiliary circuits including contactor relays) for voltages up to and including 1000V AC and 1200 V DC.	IS 13947 & IS 1336

In case of contradiction in specification the priority of the documents shall be CPWD/ IS Specifications, Drawings, Technical Specifications.

LT PANELS GENERAL

The scope of supply covers design, fabricate, integrate, pack, dispatch to site along with routine testing as per IEC of Low Voltage Switchgear & Controlgear Assemblies up-to 1000 V (Will be termed as 'LT Panel ' here forth) . Main LT Panel, Distribution Boards & Sub Panels shall be factory fabricated by Original Equipment Manufacturer or their authorized system integrators/ channel partners. All LT Panels, Distribution Boards & Sub Distribution Panels shall comply with IEC-61439 & manufactured accordingly. The Panels shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3-phase, 50 cycles system. All LT Panels shall be designed to accommodate suitable ratings of Incoming Feeders, Outgoing Feeders, Bus Couplers etc. to cater to electrical load requirements of various buildings & facilities. All LT Panels & Sub- Panels shall be BMS/ SCADA compatible and wired accordingly so that all relevant electrical parameters can

be communicated to BMS/ SCADA system. All necessary wiring, cabling etc between LT Panels, Sub-Panels etc and BMS/SCADA shall be carried out as per norms. All Incoming & Outgoing feeders of Main LT Panels located in Substations shall be controlled and monitored through SCADA System. Incoming Feeders from Transformers & DG Sets shall also be controlled through Sync Relay/ PLC for auto Load change over / load sharing.

Degree of protection shall be IP-42 for Indoor & IP-62 for Outdoor Panels. All Outdoor Panels shall be weather proof, Double Door with suitable canopy on top. The short circuit current rating of LT switchgears shall be ≥ 50 kA.

All LT Panels shall be provided with necessary instruments for Monitoring & Metering purpose to meet ECBC & GRIHA requirements.

All incoming feeders of LT panels shall have R, Y, B, ON, OFF & Trip LED Type indication lamps. All outgoing feeders of LT panels shall have ON, OFF & Trip LED Type indication lamps.

Multifunction meters with BMS compatibility shall be provided in all incoming feeders of all LT Panels to be installed in AllMS Campus. Suitable digital energy meter with CTs, wiring etc. shall be provided for all outgoing feeders of all LT panels to be installed in OPD, Hospital, AYUSH, Medical & Nusring College and Auditorium buildings.

Main LT Panels in ESS buildings shall have Multifunction meters with BMS compatibility in all Incoming Feeders & all Outgoing Feeders.

Site Conditions: The LT Panel will be located indoors and shall be designed to operate satisfactory at rated load under the service conditions. This equipment will be subject to the ambient temperature conditions at the site as specified in the Project Requirements.

- a. Location - Indoor,
- b. Altitude above main sea level - < 2000 M above sea level.
- c. Design Ambient Temperature - 40 Deg. C
- d. Temperature rise - As per IEC 61439
- e. Relative Humidity Max - 95%
- f. Relative Humidity Min - 10%
- g. Pollution - Up to Degree of pollution-3
- h. Application - Indoor

16.3.2. CONSTRUCTION-

a) Standards

The equipment covered under this specification shall conform to the latest revisions of relevant Indian and International Standards some of which are listed below:

IEC 61439 part 1 & 2: Low voltage switchgear and control Gear assemblies

IS 13947 1993 : General requirements of Switchgear and Control Gear for Voltage not exceeding 1000 / 1200V AC

IS 11353 1985 : Guide for uniform system of marking Identification of Busbar and Terminals.

IS 13703 1993 : Low voltage fuses

IS 2705 1992 : Current transformers

IS 694 1990 : PVC insulated cables for voltages including 1100 V with Copper and Aluminum Conductor.

IS 1248 1983 : Direct Acting Electrical Indicating Analog

IS 8623 1993 : Low voltage Switch gear & control gear assemblies

IS 5082 : Electrolytic Aluminum Busbar, Trunking system, Rod tubes sections for Electrical Purposes.

IS 13779 1999 : AC Electric Meters / Static Meters.

b) Main/Sub Panels shall be:

- i. Of metal enclosed, indoor, floor mounted, free standing construction (unless otherwise specified) type.
- ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.
- iii. Provide dust and damp protection.
- iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers in case of Main Panels.
- v. All panels shall be front access type.

Main/Sub Panels shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of the following:

- i. A front-framed structure of rolled/ folded sheet steel channel section, of minimum 2 mm thickness,

rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, moulded case circuit breaker, main horizontal busbars, vertical risers and other front mounted accessories. The structure shall be mounted on a rigid base frame of 100 mm height with folded sheet steel of minimum 2 mm thickness. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling, and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

The height of the panels should not be more than 2400 mm for MV Panels. Operating handle of breaker in top most compartments shall not be higher than 1800 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 350 mm.

Doors and covers shall be of minimum 2 mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 1.6 mm thickness. All sheet panels shall be smoothly finished, leveled and free from flaws. The corners should be rounded. The apparatus and circuits in the power control centers (panels) shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main/Sub Panels shall have the clearances more than as given below.

i. Between phases - 32 mm

ii. Between phases and neutral - 26 mm

iii. Between phases and earth - 26 mm

iv. Between neutral and earth - 26 mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply with those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and moulded case circuit breakers shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of bus duct for incoming breakers.

Metallic/insulated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit /units.

All doors/ covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

16.3.3. METAL TREATMENT & FINISH

All steel work used in the construction of the Main/Sub Panels should have undergone a rigorous metal treatment process as follows:-

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognized phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

- v. Drying with compressed air in a dust free atmosphere.
- vi. Panel shall be powder coated with epoxy based powder paint after the above process so as to render the material suitable for corrosive environment.
- vii. Paint shade shall be Pebble (light) grey, shade No RAL 7032 unless otherwise specified.

16.3.4. BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminum alloy complying with the requirement of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of at least 50 kA RMS symmetrical for one second. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and Creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main/Sub Panels shall be designed that the cables are not directly terminated on the terminals of breaker etc. but on cable termination links. Cross-section area/ size of aluminum busbars shall be designed considering current density as 0.8 Amp per sqmm. Likewise Cross-section area/ size of copper busbars shall be designed considering current density as 1.2 Amp per sqmm. The main busbars shall have continuous current rating throughout the length of Panels. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity up to 200 Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

All MCCBs & ACBs shall be provide with spreader links/terminals or Bus Bar extension pieces for easy termination of cables.

Clamp or screw type control terminal blocks shall be provided for outgoing control cables.

Minimum 20% spare terminals shall be provided for future use. Control terminal block shall be separated from power terminal blocks by means of an insulating barrier.

16.3.5. SWITCHGEARS

Refer 16.4 – LT switchgears

Protection Relays:

Provision of Relays like Under Voltage & Reverse Power shall be incorporated in incoming Feeders in addition to the relays already inbuilt in the ACBs as mentioned above.

16.3.6. CABLE TERMINATIONS

Cable entries and terminals shall be provided in the Main/Sub Distribution Panels 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. A cable chamber 150 mm. high shall be provided at the bottom through out the length and depth of the MDB/SDB. 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.

16.3.7. Auxiliary wiring and terminals:

Wiring for all controls, protection, metering, signaling etc. inside the switchboard shall be done with 1100 V gray colour PVC insulated FRLS copper conductors. Minimum size of these conductors shall not be less than 1.5 mm². However, CT circuit wiring shall be done with 2.5 mm². Control wiring to components fixed on doors shall be flexible type.

10% spare terminals shall always be available in each terminal block. Control wiring up to these terminal blocks shall be done by supplier.

15% spare feeders of various ratings completely prewired shall be supplied in each MCC.

All conductors should be terminated using compression type cable sockets / lugs at both the ends.

Each control wiring termination shall be identified at both the ends by PVC ferrules. The identification termination numbers should match with those on drawings. Suitable size SP MCB shall be used for tapping power for control circuit wiring.

For all motor starter feeders, provision for control wiring to remote ON/OFF control is to be made. The auxiliary wiring for the same shall be brought up to terminal block in the feeder's cubicle.

16.3.8. LABELS

Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of Main/Sub Distribution and all Panels.

16.3.9. TEST AT MANUFACTURES WORK

All routine tests specified in IS: 8623-1977 shall be carried out and test certificates submitted.

16.3.10. INSTALLATION, TESTING AND COMMISSIONING

Installations of LT Panels shall be done as per CPWD norms/Specifications.

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine Meggar test. Checks and tests shall include the following.

- a. Operation checks and lubrication of all moving parts.
- b. Interlocking function check.
- c. Insulation Test: As per CPWD Specifications for Electrical Works Part-I (2013)
- d. Trip tests & protection gear test.

16.4. LT SWITCHGEARS

16.4.1. AIR CIRCUIT BREAKERS

GENERAL

Air Circuit Breakers shall be incorporated in Main Distribution Panels wherever specified. ACBs shall conform to IS 13947 (Part 2) & IEC 60947 (2) in all respects. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply.

All electrical panels shall be provided with meters & controls suitable for SCADA control & meeting requirements of ECBC.

TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with 'trip free' operating mechanism. It shall have microprocessor based electronic release. Air Circuit Breakers shall be EDO type (Electrically draw out type unless otherwise specified) with horizontal draw out carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawn-out positions. The carriage or cradle on which the breakers are mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all draw out mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring loaded design. The sequence of operation of the contacts shall be such that arcing contacts 'make before' and break after' the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Inter phase barriers shall be provided to prevent flashover between phases.

OPERATING MECHANISM

Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately and the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of

breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring. 24 volt DC supply through battery backup for closing and opening for tripping circuit.

Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

INTERLOCKING AND SAFETY ARRANGEMENT

Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

- i. It shall not be possible for breaker to be withdrawn when in "ON" position.
- ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.
- iii. The breaker shall be capable of being racked into 'testing', 'isolated' and 'maintenance' positions and kept locked in any of these positions.
- iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.
- v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

RATING

The rating of the circuit breaker shall be as per the DBR/ drawings. Rated service breaking capacity (Ics) of the breakers shall be 50kA unless otherwise specified at 415 volts. The rated making capacity shall be as per the relevant standard. Rated service short Circuit Breaking capacity shall be equal to the Rated ultimate Short circuit breaking capacity (Icu) and short circuit withstand values (Icw) for 1 sec.

• RELAYS & ACCESSORIES

All ACBs (except bus couplers) shall be provided with micro-controller based release to offer accurate and versatile protections with complete flexibility and in the following zones:

- ☐ Overload (Phase & Neutral) protection with adjustable time delay.
- ☐ Short time protection with intentional delay.
- ☐ Instantaneous protection.
- ☐ Ground fault protection with intentional time delay.

The release should provide local LED indication for identification of type of fault, without requiring using external power supply. The release shall meet the EMI / EMC requirements.

Transformer & DG set Incomer ACB releases shall have LED/LCD display showing all Power & Energy Parameters (I, I_{max}, %loading, I_{avg}, V, Freq, PF, W, VAr, VA, Wh, VArh, Vah, MD-Active, MD-Reactive, MD-Apparent, Temperature in each Phase).

The release shall draw its power from the main breaker CTs and shall require no external power supply for its operation, release shall also be connected to aux. supply for display of parameters during off or lightly loaded conditions.

The ACB should have breaker control through Modbus Breaker control.

The breaker shall be fitted with following accessories for control, signal and interlocking.

- i. Auxiliary contacts 6 NO + 6 NC, of rating 16Amp at 415 volts 50Hz.
- ii. Shunt release for tripping the breaker remotely and shall be suitable for 240 volt/415 volt 50Hz with range of operation from 10% to 130% of rated voltage.
- iii. Micro switches shall be mounted on the cradle of draw out breaker to indicate the position of the breaker on the cradle.
 - a) Kit for test/isolated indication.
 - b) Kit for service position indication.
 - c) Kit for shutter assembly.
- iv. Accessories for following interlocking schemes shall be provided.
 - a) Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personnel and equipment safe.
 - b) Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.
 - c) Lockable trip push button.

☐ **MOUNTING**

Circuit Breakers shall be mounted as per manufacturers' standard practice.

☐ **TESTING**

Testing of each circuit breaker shall be carried out at the works as per IS 2516 and the original test certificate shall be furnished in triplicate. The tests shall incorporate at least the following.

- i. Impulse withstand test.
- ii. Power frequency withstand test.
- iii. Short circuit test.
- iv. Temperature - rise test under rated conditions

16.4.2. MOULDED CASE CIRCUIT BREAKERS.

☐ **GENERAL**

Moulded Case Circuit Breaker shall be incorporated in the Main/Sub Distribution Boards wherever specified. MCCBs shall conform to IS 13947 (Part 2) & IEC 60947 (2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts. All MCCBs shall have microprocessor based over current and short circuit releases with adjustable current setting from $0.4I_n$ to $1.0I_n$.

☐ **Technical Specifications**

The MCCB should be current limiting type with trip time of less than 10 milli sec under short circuit conditions. All MCCB should be 4 poles type unless stated otherwise.

MCCB shall comply with the requirements of the relevant standards IS13947 – Part 2 /IEC 60947-2 and should have test certificates for breaking capacities from independent test authorities CPRI / ERDA.

MCCB shall comprise of Quick Make-break switching mechanism, arc extinguishing device and the tripping unit shall be contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses.

The MCCBs shall be provided with following type of Relays for overload, short circuit & earth fault protection in the LT panels boards.

All incoming ACBs /MCCBs of LT Panel boards shall be with Microprocessor based release having inbuilt adjustable protections against Over Load (L), Short Circuit (S) and Ground Faults (G)] with time delay.

The outgoing MCCBs shall be with Thermal Magnetic type release for with adjustable Overload and fixed short circuit protections. MCCBs of ratings 250A & above shall be provided with Microprocessor based.

All MCCBs should be provided with the Rotary Operating Mechanism. The ROM should be with door interlock (with defeat feature) & padlock facility

MCCB should have Spreader links & Phase barriers as standard feature. Superior quality of engineering grade plastics confirming to glow wire Tests as Per IEC 60695-2-1 should be used for insulation purpose.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts.

For Motor application, motor duty type MCCBs shall be selected with reference to Type 2 coordination chart provided by the manufacturer.

☐ **CONSTRUCTIONS**

The MCCB's cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable "ON", "OFF" "and" "tripped" indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCBs shall be provided with rotary handle.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermal magnetic or static release type provided in each pole & connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type.

Contact trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

☐ **BREAKING CAPACITY**

All MCCB shall be 4 pole type and shall have following short circuit current rating/breaking-

- (i) MCCB rating below 250 A – 25 kA
- (ii) MCCB rating 250 A and above upto 800 A – 36 kA
- (iii) MCCB rating 800 A – 50 kA

The rated service breaking capacity should be equal to rated ultimate breaking capacities ($I_{cs}=I_{cu}$).

☐ **TESTING**

- a. Original test certificate of the MCCB as per Indian Standards (IS) 315C- 8370 shall be furnished.
- b. Pre-commissioning tests on the Main Distribution/Sub Distribution Board incorporating the MCCB shall be done as per standard.

16.5. MEASURING INSTRUMENTS, METERING & PROTECTION

16.5.1. GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 0.5 for voltmeter and 0.5 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between -10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instrument glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three-phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per DBR/Drawings.

16.5.2. DIGITAL AMMETERS

Ammeters shall be standard digital type. The ammeters shall be calibrated as per the latest edition of IS:1248. Ammeters shall be instrument transformer operated, and shall be suitable for 5A secondary of instrument transformer. The scales shall be calibrated to indicate primary current, unless otherwise specified. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

16.5.3. DIGITAL VOLTMETERS

Voltmeters shall be standard digital type. The voltmeters shall be calibrated as per the latest edition of IS:1248. The range for 415 volts, 3 phase voltmeters shall be 0 to 500 volts. Suitable selector switch shall be provided for each voltmeter to read voltage between any two lines of the system. The voltmeter shall be provided with protection fuse of suitable capacity.

16.5.4. CURRENT TRANSFORMERS

Current transformers shall be in conformity with IS: 4201 - 1983 as amended up to date in all respects. All current transformers used for medium voltage applications shall be rated for 1kV. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated acceptable minimum class of various applications shall be as given below:

Measuring : Class 0.5 to 1

Protection : Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT's shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

All Current Transformer shall be Cast resin type

16.6. MISCELLANEOUS

☐ Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

☐ Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamp covers, bulbs & lenses shall be easily replaced from the front.

☐ Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts &

provided with integral escutcheon plates marked with its functions.

16.7. LT CABLES

16.7.1. GENERAL

LT Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications as per given below. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drums.

Total number of runs and size of LT power cables shall be designed so that the distribution losses do not exceed 3% of the total power usage in the system as per ECBC norms. CODES OF PRACTICE GUIDE		
S. NO.	Reference	Description
1	IS 694 : 1990 IEC 60227 - 1 to 5 : 1979	PVC insulated cables for working voltages up to and including 1100 V
2	IS 694 : 2010	Polyvinyl chloride insulated sheathed and unsheathed cables with rigid and flexible conductor for rated voltages up to and including 450/750 V : Part general requirements(fourth revision)
3	IS: 7098: 1988 (Part-I)	XLPE insulated (heavy duty) electric cables. For working Voltages up to and including 1100 V (third revision)
4	IS 4288 : 1988	PVC insulated (heavy duty) electric cables with solid aluminium conductors for voltages up to and 1100 V (second revision)

16.7.2. CABLE CONDUCTOR MATERIAL

- a) The LT Power cables shall be XLPE insulated, PVC sheathed, copper conductor armoured cable for sizes up to & including 16 sqmm, unless otherwise stated.
- b) For LT Power cable sizes above 16 sqmm, cables shall be XLPE insulated, PVC sheathed, Aluminium conductor armoured cables, unless otherwise stated.
- c) LT Control cables shall be XLPE insulated PVC sheathed type copper conductor armoured cables, unless otherwise stated.
- d) All LT Power & Control cables shall conform to IS: 7098: 1988 (Part-I) with up to date amendments.

16.7.3. 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 laying shall be carried out strictly as per CPWD specifications.

16.7.4. INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

16.7.5. 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 utilization and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.

16.7.6. LAYING CABLES IN GROUND

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 meter. Cables shall be laid at depth of 0.75 meters below ground level for LT Cables and 1.20 meter below ground level for HT cable. A cushion of sand total of 250 mm shall be provided both above and below the

cable, joint boxes and other accessories. Cable shall not be laid in the same trench or alongside a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall be preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 meter long loop shall be provided at both ends of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

16.7.7. CABLE ROUTE MARKERS:

Cable route marker shall be provided at regular intervals as per CPWD specifications. Cost of cable route markers is deemed to be included in the cost of cables/cable laying.

16.7.8. PROTECTION OF CABLES:

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cable is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic shall be protected by running them through Hume Pipes of suitable size. Hume Pipes for road crossing of the cables shall be laid at a depth of 1000 mm.

16.7.9. EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surfaces, road ways, side walks, curbs, wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

16.7.10. LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/ CEILING

Cable shall be laid on perforated M.S. Cable tray/ladders. 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.

16.7.11. 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.

16.7.12. CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Tray tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

16.7.13. TESTING OF CABLES

Prior to installation burying of cables, following tests shall be carried out (if applicable). Insulation test between phases, phase & neutral, phase & earth for each length of cable.

- i. Before laying.
- ii. After laying.
- iii. After jointing.

Along with the test as prescribed in IS Code, cross sectional area shall also be checked. On completion

of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

i. Insulation Resistance Test (Sectional and overall).

ii. Continuity Resistance Test.

iii. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such test

16.8. CABLE TRAY

16.8.1. Ladder Type Cable Tray

Ladder type cable tray shall be fabricated out 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 centre to centre spacing of 250 mm. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanized or painted to the desired lengths.

16.8.2. Perforated Type Cable Tray

i. The cable tray shall be fabricated out of slotted/perforated M.S. Sheet as channel section single or double bended. The channel section shall be supplied in convenient length and assembled at site to the desired lengths. All cable trays shall be hot dipped galvanized only as per relevant IS Codes.

ii. Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994 as amended up to date. The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section.

iii. 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 plates and cable tray shall be scraped and removed before the installation.

iv. The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

v. The width of the cable tray shall be chosen so as to accommodate all the cable 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.

vi. Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II -1994) or as amended up to date. The radius of bend, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

vii. The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25 mm X 5 mm flats at specified spacing as per CPWD General Specification of Electrical Work Part II - 1994 or as amended up to date. Flat type suspenders may be used for channels up to 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the PMC/Consultant to take the weight of the cable tray with the cables.

viii. 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.

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

x. The cable trays 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.

16.9. SANDWICH BUS DUCTS/TRUNKING, RISING MAINS

16.9.1. Scope :

These specifications are intended for design, manufacturing, Supply, Installation, testing & commissioning of 3 Phase 3 Wire / 3 Phase 4 Wire (100% Neutral) / 3 Phase 5 Wire Sandwich type Aluminum Busbar Trunking System.

16.9.2. System details :

The Busbar Trunking System shall be suitable for operational Voltage of 415V / 690V / 1000V with

supply frequency of 50Hz, minimum insulation voltage of 1100V & impulse withstand voltage of 12 kV.

16.9.3. Standards :

The Busbar Trunking System shall be designed to comply in accordance with the following international standards,

IEC 61439 – Part 1 : Low voltage switchgear & controlgear assembly- General rules

IEC 61439 – Part 6 : Busbar Trunking Systems (busways)

IEC 60529 : Degree of protection

IS 8623 – Part 2 : Specification for Low Voltage Switchgear & Controlgear Assemblies

IS 1893 – Part 1 : Criteria for Earthquake Resistant Design of Structures

IEEE 693:2005 : High Seismic Qualification Level

Wherever required and specified, the Busbar Trunking System shall conform to Fire Rating of 600 deg C for 2 Hours.

Busbar Trunking System should also have Seismic Zone-5, Flame Propagation and Fire Resistance certification.

16.9.4. Manufacturer :

The manufacturer must have an established track record in design and manufacture of sandwich busbar trunking system, and must have supplied busbar trunking systems for at least 20 years.

16.9.5. Design & Construction requirements :

☐ General :

The Busbar Trunking System shall be of sandwich construction, non-ventilated and natural cooled design. It shall be possible to mount the Busbar Trunking System in any orientation without affecting the current rating.

☐ Busbars :

- The busbars should be made of high conductivity electrical grade Aluminum with conductivity >60%
- Purity of Aluminum conductor should not be less than 99.6%
- Aluminum busbars should be Tin plated at the joint area
- Provision for mounting external earth strip to be provided on both side of busduct. 2 Nos. Copper earth strips of appropriate size shall be provided for the complete run of bus bars enclosure.

☐ Insulation :

- Each bus bar shall be individually insulated by means of Multi-layer Class-F Insulation, Each layer shall have withstand breakdown voltage of minimum 6 kV.
- The insulation material used shall be of minimum Class F (155 deg. C)
- Insulation must be Halogen free & RoHS compliance

☐ Housing :

The housing shall be made of minimum 1.6 mm electro-galvanized sheet steel, epoxy powder coated with RAL7032 shade. Enclosure must be dust & vermin proof IP rating of indoor busduct must be IP-54 / IP-55 & Outdoor busduct should be IP-65 / IP-66 with canopy.

☐ Joints :

- The joint design shall have inbuilt provision of absorbing expansion & contraction of 12mm per joint during operation.
- The joint insulation must be of single piece moulded design of thermoset material for longer life and higher temperature withstand & better insulation property.
- The joint construction must allow +/- 3mm adjustment at the time of installation, for ease of adjusting to site measurement variations.
- The joint bolt must be insulated with a bolt insulator. The bolt insulator must be of molded one piece.
- The joint design shall have inbuilt provision to prevent excessive insertion of busduct which can damage the bolt insulator.

- The busbar ends shall not have holes or slots at the joints to avoid reduction in cross section area which will lead to temperature increase. The electrical continuity shall be through pressure plates, achieving a high contact area of joint cross section and expansion capability.

- It shall be possible to install and remove the joints without disturbing the adjacent feeder section

- Joint set should have insulators with temperature withstand capacity of class-F

- ☐ Plug-in Unit / Tap off units :

- Plug in boxes will be of draw out type. Contacts will be of silver plated copper and spring loaded. Earth connection will be the first to make and last to break during insertion and with drawl. Plug in boxes will be made from 1.6 mm CRCA sheet steel powder coated.

- Each section of Bus Bar enclosure plug in ports spread at interval of approximately 600 mm for the insertion of plug in boxes.

- Inside the plug in Boxes MCCB will be located as per requirements. The operating handle will be interlocked with plug in box cover so that MCCB can be operated only with the suitable cover in closed position. The plug in box will be interlocked with bus bar trunking so that it cannot be inserted or removed with the plug in box lid open. MCCB will be of 4 pole type. Short circuit breaking capacity of MCCB in Plug in Box should be same as that of bus trunking i.e. 50 KA.

- When the MCCB in the Plug-in unit is in 'ON' position, the operator should not be able to open the door.

- The design of plug-in units shall be such that, the PE conductor shall be of 'First-Make' 'Last-Break' type.

- The Plug-in unit will be suitable for accommodating MCCBs or other accessories, as required. The Plug-in unit should allow the flexibility of accommodating different reputed MCCB makes, to be mutually agreed depending on the tender requirements.

- Plug-in unit must achieve IP-54 protection

- Plug-in units should be plug-in type up to 400A & Bolt-on Type from 630A

- It should be possible to offer Bolt-on Type Tap-off Box for 100A & higher ratings to withstand vibration due to crane movement, heavy machines in industries

- ☐ **Routine & Type Tests :**

- The busduct shall be type tested at a reputed test laboratory (certified by ASTA or ERDA) for the tests as per IEC-61439 Part-1 (Low voltage switchgear & controlgear assembly- General rules) & Part 6 (Bus bar trunking systems & bus ways)

- Short circuit testing of busduct should be for duration of 1 Sec. Neutral & Earth conductor should also be tested for 60% short circuit rating of phase conductor

- Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory as per IEC-60529

- Dielectric test.

- Busduct should be tested for minimum Seismic Zone-4 & High Seismic Qualification level as per IEEE:693

- ☐ **Installation:-**

The Bus Section shall be joined together with flanges and tie bolts. Bus trunking shall be suspended at a uniform height as per site conditions above floor/Ground level with suitable MS suspenders and MS supports duly Hot dip Galvanised.

EARTHING & LIGHTENING PROTECTION SYSTEM

Earthing system shall conform to CPWD General Specifications for Electrical Works (Part I-Internal),

2013. Earthing system shall comprise of suitable nos. of Earhpits with GI & Copper Plate electrodes as per IS-3043 & CPWD specifications.

Neutral Earthing with suitable size Copper strips and Copper plate earhpits for Transformer, DG Sets and other equipment as specified by OEMs shall be provided. earthing of all sus. The bodyearthing for transformers, DG, HV & MV panels shall be done separately (2 Nos. for Each equipment) and shall also made a common earth bus network.

Like for a single transformer, the total number of earth electrodes shall be 4 (2 for neutral and 2 for connection to a common earth bus for body earthing).

INSTALLATION

All joints shall be riveted and sweated. Joints in the earth bar shall be bolted and the joints faces tinned. Where the diameter of the bolt for connecting earth bar to apparatus exceeds one quarter of the width of the earth bar, the connection to the bolt shall be made with a wider piece of flange of copper jointed to earth bar. These shall be tinned at the point of connection to equipment and special care taken to ensure a permanent low resistance contact to iron or steel. All steel bolts, nuts, washers etc. shall be cadmium plated, main earth bars shall be spaced sufficiently on the surface to which they are fixed such as walls or the side trenches to allow for ease of connections. Copper earthing shall not be fixed by ferrous fittings. The earthing shall suitably be protected from mechanical injury by galvanized pipe wherever it passes through wall and floor. The portion within ground shall be buried at least 60 cm deep. The earthing lead shall be securely bolted and soldered to plate or pipe as the case may be. In the case of plate earthing the lead shall be connected by means of a cable socket with two bolts and nuts. All washers shall be of the same materials as the plate or pipe. All iron bolts, nuts and washers shall be galvanized.

17.6. TESTING

After installation, the tests as specified in CPWD General Specifications for Electrical Work (Part I-Internal), 2013 shall be carried out and results recorded

17.7. LIGHTENING PROTECTION SYSTEM

Lightening Protection System shall be provided for all buildings, blocks and facilities constructed under this contract as per IS/IEC-62305:2010 amended up to date and NBC 2016. However, All earth pits shall be GI or copper Plate electrodes. Final shall be of copper material and for earth grid/meshes & downcomers, required size Copper strip/equivalent size G.I. strip shall be used.

SAFETY REQUIREMENTS

Safety provisions shall be generally in conformity with appendices (A) and (C) of CPWD General Specifications of Electrical Works (Part I-Internal), 2013. In particular following items shall be provided:

(i) Insulation Mats

Insulation mats conforming to IS 15652: 2006 shall be provided in front of all HT & LT Panels as well as other control equipments as specified.

(ii) First Aid Charts and First Aid Box

Charts (one in English, one in Hindi, one in Regional language), displaying methods of giving artificial respiration to a recipient of electrical shock shall be prominently provided at appropriate place. Standard first aid boxes containing required materials should be provided in each sub-station.

(iii) Danger Plate

Danger Plates shall be provided on HV and MV equipments. MV danger notice plate shall be 200 mm x 150 mm made of mild steel at least 2 mm thick vitreous enameled white on both sides and with the descriptions in signal red colour on front side as required. Notice plates of other suitable materials such as stainless steel, brass or such other permanent nature material shall also be accepted with the description engraved in signal red colour.

(iv) Fire Extinguishers

Portable CO2 conforming to IS 2878: 1976/ chemical conforming to IS 2171: 1976 extinguishers, HCFC Blend A (P-IV) shall be installed in the sub-station at suitable places. Other extinguishers recommended for electric fires may also be used.

(v) Fire Buckets

Fire buckets conforming to IS 2546: 1974 shall be installed with the suitable stand for storage of water and sand.

(vi) Tool Box

A Standard tool box containing necessary tools required for operation and maintenance shall be provided in the sub-station.

(vii) Caution Board

Necessary number of caution boards such as —Man on Linell = Don't Switch on 'etc. shall be available in the sub-station.

INSTALLATION OF TRANSFORMER

Installation of transformer shall be carried out in accordance with manufacturer's instructions and/or as directed by purchaser.

All power/control connections and mechanical joints shall be completed, checked and adjusted to ensure safety and satisfactory operation of the transformer.

Transformer shall not be placed on bare ground during unloading but it shall be placed on wooden sleepers. After placing on foundation, alignment, leveling etc. shall be carried out in best workman like manner.

For the power/control cabled projecting above the ground, the termination to cable box shall be run in GI conduits of suitable cross section and the same shall be supported properly and pipe ends shall be sealed with bitumen compound.

The cable box of detachable type of the transformer shall be supported properly so as to facilitate taking out of the transformer for repair without disturbing the cables.

TEST CERTIFICATES.

Test certificate shall be furnished in required number of copies for approval. The routine, special and type test certificate of the transformer shall be furnished.

The routine and type test certificates of miscellaneous components shall be furnished or approval.

19.22. ROUTINE TESTS

During manufacture and on completion the transformer shall be subjected but not limited to the following Routine Tests (if applicable) as laid down in the latest revision of the IS 11171 IEC - 726

- i) Applied voltage test
- ii) Induced voltage test
- iii) No-load loss and excitation current tests
- iv) Impedance voltage and load loss tests
- v) Resistance measurement
- vi) Ratio tests
- vii) Polarity and phase relation tests
- viii) Insulation resistance tests
- ix) Insulation power factor tests

19.23. Deleted

19.24 Deleted

19.25. ELECTRICAL & PERFORMANCE REQUIREMENT :

a) Transformer shall operate without injurious heating at the rated KVA at any voltage within variation of $\pm 10\%$ of the rated voltage of that particular tap.

b) Transformer shall be designed for 110% continuous over fluxing withstand capability.

c) The neutral terminals of the winding with star connection shall be designed for the highest over current that can flow through the winding.

d) Overloads shall be allowed within the conditions defined in the loading guide of the applicable standard. Under these conditions, no limitations by terminal bushings, tap changers or other auxiliary equipment shall apply.

e) Temperature Rise for continuous full load application shall be guided by Maximum temperature rise clause of IS 2026. The temperature rise shall not exceed 45 degree C by thermometer in oil or 50 degree C for winding over an ambient of 45 degree C.
(Please note maximum ambient temperature shall be considered 50 degree C).

19.26. DRAWINGS AND O&M MANUALS:

Four copies of manual of complete instructions for the installation, operation, maintenance and repairs circuit diagrams, foundation and trenching details shall be provided with the transformers and panels. List of spare parts shall also be indicated.

a) GA drawing showing dimension, net weight and shipping weight, quantity of insulating oil etc.

b) Drawing indicating GA of cable box and its dimension for cable entry cut out requirements etc.

The drawings in (four sets) to be furnished by the supplier for approval after acceptance of his order shall include the following.

a) GA showing front and side elevations and plan of transformer and all accessories and external features, detailed dimensions, crane lift for untanking, H.T./L.T. clearances etc.

b) Drawings of Bus duct termination arrangement.

c) HV cable box arrangement & disconnecting chamber GA drawings.

d) Name plate and terminal making and connection diagram.

e) Assembly of OLTC gear mechanism & details of mechanism parts, limits, contours of wearing parts, timing gear adjustments etc.

List of Approved Makes - ELECTRICAL		
S.No	Item Description	Approved makes
1.	11 KV HT Panel with 11kV Vacuum Circuit Breaker (VCB)	L&T/ ABB / Schneider/ Siemens or their authorized Channel Partner
2.	33/66 kV HT Panel with 33/66 kV SF6 Breaker	L&T/ ABB / Schneider/ Siemens or their authorized Channel Partner
3.	33/66 kV HT Panel with 33/66 kV Vacuum Circuit Breaker (VCB)	L&T/ ABB / Schneider/ Siemens or their authorized Channel Partner
4.	ACB (TP,4P) with variable microprocessor	L&T (U-Power Omega)/ Siemens (3 WL)/ Schneider (Nw Masterpact)/ ABB (Emax)
5.	Automatic Transfer Switch (ATS)	L&T/ ABB/ Siemens/ Schneider / Socomec
6.	Auxiliary relays compatible with PLC etc.	Siemens/ L&T/ ABB/ Areva/ Schnieder
7.	Batteries	Hitachi/Panasonic/ Yuasa/ SF/ Exide/ Amco/ Amaraja
8.	Battery Charger	Amaraja/ Sabnife/ Statcon/ Voltstat/ HBL
9.	Battery Charger-cum-DCDB	Amaraja/ Volstat/Caldyne/ Expo-Fyn/ BCH/ HBL
	Boom Barrier	FAAC/ Godrej Vigiguard/ Somfy/Gunnebo

10.		
11.	Brass compression Gland (Heavy duty)	Commex/ Gripwell/ Dowell
12.	Bus bar	Jindal/ Hindalco/ Indal
13.	Bus Duct - Sandwich	L&T/ Schneider/ C&S/ Godrej/ Legrand/ EAE
14.	Bus trunking , rising mains, end feed unit, top-off box (plug-in type)	L&T/ Schneider/ C&S/ Godrej /Legrand/ EAE
15.	Cable Jointing Kit / HT termination Kit	Reychem/ Xicon/ 3M
16.	Cable Lugs & Glands	Dowel/ Johnson/ Gripwell/ Comex/ Hex/ Comet
17.	Cable Tray/ Race ways / Floor trunking / wall channels	MEM/ BEC/ MK/ OBO Bettermann/ Indiana/ Legrand/Sai Metal Craft
18.	Capacitors with harmonic filters	L&T/ Siemens / Schneider/ ABB/ Ducati
19.	Ceiling /Exhaust/Wall fans	Crompton/ Usha/ Orient/ Bajaj/ Havells
20.	Chemical Earthing	JMV LPS Ltd./ Pragati Electrocom
21.	Coaxial Wires	Finolex/ Delton/ Skytone/ L&T/ KEI/ Finolex/ Gloster
22.	Colour Monitor	Samsung/ LG/ Sony/ Philips
23.	Compression Gland and Lugs / thimbles	Dowel/ Comet/ Gripwell
24.	Contactors	ABB/ L&T/ Schneider/ Siemens
25.	Control fuse base with HRC fuse / HRC Fuse	L&T/ Siemens/ ABB/ Alstom/ Schnieder
26.	Crimping Lugs/ Thimbles	Dowells/ Hex/ Commet
27.	CT/ PT's	L&T/ Kappa/ C&S/ CGL/ AE / Meco
28.	Cubicle Type Fuse Unit/ RMG/ RMU	Siemens/ L&T/ ABB/ Schneider

29.	Data/Telephone/TV Outlets	Systemax/ Belden/ Simone/ MK/ Legrand/ Havells/ Anchor
30.	DB's / Pre-wired DB's	Hager/ Havells/ Legrand/ L&T/ Schneider/ ABB/ Siemens
31.	DG Set - Assembler	Jakson & Company / Jakson Ltd/ Sterling Generators / Sudhir Gensets/ C&S Himoina/ Powerica/ Kirloskar (KOEL authorized OEM) / TIPL
32.	DG Set - Alternator	Stamford/ Leroy Somer/ Toyo Denki/ AVK-SEG/ Kirloskar (KOEL Green)
33.	DG Set - Engine	Cummins/ Mitsubishi/ Perkins/ Volvo/ Caterpillar/ Kirloskar (KOEL Green)
34.	DG Synchronizing Controller	Woodward/ Dief/ Deep sea
35.	Digital Lighting Control System	Wipro/ Siemens/ Philips/ Schneider/ ABB/ L&T
36.	Digital Numerical Relays	L&T/ ABB / Siemens/ Schneider/ Areva
37.	DWC HDPE Pipe	DURA-LINE / REX / CARLON/ EMTELLE
38.	Digital Energy Meters including Dual Source Energy Meters	L&T/ Rishabh/ Schneider/ HPL/ Siemens/ ABB/ Socomec/ Neptune
39.	Electrical Motors	L&T/ ABB/ Siemens/ Kirloskar
40.	Optical Fiber Cable	Sterlite Technologies/ Finolex/ Belden/ Delton/ Skytone
41.	Fire Extinguisher	Ceasefire/ Exflame/ Minimax/ Life Guard/ Safex
42.	Fire Survival Cables	KEI/ Polycab/ Havells/ Fusion Polymers
43.	PVC insulated FRLS - Aluminum / Copper 1.1 KV grade flexible wires	L&T/ Gloster/ Havells/ Polycab / Finolex/ RR Kable/ KEI/ Batra henlay
44.	G.I./Cu. Strip & earthing material	Bharati/ Indiana/ Slotco
45.	Hand Gloves & Rubber Mat	Premier Polyfim Ltd/ Polyelectrosafe/ Challenger/ Electromat/ Safe Hold
46.	HRC Fuse	Siemens/ L&T/ ABB/ Schneider

47.	HT & LT Cables (Power & Control Cables, Solar Cables)	Gloster/ Havells/ Nicco/ Finolex/ KEI/ Polycab
48.	Indicating Lamps	AE/ Kaycee/ Vaishnav/ L&T/ Siemens/
49.	Industrial Socket Outlets	ABB/ L&T/ Legrand/ Siemens/ Hager
50.	Insulated Rubber Mat	Premier Polyfilm Ltd/ Polyelectrosafe/ Challenger/ Electro Mat/ Safe Hold
51.	Insulators	Jaya Shree/ Modern/ IEC/ WSI
52.	Intelligent Detectors/ Hooters & accessories	Notifier-Honeywell/ Schneider/ Edwards/ Siemens/ L&T
53.	Intelligent Fire Alarm Panel	Notifier/ Honeywell/ Schneider/ Edwards/ Siemens/ L&T
54.	Inverter	Microtek / Luminous / Su-Kam/ Eaton
55.	Isolators	Siemens/ L&T/ ABB/Socomec/ Schnieder
56.	Jointing Kit	Reychem/ Xicon/ Birla-3M
57.	LED Light Fixtures and Lamps	Philips/ Wipro/ Trilux /Havells
58.	Lighting for Facade	Philips/ Wipro/ Trilux /Allurays/RZB/BEGA
59.	Lightening Arrestors	L&P ELECTRO/ LPI/ Indelec
60.	LT Panels / Synchronizing Panels/ Capacitor Panels	L&T/ ABB / Schneider/ Siemens or their authorized Channel Partner
61.	MCBs / RCCB/Isolaters / RCBO / Change over switch	Hager/ Havells/ Legrand/ L&T/ Schneider/ ABB/ Siemens
62.	MCCB with Variable Microprocessor based (O/C, S/C, E/F) / Thermo magnetic releases	L&T (D-sine)/ Siemens(3 VL)/ABB (T max)/ Schnieder (NSX)
63.	Measuring Instruments (Analog Meter)	L&T/ AE/ MECO/ Rishabh/ Schnieder
64.	Measuring Instruments (Digital Type)/ MFM/KWH meter	L&T/ Ducati/ Konzerv/ Secure/ Siemens/ Schnieder/ ABB
	Modular Switches/ Socket outlets and wiring	MK (wraparound plus) / Siemens (Delta)/ Legrand

65.	accessories with moulded cover plate	(mylinc)/ L&T (Entice)/ Havells (Crab tree-Athena)/ Anchor (Roma)/ Schnieder (Opale)/ Wipro (North-West)
66.	MPCB	L&T/ Siemens/ ABB/ Schnieder
67.	MS Conduit	BEC/ AKG/ Steel Kraft
68.	MS Conduit accessories	BEC/ AKG/ Steel Kraft
69.	Multi-function Meter	L&T/ ABB / Siemens/ Schneider
70.	Nurse Call System	Schrack Seconet/ Honeywell/ Rauland-Borg/L&T/ Siemens
71.	Occupancy Sensors/ Lighting Control System	Phillips/ Schneider/ Legrand/ Wipro/ L&T/ Havells
72.	Overload relay & Single phase preventer	ABB/ L&T/ Siemens/ Schnieder
73.	Package/ Unitised Substation	ABB/ Siemens/ Schnieder/ C&S
74.	Panel Accessories	L&T/ Teknik/ Rishabh/ Siemens/ Schnieder
75.	Power Capacitor	L&T/ Meher/ EPCOS/ Siemens/ Schneider
76.	Programmable timer (self-powered electronic digital) /Astronomer	L&T/ Siemens/ Hager/ Havells/ Legrand/ Schnieder
77.	Protective relays (Microprocessor based compatible with PC & PLC)	Siemens/ L&T/ ABB/ Areva/ Schnieder
78.	Push Buttons	Siemens/ L&T/ ABB/ Schneider/ C&S/ Teknik
79.	PVC Conduit & Accessories	Clipsal/ Polypack/ BEC/ AKG
80.	Relay / Contractors/ Timers / Starters and Control Panel	Siemens/ L&T/ Schneider/ ABB
81.	Selector Switch	Siemens/ L&T/ Teknik/ Salzer/ Schnieder/ ABB
82.	Street Light Poles & Light Fixtures – Solar & Conventional	Philips/ Wipro/ Havells/ Bajaj/ Keselac Schreder
83.	Surge Diverter	Tercel/ ABB/ Siemens/ Emerson/ Hager/ Phoenix/ Legrand

84.	SCADA & BMS System	Schneider/ L&T/ Honeywell / Siemens/ABB
85.	Tap-off/ Splitter box	Zinwell/ Novatron/ Catvision
86.	Telephone Tag Block/Jack Panel/ Face Plate	Krone/ Phoenix/ Wago/ Beldon/ Panduit/ Huwaei
87.	Terminal Strip	Connect well/ Phoenix/ WAGO
88.	Termination Kits	Raychem/ Birla/ 3M
89.	Transformer (Oil Type / Dry Type)	ABB/ Siemens/ Kirloskar/ Voltamp/ Areva/ Schneider
90.	Trivector - Meter (Digital type) only for SEB supply	L&T/ Secure meter/ Enercon/ Siemens/ Socomec/ Schnieder
91.	UPS	Emerson (Vertiv)/ Schnieder (APC)/ Eaton/ Socomec
92.	Variable Frequency Drive	L&T/ Siemens/Danfoss/ABB/ Schneider

List of Approved makes -CIVIL		
S.No	Details of Materials/Equipments	Manufactures name
1	MS & GI pipes	TATA, Jindal, SAIL
2	Cement	ACC / Ultra tech / JK Cement / Jaypee-Rewa / Ambuja / Lafarge / Bangur/ Shree/ Dalmia/ Amrit/ STAR/TAJ
3	Paints - Other Paints / Primer	ICI Dulux/ Asian/ Berger/ Nerolac
4	Sand	River Sand/ M-sand
5	Brick	Common Burnt Clay Country Bricks
6	Stainless Steel	TATA, Jindal, SAIL, TISCO
7	Paints - Oil Bound Distemper / Acrylic Washable Distemper	ICI Dulux/ Asian (Tractor)/ Berger (Bison)/ Nerolac (Super Acrylic), ICI (Maxlite)
8	Paints - Plastic Emulsion Paint (exterior)]
9	Paints - Synthetic Enamel Paints	
10	Tiles: Ceramic Tiles	Kajaria / Somany/RAK/ Johnson
11	Tiles: Glazed (Ceramic) tiles	Kajaria / Somany/RAK/ Johnson
12	Reinforcement Steel / Structural Steel	SAIL/ RINL/ TATA Steel Ltd./ Jindal Steel & Power Ltd./ JSW Steel Ltd.
13	GI sheet	JSW, TATA or equivalent
14	GI Fittings	Unik/ Jain Sons/Zoloto /DRP
15	GI / MS pipes	Tata Steel/Jindal/SAIL
16	RCC Hume pipe	Indian Hume Pipes & Co/ CH patel/ Sport Pipes & Co

END OF VOLUME - III