

ELECTRICAL SPECIFICATIONS
SECTION - 1 : SCOPE OF WORK

The contract involves Annual Rate Contract for Electrical works in HBCH&RC- Visakhapatnam, Andhra Pradesh, 530053 for the year 2022-23

Special Conditions for Electrical Works:

1. The work shall be carried out as per national code or C.P.W.D Specifications.
2. The work shall be carried out in conformity with this specification, The relevant Specifications/ code of Practice of the Indian institutions, approved drawings and instructions of the Engineer-In-Charge or his authorized conform to the requirements of the following :
 - a) Indian Electricity Act and rules.
 - b) Regulations by CEA (Central Electricity Authority)
 - c) Relevant Indian Standards and National Electrical Code.
 - d) Any other regulation by the Local authorities.

This contract includes supply, installation, Testing and commissioning of electrical items as and when required

- 1 The tenderer should clearly indicate departure if any, from the specifications with reasons for the same. The tenderer should incorporate no additions/alterations in the specification. However, any deviation should be brought out separately along with their offer.
- 2 Any work, fittings, accessories or apparatus which may not have been mentioned in the specifications but which are necessary in the equipment/unit for the efficient and satisfactory working of the plant/unit/system should be included in the offer by the tenderer. All the plants, units and systems which are included in the schedule of quantities should be in satisfactory working condition, throughout the period of contract, after the same are serviced/repared by the contractor.
- 3 Contractor intends to carry out certain changes in the existing circuits or layouts, they will be permitted to do so, for which the contractor is required to submit the merits of their circuit layout along with four copies of drawings and will carry out the changes only after getting the approval in writing from the Competent Authority nominated for the purpose.

4 **MATERIALS:**

All materials, spares used for the maintenance and repairs of the equipment's shall be new and of the best quality, confirming to the relevant ISI specifications. They must be the product of reliable manufacturers of many years of standing. All like parts of materials shall be interchangeable. The name of the manufacturers of various materials shall be furnished. Samples of materials shall, wherever required, be

submitted and got approved by the Competent Authority before use in the installations. All materials shall be rust/weather proof or rendered rust/weather proof by application of suitable covers be complete with accessories, fittings and mountings, as may be required for their proper performance.

5 WORKMANSHIP:

- 5.1 Good workmanship and neat finish/appearance are the pre-requisites for complying with the specifications. The contractor shall employ qualified staff for carrying out servicing and repairs to the equipment's listed in the schedule of quantities. The service and repair work should be done under the supervision of competent and qualified experienced person with requisite educational qualifications and considerable experience.
- 5.2 Sub-standard workmanship will not be accepted and shall be rectified at contractor's own cost and risk to the satisfaction of Competent Authority.
- 5.3 The tenderer shall furnish the name of technicians and members of staff who will be engaged in the work details of their working experience.

6 CHARACTER AND CONDUCT OF STAFF EMPLOYED:

The contractor should note that the staff recruited/appointed for the purpose of work should be of Indian Origin/domicile of this country only. The person recruited/appointed for the purpose of contract should have good moral CHARACTER and must not be in the wanted list of criminals of any country.

7 PAINTINGS AND NAME PLATES:

- 7.1 Wherever equipment's like motors etc. are required to be painted, specifications as mentioned in this document should be followed strictly.
- 7.2 Wherever any equipment/unit/installations bear nameplates, the preservation of the same on its place will be the responsibility of the contractor.

8 INSURANCE:

- 8.1 The tenderer shall insure in his own cost, all the materials, tools, jigs, spares, during transit from his factory/office to site as well as during storage at site till the contract is in force.

9 SECURITY:

- 9.1 No security will be provided by the Department for the equipment's, tools jigs, spares etc. brought at site by the contractor or issued to the contractor and the contractor will be required to make his own arrangements for the security of such materials, spares, equipment's etc.
- 9.2 The equipment's covered under this contract belonging to this Department taken by the contractor to the site workshop/repair shop unless installed back in position will be under the custody of the contractor for security. Any damages etc. of whatsoever nature will be the contractor's responsibility.

- 9.3 The staff required to work in the workshop/field, to manage material requirements, inventory is to be recruited/appointed by the contractor and the staff will be on the pay roll of the contractor. The security and safe working of the staff will be the contractor's responsibility. The staff employed will be purely the risk & responsibility of the contractor and the Department will not pay any compensation whatsoever to the contractor or to their employees in case the said staff meeting with any unfortunate incidents which may cause damage of any kind. And it will be of contractor's responsibility and the Department will pay to the contractor or to the is staff no compensation of whatsoever kind.
- 9.4 During the period of contract, the contractors and their staff will have to follow Departmental Security Rules and in the event of dispute, the decision of the Department will be final and binding.
- 9.5 Any equipment/unit if lost, while in the custody of tenderer/contractor or damaged for any reasons, the contractor will be liable to pay the full cost of the equipment at current market rates, prevailing at that time.
- 10 **TRANSPORTATION OF WORKMEN AND MATERIALS:**
No transport facilities will be provided for transportation of men and/or materials at any location of installation. The contractor should make the transport arrangement for the staff as well as for the material and equipment/components needed to carry out servicing/repair including those required for dismantling/shifting of unit from user's location to service station and back.
- 11 **HANDLING OF EQUIPMENT:**
- 11.1 The contractor shall be entirely responsible for handling of the equipment while dismantling and reinstalling the same including any damage or loss of the components or equipment's as a whole during the repair work. Any damage or less is to be replaced by the contractor without additional cost to the Department.
- 11.2 Wherever equipment's covered under the contract are installed at higher heights, it will be the contractor's responsibility to provide safety arrangements for his staff for carrying out servicing/attending to repair to the equipment etc.
- 11.3 Wherever equipment's covered under this contract are installed at higher heights, the contractor should make, arrangements so as to ensure that the member of his staff will not damage or cause loss to HBCH&RC property in any way. In case any such damages are made, the contractor will be required to make up the losses in full.
- 12 **RECORD OF WORK:**
- 12.1 The contractor shall attend immediately to all intimations on telephone/by letter/or by person received from the users/in respect of unsatisfactory working condition of the equipment without any extra charge and the same shall be attended within 24 hours of the date and time of receiving the call from the users.
- 12.2 The contractor will be required to maintain suitable service card record of the works, which has been carried out in each equipment and must

produce it to concerned Engineer or their representative as and when asked for.

12.3 The details of such service card are to be formulated by the contractor and to be got approved from the Competent Authority of the Department.

13 **DURATION OF REPAIR:**

13.1 Whenever any equipment/unit covered by this contract is taken up for repairs to workshop for necessary repairs, a replacement unit of equipment capacity be provided/installed in its place, by the contractor considering the importance of the machine in operation.

13.2 Unit/equipment taken up for repairs to work shops must be brought back and commissioned in its place within Fifteen Days from the date it has been removed from its place.

14 **GUARANTEES:**

14.1 All the spare parts along with its installation and commissioning will be guaranteed for a period of one year from the date of commissioning of the equipment. This includes the refrigerant charging etc., if any required for the commissioning of the equipment.

14.2 The equipment/unit covered in this contract are installed/located in the various offices/Dispensaries/Guest Houses of various divisions of HBCH&RC. The contractor after issue of work order will contact Engineer-in-charge, as and when required by them for service/repair of these units. The detailed list of Units/equipment's with their locations will be given to the successful tenderer.

TECHNICAL TERMS AND CONDITIONS

1 The annual item rate running maintenance contracts of the unit/component/equipment of the system at HBCH&RC .

1.1 Routine Maintenance/ operation of substations, pumps etc.

1.2 Servicing

1.3 Break-down maintenance

1.4 Repairs and replacement of parts

2 Technical specifications for operation and item rate running contract.

2.1 **ROUTINE MAINTENANCE:**

The agency shall regularly examine the operation of equipment's, motors etc.

They shall carry out planned maintenance in a systematic and controlled manner using manufacturer's techniques, spares and expertise and as recommend by original manufacturers.

A minimum schedule of routine maintenance may be furnished and got approved by the competent authority of the department in advance.

The routine maintenance carried out shall be cross checked by Supervisor / Engineer-in-charge and duly signed.

The necessary spares for routine maintenance shall be supplied by the agency at extra payment. Any extra manpower required for timely

completion of routine maintenance shall be arranged by the agency at no extra payment.

2.2 **SERVICING:**

Servicing of equipment's and their associated components shall be carried out using manufacturer's techniques, spares and expertise as recommended by original manufacturer. The frequency of servicing shall be as recommended by the manufacturer. A minimum schedule of servicing is required to finalize/submit as per recommendation by manufacturer. Any additional servicing necessary to achieve better performance and availability of system shall also be carried out.

The necessary spares required for servicing shall be supplied by agency at no extra payment. The following shall also be included in servicing for smooth and safe functioning of system: Providing lubricants/greases etc., for rotating parts/equipment's as per manufacturer's standards.

Checking/testing safety devices for proper functioning and as intended.

Systematically examining, servicing, and cleaning following components: bearing, rotating elements, breakers, starters, contactors, panels etc.

Servicing of all other equipment's components added during maintenance contract period and pertaining to system.

Any extra manpower required to complete servicing in time shall be arranged by the agency at no extra payment.

BREAK-DOWN MAINTENANCE:

Whenever there is any fault noticed with the system by the agency or any complaint is given to agency to rectify the same shall be responded in shortest possible time. The maximum period required for rectifying any break- down shall be as follows:

Minor breakdown: Within 24 hours or as required by Supervisor/Engineer-in-charge whichever is early. Extension of period at the sole discretion of Engineer-in-charge with valid reason.

Major breakdown: The contractor should start the work immediately & to procure the materials & spares required for attending breakdown service. Extension of time at the sole discretion of Engineer –in-charge with valid reason.

Necessary spares shall be supplied by the agency as per rate running contract for keeping necessary spares within the premises at HBCH&RC for immediate use. Following approved make spares shall be made available in the premises to attend any emergency work. However, the material stored by the agency shall be used as and when required by giving proper requisition and at the end of contract period the contractor will take away all the remaining material.

2.3 LED Tube lights, normal tube lights, Chokes,

Ceiling fan, wall fan, Exhaust fan metal body (450mm, 300mm, 225mm), PVC body exhaust fan (150mm, 200mm)

5/15A switch sockets Normal, Modular

9w,11w,18w, 36w PI lamps

Lamps for street lights/ floodlight

PVC conduit, casing capping, 5/15 combine board

MCB 16A, 20A,25A,32A,63A DP/4P

PVC boards 4x4,4x7,6x8,8x10,10x12 size

5/15A plug top, AC enclosure box, angle holder, ELCB single phase/ three phase – 30/60 Amps. Flexible wire
1.5/2.5/4sq mm

3/6/7/9/12 Watts LED lamps

ring, Pin type lugs 10,16,25,35sqmm

Flexible cable 2core/3core - 1.5sqmm, 2.5sqmm,4sqmm any other spares as suggested by OIC-ES

The agency may increase the number or types of spares as deemed fit by them on intimation to Engineer-in- charge. For timely completion of break-down repairs extra man power shall be arranged by the agency.

2.4 **REPAIRS AND REPLACEMENTS OF PARTS:**

During routine maintenance daily, monthly, quarterly, half yearly and annual servicing and other break-down maintenance, the agency shall replace/repair any component/equipment/instrument or any part thereof pertaining to system required for smooth and safe functioning of the system and as directed by the Engineer-in- charge of this Department at no extra cost.

3 **PENALTY FOR NON-COMPLIANCE WITH TERMS AND CONDITIONS OF THE CONTRACT:**

The agency shall complete the minor as well as major breakdowns in the stated hours or the duration (No. Of hours) fixed by Engineer-in-charge. If the number of hours exceeds the permitted number of hours for the said breakdown, a penalty as decided by the competent authority shall be imposed and recovery from bills shall be made accordingly. Penalty is liable to be levied to the agency and necessary recovery will be made from the running bills as decided by the competent authority, in case the routine maintenance, servicing and break- downs maintenance is not carried out as per tender specifications in the month.

4 **OTHER CONDITIONS:** The following shall also be included in the scope of the terms and

conditions of the contract.

- 4.1 The agency shall ensure smooth functioning of the system. Shut-down of any of the equipment/component of the system without any valid and genuine reason and without the approval of Supervisor/Engineer-in-charge shall not be permitted. All motors and other allied accessories shall also be subject to necessary preventive maintenance checks by the agency along with all mechanical equipment's/components.
- 4.2 Offer shall include the operation and comprehensive maintenance of all the machineries/equipment's/components both electrical as well as mechanical of the system as mentioned in the schedule of quantities.
- 4.3 While undertaking preventive maintenance or outage for major overhauling, it shall be ensured that minimum required numbers of units/components/equipment's are available for operation. However, decision will be at the sole discretion of Supervisor/Engineer-in-charge.
- 4.4 Before effecting regular servicing and maintenance of any units/equipment's/component advance information shall be given to the concerned Engineer-in-charge/Supervisor, Servicing and routine maintenance done without information shall be treated as null and void and charges towards same shall not be paid.
- 4.5 The agency must maintain sufficient inventory of the spares of preferably all types at site under intimation to the Engineer-in-charge. Necessary space shall be provided by the Department for keeping spare parts. However, the agency shall be solely responsible for the security of his materials and equipment's etc.
- 4.6 All the scraps/dismantled unusable parts of the units/equipment/components generated during and maintenance work shall be kept at Scrap yards by the agency under supervision of departmental person or E-I- C.
- 4.7 The rate running maintenance contract shall be for 12 months and further extended for one more year in the same rate and condition of contract.
- 4.8 Rates quoted for the works shall remain firm during the said period and no escalations whatsoever shall be permitted.
- 4.9 One-month notice shall be given from either side in writing before effecting the termination of this contract.
- 4.10 The bills for the works done by the agency shall be paid on monthly basis (every month) after satisfactory completion of all the schedules and works, which shall be certified by the Engineer-in-charge. You shall depute your representative to take joint measurement for all works executed after previous measurement and submit your bills for the same on or before 3rd of every month.
- 4.11 Security deposit as per tender conditions shall be deducted from the bills of the contractor.
- 4.12 Agency may visit the place (HBCH&RC) with prior permission of Engineer-in Charge before quoting, if they so desire.

ELECTRICAL SPECIFICATIONS
SECTION - 2 : GENERAL REQUIREMENT

1.0 INTRODUCTION

This specification provides for the manufacture, supply, assembly, testing before dispatch and delivery at site, erection & commissioning of various equipments, earthing, etc. as detailed in schedule of quantities, drawings and specifications required for the proposed TATA MEMORIAL CENTRE – VISHAKAPATNAM.

2.0 ELECTRICAL SYSTEM DETAILS

Incoming Voltage	-	HT, 33 KV, 3 Phases
Operating Voltage for 3 Phases	-	LT, 415V, 4 Wire, AC.
Operating Voltage for 1 Phase	-	LT, 230V, AC,
Frequency	-	50 Hz.

The design ambient temperature for Electrical Equipment shall be considered as 50 Degree Centigrade.

3.0 SCOPE OF WORK

The scope of work covered by this Tender shall include Supply, Installation, Testing and Commissioning of the following items indicated in item no. 4.0.

The Scope of Work shall also include transportation of all material to site, unloading safe keeping, storage and leading to site for installation.

It is the contractor's sole responsibilities to obtain all permits and statutory approvals from CEA and or other statutory bodies..

Description of item in the schedule of quantities is brief and therefore, shall be read in conjunction with the relevant drawings and the specifications and the contractor's rate shall be deemed to be for such complete work unless otherwise specified by the contractor while

tendering. In case any difference or discrepancy between the description in the schedule of quantities and the specifications, the schedule of quantities shall take precedence. In case any difference or discrepancy between the description in the schedule of quantities and the drawings, the description in schedule of quantities shall take precedence. In case of any difference or discrepancy between drawing and specifications, the specifications shall take precedence.

4.0 BRIEF DESCRIPTION OF SCOPE OF WORK

Design, supply, erection, testing and commissioning of the following:

- 33 KV RMG Indoor panel.
- 33 KV Consumer Indoor RMG Panel (Adjacent to RMG Yard)
- 33 KV Consumer Indoor HT VCB Panel (Near Substation Building)
- 33 KV XLPE H.T Cabling and end joints.
- 2500 KVA, 33 KV/ 415V Oil filled Outdoor Transformers with OLTC, RTCC Panel & AVR
- Sandwich type Cu Bus-duct.
- LT – XLPE Armoured cabling and end joints.
- Cable trays of various sizes with suitably fixed supporting arrangement.
- LT MPCC & Sub Distribution Panels.
- Distribution boards.
- Light fittings and fixtures.
- Wiring in conduits/ cables for various light fittings / plug points etc.
- Nurse Call System.
- Earthing.
- UPS system
- Early Streamer emission Lightning Protection system.

- Bed Lift and Passenger Elevators.
- Street Lighting.
- Battery & Battery Charger.
- Substation Safety Equipments.
- Preparation of drawings, submission to the Central Electrical Authority of Govt. And obtaining approval, arranging inspection after completion of work and obtaining Safety Certificate etc.
- Obtaining electrical loads sanction from Andhra Pradesh Electricity Board with necessary follow-up, obtaining service connection and energize the installation. The statutory fees payable to the Electrical Inspectorate / Andhra Pradesh Electricity Board will be paid by the Client against demand notice. The TMC will render necessary assistance to the successful tenderer in the form of furnishing letter and documents for obtaining above approval from statutory authorities. But the responsibility for obtaining above approvals including arrangements for inspection etc. is with the tenderer.
- Necessary civil works required for execution of works such as installation of HT panel, Transformer, will be part of civil scope. However necessary required technical details should be submitted by Electrical contractor to
- design the system.
- Chipping breaking grouting and making good of damaged civil works for cable trays, conduit pipes etc. All openings made by the Electrical Agency in the Wall / Ceiling / Trench etc., for laying of Cables / Trays / Conduits / Bus-ducts shall be closed by the Fire seal in the unused openings.
- Construction of earth pits with heavy duty RCC slab cover for to suit heavy vehicle movements.

5.0 SPECIFIC INCLUSIONS

- Pre-fabricated GI Cable trays, bends, couplers, down road supports, provision of Anchor fasteners, wherever required.
- Epoxy painted steel angles and channel support for cable trays with proper earthing at equal intervals – will be paid in separate line item.
- Steel support channels for panels / DBs.
- Excavation of pits for earth electrode, Construction of earth pits including masonry and covers.

- Provision of pipe sleeves for cables and earth bus
- Chipping, Breaking and making good the damaged portion of civil works
- Calibration & Testing of all protective relays, meters & other measuring and Protective devices.
- Co-operation / Co-ordination for testing and commissioning with other suppliers
- Obtain drawing approval from necessary authorities, arrange inspection and obtain safety certificate for entire installation.
- Submission of 6 (six) copies of As Built Drawings, Documents and maintenance manuals
- Epoxy / Zinc rich painting, wherever required
- Preparation of drawings for CEA submission.
- Power Supply during installation.

6.0 CENTRAL ELECTRICAL AUTHORITY OF GOVT'S APPROVAL

The contractor shall submit the required application, drawings etc. to the corporation, Electrical inspector, Factory inspectors & any other authorities and obtain their approved licenses and / or sanctions to the drawings. The final completion certification shall be obtained by the contractor from the corporation, electrical inspector, factory inspector and / or any other authority to enable the owner to commission the electrical equipment for its utilisation. Also the electrical contractor shall submit the required work completion test report to electric supply authority and obtain the power supply to enable the owner / department to commission the electrical equipment for complete utilisation. The contractor shall be responsible for all fees etc. Department will bear the deposits to be paid to supply company if required to be paid to the various authorities and the employer will not be liable to refund any such payments to the contractor. The work shall not be deemed to have been completed until the above approvals / certificate etc. have been obtained by the contractor.

7.0 ALTERATION OF WORK

If during inspection by Electrical Inspector, any defects are pointed out either on equipment supplied by the contractor or on the workmanship, the Contractor shall replace/ repair the equipment and redo the work as per Electrical Inspector's requirements without any extra cost.

SECTION- 3 : 1.1 KV GRADE LT POWER & CONTROL CABLES**3.1 SCOPE :**

This specification establishes the requirements of design, manufacture, testing at manufacturer's works and delivery to site and installation, testing at site & commissioning of 1.1 KV grade LT PVC/XLPE insulated, galvanized round wire/flat strip armoured Aluminium/copper conductor cables.

3.2 STANDARDS AND CODES :

Unless otherwise specifically mentioned in the document, the design, manufacture, testing and performance of all cables shall conform with latest edition of the following standards & codes:

IS : 7098 (Part-I)	:	Cross linked polyethylene insulated PVC sheathed cable for working voltage and including 1100 Volts.
IS : 1554 (Part-I)	:	PVC insulated (heavy duty) electric cables for working voltage upto and including 1100V.
IS : 3961 (Part-II)	:	Recommended current ratings for cables.
IS : 3975	:	Mild steel wires, strips and tapes for armouring of cables
IS : 4905	:	Methods for random sampling
IS : 5831	:	PVC insulation and sheath of electrical cables.
IS : 8130	:	Conductors for insulated electrical cables and flexible cords.
IS : 10418	:	Specification for drums for electric cables.
IS : 10810	:	Method of tests for cables.

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- ASTM-D-2843 : Standard test method for density of smoke from the burning or decomposition of plastics.
- ASTM-D-2863 : Standard method for measuring the minimum oxygen concentration to support E3 candle like construction plastics.
- IEC-754 (Part-I) : Test on gases evolved during combustion of electric cables.
- SS:4241475 : Flammability testing of cables.

3.3 Technical parameters:

- i) Power system details : 415 V +/-10%, 3 phase, 4 wire solidly earthed.
- ii) Frequency : 50 Hz.
- iii) Size of cable, conductor & quantity : As per S.O.Q.
- iv) Core identification : Colour scheme as per IS 1554 (part I) /88 or latest
- v) Conductor : Stranded circular/sector shape core Aluminium/Copper conductor
- vii) Insulation : PVC material type A/XLPE

viii)	Maximum conductor temperature at rated current.	70 degree C/90 degree C
ix)	Maximum conductor temperature during short circuit under hot condition	160 degree C/250 degree C
x)	Inner sheath	Extruded PVC inner sheath
xi)	Filler material	If used shall be compatible with other materials of cable construction
xii)	Armouring	Single layer galvanized steel round wire/ flat strip armoured.
xiii)	Overall serving (outer sheath)	Anti rodent and anti termite extruded black FRLS grade PVC sheath (Type ST-2)
xiv)	Cable shall be embossed / printed on the outer sheath at every 1 m. length as under :1.1 kV, PVCA/XLPE, conductor material, No. of core and size of cable, sequential marking for the metered length of cable, make and year of manufacturing	

3.4 Installation of LT cables in ground :

Cables shall be laid on the ground that they will not interfere with other underground structure/services. 1.1 KV grade, copper/Aluminium conductor PVCA/XLPE cables shall be laid at a depth of 900mm below ground level including excavation in all type of soil/concrete, road cutting/footpath cutting, temporary reinstatement, back filling, levelling, dewatering, consolidation, removal of excess earth within the radius of 500 m, sand bedding, cables covered on top & sides by baked bricks conforming to IS: 1077, sand cushioning all around, making good to the original finish, providing brass cable number tag including supply of bricks, sand, cable tags etc. complete as per instructions of EIC. The minimum width of trench for single LT cable shall be 450 mm as per standard drawing. The rate for installation of LT cables shall include in the cost of sand, cost of bricks. Cables markers shall be provided along the cable route at every 15 m. For road crossing a RCC pipe of 150 mm. dia. shall be provided. The pipe shall be laid to a depth of 1meter below the surface of the road. The pipe shall be plugged to prevent choking.

3.5 End termination of LT and Control cables:

End jointing of 1.1 KV grade, Aluminium / copper conductor PVCA/XLPE power / control cables with supply & installation of all jointing materials including supply of double compression type glands, crimping type long barrel heavy duty copper lugs, insulation tape etc. of sizes as detailed in schedule of quantities (SOQ). Cable gland shall be suitably earthed. Earthing of clamp should be included in the cost.

3.6 TESTS :**3.6.1 Shop Tests :**

The cables shall be subjected to shop tests & witnessed by department engineer in accordance with relevant standards to prove the design and general qualities of the cables as below:

3.6.1.1 Routine tests on each drum of cables.

3.6.1.2 Acceptance tests on drums chosen at random for acceptance of the lot.

3.6.1.3 Type tests Certificates shall be submitted for particular size & design of cable .

3.7 Site Tests :

The cables after installation at site shall be subjected to HV test & Megger test as per instruction of EIC.

3.8 DEVIATION :

No deviation with respect to specification requirements is acceptable. Deviation if any, shall be clearly spelt out by the Bidder referring clause No.

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SECTION- 4 : LT SWITCHGEAR PANEL4.1 SCOPE :

This specification covers the technical requirements of design, manufacture, testing at manufacturer's works, supply, installation, testing and commissioning of LT Switchgears.

4.2 TECHNICAL PARAMETERS:

A.	System Details		
i)	System Voltage	:	415V +/- 10% 3 phase 4 wire solidly grounded network
ii)	Frequency	:	50Hz +/- 3%
iii)	Control Supply	:	230 Volts AC +/- 10% (tapped from phase & neutral) and 110V DC +/- 10%
B.	CIRCUIT BREAKERS		
1	Standard Applicable(Isolation function with the test for line/ load inter-changeability)	:	IS : 13947 (Part –I to Part –IV)
2	Rate insulation voltage (Ui)	:	1000 Volts
2.1	One minute dry withstand test voltage	:	2500 Volts
2.2	Service (Ics) Breaking capacity at 415V, 50Hz	:	As per SOQ
2.3	Making capacity	:	Min 84 KA peak

3	Momentary short time current rating (rms) for 1 sec. (Icw)	:	As per SOQ
4	Rating of circuit breaker	:	As per bill of material
5	Type and material of inter phase barriers wherever required	:	FRP/SMC/Poly Carbonate
6	Type of tripping mechanism	:	i. Direct /Shunt trip (Electrical) ii. Manual (mechanical)
7	Normal voltage of tripping coils	:	110 V DC +10% - 15%
8	Voltage for spring charging motor (for stored energy mechanism)	:	230 V AC +10% - 15%
9	Breaker operations	:	Electrically operated with draw out type.
10	Electrical Closing and tripping	:	By spring return sequence locking type ODS switch
11	Operating duty	:	0-3 min. – CO - 3Min. – CO
12	Features of circuit breaker	:	Trip free and anti pumping
13	Method of closing	:	Electrically operated spring charged (normal), mechanical (emergency).
14	Communication capability	:	All ACB's shall be BMS compatible with RS 485 port
C	SWITCHGEAR CUBICLES:		

1	Design voltage of switchgear bus	:	415 Volts
2	Clearances (Except Component terminals).		
	a) Between phases	:	25mm
	b) Between live parts and earth	:	19mm
3	Degree of protection	:	IP 42
4	Power frequency withstand voltage for complete cubicle	:	2.5KV
5	Method of circuit grounding	:	Solid/flexible copper
6	Space heater details	:	
	a) Voltage	:	230 V
	b) Ratings	:	100W (min) / Adequate capacity
	c) Numbers	:	one per Shipping section
	d) Type of controls	:	Thermostat with MCB.
7	Bus bars		
7.1	Material	:	Tinned Copper
7.2	Continuous rating of main bus bars	:	As Per SLD
7.3	Continuous rating of feeder bus bars	:	As Per SLD
8	Temperature rise of the bus bar over the specified	:	As per IS.

	design ambient temperature		
9	One minute power frequency withstand voltage	:	2.5 KV
10	Ground Bus		
10.1	Material	:	Tinned Copper
10.2	Cross Section	:	Min.300 sq.mm
11	C.T. Mountings	:	At rear side of the panel
12	Control wire size		
12.1	CT circuit	:	2.5 sq.mm. copper
12.2	Other than CT circuit	:	1.5 sq.mm. copper
13	Painting Procedure	:	With 7 tank sheet treatment and powder coating as per shade indicated in SOQ.
14	Cable entry	:	Bottom
15	Cable compartment door	:	To be provided with hinged doors and knobs
16	Feeder compartment	:	To be provided with hinged doors and knobs
17	Design of switchgear	:	Incomer and bus coupler shall be single tier, outgoing in two tier
18	Quantity	:	As Per SLD

4.3 GENERAL :

The switchgear shall be designed, manufactured and equipped with accessories in accordance with this specification and applicable standards indicated above. The switchgear shall be of indoor, metal clad, air break with a draw out construction for AIR CIRCUIT BREAKERS.

4.4 CONSTRUCTION FEATURES:

4.4.1 SWITCHGEAR CUBICLES:

The sheet steel used in the fabrication of the switchgear housing shall be cold rolled thick & leveled and finished smooth in such a manner that the complete structure shall be rigid, self supporting. The thickness of the load bearing members shall be min. 2mm and non load bearing members min. 1.6 mm thick. All the steel panels enclosing a switchgear unit, hinged doors, partitions and removable panels shall be provided with stiffeners to minimize flexing and vibration. All panel edges and door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement members. Cut outs shall be turned in shape and devoid of sharp edges.

Structures, buses and control wiring troughs shall be so designed and arranged as to make future extensions readily feasible. Access to the circuit breaker operating mechanism shall be through compartment doors provided with hinges and key type locks, so arranged as not to expose any live parts or circuits. All compartment doors shall be so constructed that they will not seize in the event of fire within the switchgear.

Instruments shall be mounted on hinged type front doors. All doors shall have neoprene gaskets wherever required. Panels shall be supported by strong hinges of concealed type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts. Cable compartment shall also have hinged doors. Main bus bar, circuit breakers, outgoing feeder housing and cable compartment, shall be generally compartmentalized so that during maintenance the same should not be easily accessible from other compartment. Please note that self-threading screws shall not be used for panel fabrication.

All inter panel/compartments openings for wiring buses or for any other purposes shall be used with PVC bushes. The different materials used in the making of switchgear units, such as bus insulation, bus supports etc. shall not support combustion. All cable entries for outgoing feeders shall be from the bottom through gland plates assembled at the bottom.

The integrated base frame of the switchgear panel shall be designed in such a way that it shall be very strong enough for manual shifting of the panels at site.

4.5 INTERLOCKS :

4.5.1 MECHANICAL:

The following general mechanical interlocks shall be provided to ensure safety of personnel as well as to prevent damage. It shall not be possible to engage or disengage unless the breaker is in the open position. It shall also not be possible to operate the breaker unless it is in the fully latched in position, fully drawn-out position or test position. Provision shall be made for automatic closing of shutters to prevent accidental contact with main stationary contact or other live parts, when the breaker is drawn out. When the breaker is inserted back into its cubicle it shall automatically raise the shutters allowing the breaker to continue its travel until it finally engages the main stationary contacts. Suitable guides, slides and stops for proper positioning of the truck or trolley with the breaker shall be provided to ensure easy removal, replacement and positioning of the breaker. Locking devices shall be provided on each circuit breaker for securely locking it in the 'Isolated' and 'Test' positions.

4.5.2 AC auxiliary & indication supply:

230Volts, 50 Hz. Single phase AC control supply shall be derived from incomer cable side from one phase & neutral of both incomer with a automatic selection scheme to changeover the control supply from one incomer to other in case of failure of power to one incomer.

The circuit breakers shall be operated by a motor operated spring charging mechanism. Each mechanism shall be so designed as to enable one continuous sequence of circuit breaker opening, closing & opening operation on failure of power supply to the motor. The operation of the circuit breakers shall be independent of the motor, which shall be used solely for the charging the spring. The rating of the motor shall be such that it does not require more than 30 seconds for fully charging the closing spring. Charging of the spring shall occur automatically whenever it is discharged. The closing action of the circuit breaker shall charge the opening spring to keep it ready for tripping. Provision should be available for manually charging the spring.

Spring charging motors shall be suitable for operation from the available AC control voltage, unless otherwise specified and shall operate satisfactorily between 85% and 110% of the rated voltage. The anti pumping features shall be achieved electrically. All circuit breakers shall be trip free in TEST and SERVICE positions.

The closing coils and tripping coils and other auxiliary devices shall operate satisfactorily at all voltage between 85% and 110% of the rated voltage.

The auxiliary switches for the circuit breaker shall have multistage electrically separate, reversible, rotary/sliding type contact. Mechanical indication for 'open' / 'closed' positions of the breakers shall be provided.

It shall be preferred that components like spring charging motor, closing coil, tripping coil and auxiliary contacts shall be approachable from the front for the maintenance / replacement without withdrawing the breaker from the guide rail.

LED type Red, green, amber (for incomers only) and white lamps shall be used to indicate breaker 'close', 'open' , trip circuit healthy (for incomers only) and 'auto trip' respectively.

Interlocks shall be provided for the following functions:

- a) The incomer breaker shall trip in case the door of the cable chamber of incomer breaker is opened.
- b) Prevent the circuit breakers being moved to or from the SERVICE/TEST position when it is in closed position.
- c) Prevent manual closing of breaker unless it is in the 'SERVICE', 'Test' or 'Isolated' position.
- d) Integral key lock shall be provided to lock position of breaker during maintenance.
- e) Safety interlock shall be provided such that the door of the cassette can not be opened till the breaker is racked out to the isolated position.
- f) Breaker operation counter shall be provided.

Following LED indications on each breaker shall be provided:

- a) Mechanical – Close / open, spring charged / discharged, service position/test position/ isolated position.
- b) Electrical – ON, OFF, auto trip for all feeders and additional trip circuit healthy for incomers.

4.6 CONTACTS:

The main contacts of the circuit breaker shall be silver faced and shall have sufficient area so that there is no excessive temperature rise which may cause pitting or welding during the course of normal operations. The contacts shall be replaceable.

4.7 BUS BARS:

The main bus bars and vertical bus bars shall be with heat shrinkable PVC sleeved. Shrouds shall be provided for bus bar joints. Bus bars shall be high conductivity mechanically strong Tinned Copper.

GROUND BUS:

The ground bus shall be tinned copper, continuous throughout the switchgear cubicles and shall be bolted on each cubicle frame by means of hexagonal headed bolts and spring washers.

Grounding terminals shall be provided at each end of the ground bus for connection to purchaser's grounding cables. Continuity with enclosure should be provided. The non-current carrying metal parts of equipment within each switchgear shall be permanently grounded through the ground bus which shall be easily accessible from both ends for connections to the station ground system.

4.8 WIRING AND TERMINAL BLOCKS:

All the internal wiring shall be carried out with stranded copper conductors, PVC insulated 1100/650 V grade of the following sizes :-

Control	-	1.5 sq. mm.
Earth	-	2.5 sq. mm.
CT	-	2.5 sq. mm.
16A	-	2.5 sq. mm.
25A	-	6 sq. mm.
32A	-	10 sq. mm.
63A	-	25 sq. mm.
100A	-	25 x 3 sq. mm. copper strip

Each terminal block shall be one piece moulded, barrier type, 650 volt grade, complete with washers, heads, studs with two nuts and identification strips and shall have adequate continuous current rating. For tap-offs, adjacent terminals with shorting strips shall be used. **10% Spare terminal blocks shall be provided.** Wire identification on marking strip shall correspond to the designation of the wiring diagrams. All wire terminals on the equipment shall also be marked with designation corresponding to those of the wiring diagram.

Wires shall be provided with numbered ferrules at both ends shall bear the same numbers. All auxiliary contacts whether spare or otherwise shall be wired and brought out to the terminal blocks. Wiring between components within switchgear cubicle shall be done through the terminal block only. Direct connection shall not be permitted. Current transformer secondary leads shall be brought on to the terminal of the terminal blocks where facility for short circuiting and grounding of CT secondary shall be provided. The terminals shall be similar to type CDTTS of M/s.Connectwell make with shorting and earthing facility.

All wiring shall be enclosed in plastic channels and neatly bunched and closed in metering chamber, Wiring between terminals of various devices shall be 'point to point' (no wire splitting or tee connections) with wires neatly trucked along the back of the panels, adequately supported to prevent sagging or damage due to vibration in transit and operation. Double pole M.C.B. should be provided for control supply to each of the panels.

4.9 SPACE HEATERS:

Switchgear enclosures shall be equipped with space heaters of adequate capacity to maintain the internal temperature above the dew point to prevent moisture condensation within the enclosure. Space heater shall be rated for 230 Volts, single phase, 50Hz. A.C. supply. Differential Thermostats shall automatically control the space heaters. ON/OFF and protection should be through adequate rating of MCB for each space heater.

4.10 ILLUMINATION:

The control compartment shall be provided with 9W PL (CFL) lamps, provided with MCB of suitable rating operating on 230 volts, 1 phase 50 Hz AC supply and 5+15A socket with switch to be wired in each compartment.

4.11 CABLE ENTRY :

Cable entry for all feeders shall be from top/bottom. Cables end base of adequate size to be provided wherever required.

Removable 3 mm. thick sheet steel gland plates with appropriate size of knockouts for cables shall be provided. Holes for appropriate size of cable glands shall be made at site.

Double Compression type brass plated cable glands shall be provided.

4.12 INSPECTION AND TESTING :

To be carried out in presence of Department representatives :

4.12.1 Inspection :

The inspection shall consist of following, but shall not be limited to the same -

- i) Appearance and construction.
- ii) Dimensions, mounting details etc.
- iii) Feeder arrangement and feeder details.
- iv) Door alignment, gaskets etc.
- v) Alignment of switch drive and handle.

4.12.2 Tests :

The following tests shall be carried out -

i) Insulation resistance :

The insulation resistance shall be measured between phases, between phase and neutral and between phase and earth. The insulation resistance shall be measured with 1000Volts megger, both before and after high voltage power frequency test. The insulation resistance shall not be less than three megaohm in any case.

ii) High voltage power frequency test :

This test shall be carried out by applying a voltage of 2.5KV for one minute.

- a) between all three phases and earth.
- b) between the phases.
- c) between phases and neutral.
- iii) Routine test as per IS & Heat run test (type test) shall be carried out on the panel.

If the result of inspection and tests are not satisfactory, the defects shall be rectified and tests shall be repeated to entire satisfaction of engineer-in-charge/consultant without any extra charge to employer. The inspection and tests result shall be submitted in quadruplicate for engineer-in-charge/consultant's approval.

The heat run test shall be carried out as one panel of each different rating. The selection of the panel on which heat run test shall be carried out shall be decided by Engineer-in-charge.

Test certificate for all type test conducted on similar type complete switchgear assembly, relay and energy meter shall be submitted.

4.13 DRAWINGS :

The following shall be submitted for engineer-in-charge/consultant's approval before taking up the fabrication.

- a) Complete assembly drawings of the switchgear showing plan, elevation and typical sectional view.
- b) Foundation plan showing locations of channel sills, foundation bolts and anchors, floor plans and openings.
- c) Complete wiring diagram including terminal wiring designations.
- d) Schematic control diagram both AC and DC for breaker control, interlocks, relays, instruments and space heaters.
- e) Complete terminal block details, showing ferrule numbers wire destinations.

The following shall be submitted on delivery of panels:

- a) 4 Nos. of installation and operation manual
- b) 4 Nos. of all approved drawings.
- c) 6 Nos. of operating handle.
- d) Reproducible drawing on Compact Disc.

4.14 PAINTING :

All steel work shall undergo a process of degreasing, pickling in acid bath, phosphatising & shall be subjected to seven tank process and then Powder coated with approved shade as per SOQ.

4.15 LABELS :

Engraved PVC/black anodised labels shall be provided on all the components.

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ELECTRICAL SPECIFICATIONS
SECTION – 05: CABLE TRAY

5.1 General Requirement:-

Cable Tray and Cable Ladder systems are intended for the support and accommodation of cables and possibly other Electrical equipment in Electrical/ Instrumentation/ Communication systems.

5.2 Design and Fabrication of Cable Trays / Ladders:-

The cable trays / ladders shall be fabricated according to the design specified by IEC 61537 and should be tested for Safe Working Load (SWL). The relevant details of SWL and the load chart with respect to SWL, supporting distance and the deflection should be according to the following chart.

Safe Working Load (SWL) with a span length up to 3 meters						
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)			
			1.5m	2m	2.5m	3m
			Permitted Load (in kg/ meter)			
Perforated Cable Tray	35	50 - 300	125	90	50	-
	60	50 - 600	150	100	50	-
	85	100 - 600	175	110	50	-
	110	100 - 550	185	130	75	60
Cable Ladder	45	200 - 600	180	140	100	55
	60	200 - 600	-	225	150	100
	110	200 - 600	-	310	200	140

Safe Working Load (SWL) with a span length up to 10 meters									
Description	Side Height (in mm)	Width (in mm)	Span length (in meters)						
			4m	5m	6m	7m	8m	9m	10m
			Permitted Load (in kg/ meter)						
Perforated Cable Tray for long span distance	110	200 - 300	160	110	75	-	20	-	-
		400 - 600	200	150	100	-	40	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
Cable Ladder for long span distance	110	200 - 300	160	110	80	40	-	-	-
		400 - 600	210	150	100	70	-	-	-
	160	200 - 300	230	180	140	100	70	-	-
		400 - 600	250	200	160	130	100	-	-
	200	200 - 600	-	-	300	250	200	140	100

Fabrication of Tray / Ladder and accessories at site and welding is not permitted. In unavoidable circumstances, If any cut or holes are made in the trays/ Ladder/ accessories, zinc spray need to be applied over the surface. The metal edge has to be protected by edge protection sleeves to avoid cable damage. Edge of the supports has to be protected with plastic END caps. Screwed connections and internal fixing Devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections. Cables shall run in cable tray/ ladder mounted horizontally or vertically on cable tray support system which in turn shall be supported from floor, ceiling, overhead structures, trestles, pipe racks, trenches or other building structures using mounting accessories

5.3 Cable Tray:-

The cable tray and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications & should have a Base Perforation Class B according to IEC 61537. The cable trays shall be supplied in standard lengths of 3000mm and the width of the tray shall be as follows.

Width: 50, 100, 150, 200, 300, 400, 500, 600 & 750 mm.

All the cable tray accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be from the same material as of the tray and modular type, it should be connected with the trays by using fasteners. Typical details of trays, fittings and accessories. etc are shown in the enclosed drawings.

For Cable trays designed, tested and confirming to IEC 61537, thickness of cable tray should be according to the manufacturers' catalogue. For locally fabricated and non tested tray, thickness should be 2 mm up to span length of 1.5 meter, 2.5 mm for span length between 2 to 3 meter and 3 to 4 mm for span length between 4 and 10 meter

5.4 **Cable ladder:-**

The cable Ladder and all accessories shall be fabricated from sheet steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications & should have a Free Base Area classification Y according to IEC61537. The cable ladders shall be supplied in standard lengths of 3000/ 6000 mm and the width of the tray shall be as follows.

Width: 200 to 1200 mm in multiples of 100 mm

Maximum rung spacing in the ladder shall be 300mm. The rungs should be made of C profiles suitable to fix cables by special metal clamps according to the drawing. The ladder shall be of riveted and foldable type for easy transportation and to avoid damage during transportation and storage. All the ladder accessories like Bend's, TEES's, Cross over's etc should be designed in accordance with IEC 61537 and shall be factory fabricated. The accessories shall be made from the same material as of the ladder and modular type; it should be connected with the ladder by using fasteners. The details of ladders, fittings and accessories .etc are shown in the enclosed drawing.

For Cable Ladders designed, tested and confirming to IEC 61537, thickness of cable Ladder should be according to the manufacturer's catalogue. For locally fabricated and non tested Ladder, thickness should be 2.5 mm up to span length of 1.5 to 2 meter, 3 mm for span length between 2.5 to 4 meter and 3 to 4 mm for span length between 5 and 10 meter

5.5 **Cover for Cable Trays / Ladders:-**

Cover for trays/ ladders to protect the cable insulation from falling objects, water droplets, and harmful effects of ultraviolet rays and accumulation of dust. The cover shall be made either from Hot Dip Galvanized sheet steel or superior quality Double Dip Galvanized Sheets. For Outdoor application, Double dip Galvanized material shall be used. The covers should be fitted properly to the Ladder / Tray by using pre fixed

and tested locks which ensure that covers are fitted rigidly to Tray / Ladder. For outdoor application in high wind areas, additional cross over beadings to be used for fixing the cover on tray / ladder of width more than 500 mm.

5.6 Mounting Accessories (supports and Brackets):-

The mounting accessories shall be fabricated from steel and has to be hot dip galvanized against corrosion confirming to ISO 1461-1999 for installations in both indoor and outdoor applications and should be of completely modular type.

All supports and Brackets should be factory made, hot dip galvanized after completing welding, cutting, drilling, other machining operations and tested according to IEC 61537 according to the arrangements in the enclosed drawing. The system shall be designed such that it allows easy assembly at site by using Bolts and Nuts. The main support and brackets shall be fixed at site using necessary brackets, clamps, fittings, bolts, nuts and other hard ware etc to form various arrangements required to support the cable trays. Welding of the components at the site shall not be allowed.

5.7 Corrosion Protection:-

The cable tray / ladder/ accessories shall be of HOT DIP Galvanized (ISO 1461-1999) for installations in corrosive atmospheres both indoor and outdoor application. Sample tray / ladder / accessories / mounting accessories and supports should be salt spray tested according to ISO 9227 for > 500 hours. (*550 hours according to class 6 for Hot dip Galvanized surface as per ISO)

5.8 Testing and Certification:-

Cable tray / Ladder bend, T Bend, cross, and all supports are to be tested for Safe Working Load (SWL), deflections, Impact resistance, Salt Spray & Electrical continuity test according to IEC 61537. The cable tray/ ladder should not deflect more than 1/ 100th of the span length at SWL in Mid span and the transverse deflection of all mounting accessories at SWL shall not exceed 1/ 20th of the length. The cable tray / cable ladder should be tested up to 1.7 times SWL at minimum and maximum room temperature. The temperature classification of cable tray system should be - 5 to + 150°C.

5.9 Marking, Documentation, Compliance and Inspection:-

Each system component shall be durably and legibly marked with:

- the manufacturer's or responsible vendor's name or trade mark or identification mark;
- a product identification mark which may be, for example, a catalogue number, a symbol, or the like.

When system components other than cable tray lengths and cable ladder lengths are supplied in a package, the product identification mark may be, as an alternative, marked on the smallest package unit.

Marking shall be applied, by moulding, pressing, engraving, printing, adhesive labels, or water slide transfers. Compliance is checked by inspection and, for marking on the product, by rubbing by hand for 15 s with a piece of cotton cloth soaked with water and again for 15 s with a piece of cotton cloth soaked with petroleum spirit. Marking made by moulding, pressing, or engraving is not subjected to the rubbing test. After the test, the marking shall be legible.

If a system component is stored and transported at a temperature outside the declared minimum and maximum temperatures, the manufacturer or responsible vendor shall declare the precautions and the alternative temperature limits. Compliance is checked by inspection.

The manufacturer or responsible vendor shall provide in his literature all information necessary for the proper and safe installation and use of the cable tray system and cable ladder system. The SWL and impact resistance is valid for the whole temperature classification declared. The information shall include

- a. Instructions for the assembly and installation of system components and for the precautions required to avoid excessive transverse deflection, which could cause damage to the cables.
- b. Thermal Expansion properties and precautions to be taken, if necessary,
- c. Material, Surface Treatment and Salt Spray Test certificate
- d. Relative humidity if it affects the material and Surface Treatment
- e. Information on holes or devices provided for equipotential bonding or to run Earth Bonding Bar
- f. Precautions for transport and storage outside the declared temperature classification, where applicable
- g. Product dimensions
- h. Torque setting in Nm for screwed connections and internal fixing Devices. These devices should not create any damage to the cable when correctly fixed. Sudden or jerky motions shall not be used to tighten reusable screw connections. To test the screwed connections, it shall be tightened and removed.
- i. End Span Distance
- j. Position and type of coupling along the span
- k. SWL in kg/ m for the fittings when not directly supported
- l. Fixing method for installing cable tray or cable ladder to the supports
- m. SWL in kg/ m for the cable tray lengths or the cable ladder lengths including joints for various Span Distances. SWL information can be given in the form of a diagram, table or similar. Compliance is checked by inspection
- n. SWL in kg for cantilever brackets
- o. SWL for pendants as a bending moment in kg and / or as a force in N
- p. The appropriate material specification and environmental conditions, chemical environments or aggressive agents for which the product is suitable

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SECTION – 6 : DISTRIBUTION BOARDS6.1 SCOPE :

The specification covers design, manufacture, testing and commissioning of fabricated lighting / power distribution boards. (Readymade DB to be supplied & installed as per the preferred makes of material & Schedule of Quantity.)

6.2 STANDARDS :

The design, manufacture and testing of lighting/power distribution board shall comply with the latest issue of following standards :

IS - 2675	:	Specification for enclosed distribution fuse boards and cut-outs for voltages not exceeding 1000Volts.
IS - 4237	:	General requirement for switchgear and controlgear for voltages not exceeding 1000Volts.
IS - 375	:	Specification for marking and general arrangement for switchgear, busbar, main connection & auxiliary wiring.
IS - 2147	:	Degree of protection provided by enclosure for low voltage switchgear.
BS - 3871	:	Specification for miniature circuit breakers

(Part-I)

6.3 CONSTRUCTION :

Lighting/power distribution board shall be cubical type suitable for wall mounting or recessed mounting. It shall be totally enclosed, completely dust proof & vermin proof & shall have IP-42 degree of protection.

Sheet steel work shall be of high quality and shall be free from burrs.

Sheet steel used for the body and door shall be 18/20 SWG thick, as per manufacturers standard.

Lighting/power distribution board shall have one concealed hinged door which will cover the entire front portion. The door shall be provided with gasket to make the equipment dust tight and also with insulated quick turn screws.

Design shall be dead front type. No live components shall be mounted on door.

Adequate space shall be provided for termination of aluminium cables and wires.

The DBs shall be with double door design, with all components to be mounted on removable base plate.

The recess mounting DBs shall be provided with two hold fast arrangement.

The DBs shall be provided for wire way box at incomer /outgoing, as applicable.

For DBs with width greater than 500 mm, double leaf door shall be provided.

6.4 BUSBARS:(wherever applicable)

Phase and neutral copper busbars shall be provided at the top for the entire length of the lighting/power distribution board.

The busbars support shall be epoxy material (non-hygroscopic anti tracking material).

6.5 WIRING AND TERMINAL :

The lighting/power distribution board shall be factory wired.

Flexible copper wires shall be used for internal wiring.

Elmex type terminal blocks shall be provided for all outgoing phase wires.

For neutral terminals, brass neutral terminal block shall be provided. It should have spare capacity of at least 10% or as per manufacturers standard.

6.6 CABLE ENTRY :

Cable entry for incomer shall be from bottom/top but entry for outgoing circuit shall be from top.

Removable sheet steel plates shall be provided for conduit entry/cable entry.

Compression type plate brass cable gland shall be provided for incoming/outgoing cables.

Wire way boxes shall be provided at incoming /outgoing side.

6.7 EARTHING :

Two numbers earthing terminals shall be provided on either side of the lighting/power distribution board.

6.8 MINIATURE CIRCUIT BREAKERS:

The Miniature Circuit Breakers (MCBs) shall be heat resistant, moulded type, designed, manufactured and tested as per IS 8828. The MCBs shall have inverse-time tripping characteristic against over loads and instantaneous trip against short circuits. The MCBs shall be of fault current limiting type also. The MCBs shall be slip on type to the Bus-bar. The ON and OFF machines of the switch handle shall be clearly marked. The incoming and outgoing of the MCBs shall be accessible only after opening the front door of the DB. The MCBs shall be suitable for 415V, 3 phases, 4 wires, 50 Hz system with the fault level of 10 KA RMS symmetrical. The terminals of MCBs shall be suitable for use with eye lugs. The 4 pole, 3 pole and 2 pole MCB knobs shall be trunked with adequate strength tandem pin.

The MCB value of the instantaneous tripping current, they are categorized into 3 types, namely, B,C and D. Type B is for resistive or slightly inductive loads such as heating and lighting, Type C for Inductive loads such as motors or transformers and Type D for loads such as UPS, VFDs and high discharge illumination.

6.9 EARTH LEAKAGE, OVERLOAD & SHORT CIRCUIT PROTECTION BREAKERS:

Incomer of the DB shall be provided with current operated Earth leakage circuit breakers with a sensitivity of 30mA as specified in the BOQ. The RCBOs shall have Trip free mechanism and shall operate even on neutral failure.

The RCBOs shall be provided with a Test Push Button to stimulate leakage and test the RCBOs. The RCBOs shall operate and switch off the circuit within milliseconds in case of a fault. The enclosures of the RCBOs shall be moulded from High quality insulating materials, which shall be fire retardant, anti-tracking, non-hygroscopic, and impact resistant and shall withstand high temperatures.

RCBOs (HI/ SI/ Hpi Version) used for UPS application shall have enhanced high immunity against transient current and voltage and hence reduce unwanted tripping of the circuit in environments with disturbances and defects faults with DC components

6.10 INSPECTION AND TESTING : To be carried out in presence of Department representatives

6.10.1 Inspection :

The inspection shall consist of following, but shall not be limited to the same -

- i) Appearance and construction.
- ii) Dimensions, mounting details etc.
- iii) Feeder arrangement and feeder details.
- iv) Door alignment, gaskets etc.

6.10.2 Tests :

The following tests shall be carried out -

i) Insulation resistance :

The insulation resistance shall be measured between phases, between phase and neutral and between phase and earth. The insulation resistance shall be measured with 1000Volts megger, both before and after high voltage power frequency test. The insulation resistance shall not be less than two megaohm in any case.

ii) High voltage power frequency test :

This test shall be carried out by applying a voltage of 2.5KV for a minute.

a) between all three phases and earth.

b) between phases.

c) between phases and neutral.

If the result of inspection and tests are not satisfactory, the defects shall be rectified and tests shall be repeated to entire satisfaction of engineer-in-charge/consultant without any extra charge to employer. The inspection and tests result shall be submitted in quadruplicate for engineer-in-charge/consultant's approval.

6.11 DRAWINGS :

The following shall be submitted for engineer-in-charge approval:

Assembly drawing - This should incorporate dimensions, weight and MCB arrangement.

Mounting details.

6.12 PAINTING :

All steel work shall undergo a process of degreasing, pickling in acid bath, phosphatising & shall be subjected to seven tank process and then Powder coated with shades as per SOQ.

6.13 LABELS :

Engraved PVC/black anodised labels shall be provided on all incoming & outgoing circuits.

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ELECTRICAL SPECIFICATIONS
SECTION - 7 : WIRING INSTALLATION

7.1 SCOPE :

This specification covers supply, erection, testing and commissioning of mains/sub-mains/power wiring, point wiring, plug socket and switches, light fittings and fixtures etc. as detailed under bill of materials/quantities.

7.2 STANDARDS AND CODES :

The design, manufacture, erection, testing and commissioning shall comply with, but not limited the latest issue of the following standards and rules :-

- IS - 9537 : Specification for rigid steel conduit for electrical wiring (Part-II)
- IS - 9537 : Specification for rigid PVC conduit for electrical wiring (Part-III)
- IS - 14927 : Specification for UPVC trunking for electrical wiring
- IS - 694 : PVC insulated cables with copper conductors for voltages upto 1100Volts (Part-I)
- IS - 732 : Code of practice for electrical wiring installation (system voltage not exceeding 650Volts)
- IS - 1646 : General code of practice for fire safety of bldg.- electrical installation
- IS - 3043 : Code of practice for earthing

Indian Electricity Rules 1956, Indian Electricity Act 2003 as amended up to date and local supply authorities rules & regulations.

7.3 SURFACE PVC CASING-N-CAPPING WIRING :

All casing-n-capping shall be rigid PVC heavy gauge with double locking type.

The outer surface of the casing-n-capping including all bends, unions, tees, junction boxes etc. forming part of the casing-n-capping system shall be adequately supported.

The casing and capping shall be individually fixed using galvanised screws at interval of 450 mm along horizontal run and 600 mm. along vertical run.

Junction box for lighting fixtures, fans etc. shall be surface mounted. The box shall be complete with covers fixed with screws.

The casing-n-capping of each circuit or section shall be completed along with conductor are drawn in. Separate earth wire of appropriate size shall run in each casing-n-capping for earthing.

7.4 CONCEALED HMS PVC CONDUIT WIRING :

All conduits and wiring shall be completely concealed. Outlet junction boxes, inspection boxes shall be provided flush with surface.

All conduit wiring shall conform to IS-9537 (Part-III) and shall be rigid HMS PVC conduit. Conduit accessories shall be PVC grip type. No PVC conduit less than 20 mm. dia shall be used.

Conduit pipe shall be joined by means of couplers and accessories. In long distance straight runs of conduit, inspection boxes at reasonable intervals shall be provided.

The outer surface of the conduit pipes including all bends, unions, tees, junction boxes etc. forming part of the conduit system shall be adequately supported.

All necessary bends in the system shall be done by bending pipes or by using standard bends for diversion purpose pipes shall be bent.

At least 18 SWG G.I. fish wire shall be laid through the conduit to enable to pull the wires through the conduit.

The conduit for concealed wiring in slab or in RCC wall shall be tied to the reinforcement bar by M.S. galvanised wires at suitable places to give the conduits rigidity. Before installing conduits junction boxes and inspection boxes in the brickwall, a chase shall be made. This work is done before plastering of the walls is done and shall be co-ordinated with the other agency. After installing the conduits the chase shall be closed and shall be finished flush with the wall.

The junction boxes, inspection boxes and switch boxes shall be temporarily blocked by jute before concreting is done and shall be co-ordinated with engineer-in-charge/consultant. After concreting is over, all boxes shall be cleaned if they are choked up by concrete.

Separate insulated earth wire of appropriate size shall be used for earthing & drawn inside the PVC conduit.

The conduit of each circuit or section shall be completed before conductors are drawn in.

7.5 SURFACE HMS PVC CONDUIT WIRING :

All conduits shall be rigid PVC conduits. All conduits accessories shall be PVC grip type. No PVC conduit less than 20 mm. dia shall be used.

Conduit pipe shall be jointed by means of couplers and accessories. In long distance straight runs of conduit, inspection type couplers at reasonable intervals shall be provided.

The outer surface of the conduit pipes including all bends, unions, tees, junction boxes etc. forming part of the conduit system shall be adequately supported.

Conduit pipes shall be fixed by heavy gauge PVC saddles & spacers for 25 mm to 40 mm. dia PVC conduits shall have 5 mm. overall thickness and length 62 mm. & PVC saddles of thickness of 2 to 3 mm. The conduit pipes shall be individually fixed using galvanised screws at every 600 mm.

All necessary bends in the system including diversion shall be done by bending pipes or by inserting normal or inspection type normal bends or by fixing inspection boxes whichever is more suitable. Conduit fittings shall not be used on conduit system exposed to weather. Radius of such bends in conduit pipes shall not be less than 7.5 cm. No length of conduit shall have more than the equivalent of two quarter bends from outlet. Additional bends shall be inspection bends/boxes.

The junction boxes for lighting fixture, fans etc. shall be surface mounting. The boxes shall be complete with covers to be fixed with screws.

The conduit of each circuit or section shall be completed before conductors are drawn in. Separate insulated earth wire of appropriate size shall run in each conduit for earthing.

7.6 SURFACE G.I CONDUIT WIRING :

All surface conduiting shall be rigid steel G.I conduit. All conduits accessories shall be threaded type and under no circumstances pin grip type or clamp type accessories be used. No G.I conduit less than 20 mm. dia shall be used.

Conduit pipe shall be jointed by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers at reasonable intervals shall be provided.

Threads on conduit pipes in all cases shall be between 11 mm. to 27 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges not any burrs left to avoid any damage to the insulation of conductors while pulling them through.

The outer surface of the conduit pipes including all bends, unions, tees, junction boxes etc. forming part of the conduit system shall be adequately protected against rust. In no case, bare threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive preservative or covered with approved plastic compound.

Conduit pipes shall be fixed by heavy gauge galvanised M.S. saddles secured to M.S. galvanised flats of 5 mm. thick. The width of flats shall suit the total number of conduits to be run. The conduit pipes shall be individually fixed using galvanised screws at every 600 mm. The G.I. saddles for fixing of G.I conduit should not be less than 20 gauge and 19 mm wide for conduits upto 25 mm dia and not less than 18 gauge and 25 mm. wide for large dia conduits.

All necessary bends in the system including diversion shall be done by bending pipes or by inserting normal or inspection type normal bends or by fixing M.S. painted inspection boxes whichever is more suitable.

No length of conduit shall have more than the equivalent of two quarter bends from outlet to outlet. Additional bends shall be inspection bends/boxes.

The junction boxes for lighting fixture, fans etc. shall be M.S. 16 gauge black enamelled for surface mounting. The boxes shall be complete with covers to be fixed with screws.

The conduit of each circuit or section shall be completed before conductors are drawn in.

Conduit shall not be used as a earth medium. Separate tinned copper earth wire of appropriate size shall run along with each conduit for earthing externally fixed with suitable tinned copper clips with screws.

7.7 CONCEALED G.I CONDUIT WIRING :

All conduits accessories shall be threaded type and under no circumstances pin grip type or clamp type accessories be used. No G.I conduit less than 20 mm. dia shall be used.

Conduit pipe shall be jointed by means of screwed couplers and screwed accessories only. In long distance straight runs of conduit, inspection type couplers at reasonable intervals shall be provided.

Threads on conduit pipes in all cases shall be between 11 mm. to 27 mm long sufficient to accommodate pipes to full threaded portion of couplers or accessories. Cut ends of conduit pipes shall have no sharp edges not any burrs left to avoid any damage to the insulation of conductors while pulling them through.

At least 18 SWG G.I. fish wire shall be laid through the conduit to enable to pull the wires through the conduit.

The conduit for concealed wiring in slab or in RCC wall shall be tied to the reinforcement bar by M.S. galvanised wires at suitable places to give the conduits rigidity. Before installing conduits junction boxes and inspection boxes in the brick wall, a chase shall be made. This work is done before plastering of the walls is done and shall be co-ordinated with the other agency. After installing the conduits the chase shall be closed and shall be finished flush with the wall.

The junction boxes, inspection boxes and switch boxes shall be temporarily blocked by jute before concreting is done and shall be co-ordinated with engineer-in-charge/consultant. After concreting is over, all boxes shall be cleaned if they are choked up by concrete.

The outer surface of the conduit pipes including all bends, unions, tees, junction boxes etc. forming part of the conduit system shall be adequately protected against rust. In no case, bare threaded portion of conduit pipe shall be allowed unless such bare threaded portion is treated with anti-corrosive preservative or covered with approved plastic compound.

All necessary bends in the system including diversion shall be done by bending pipes or by inserting normal or inspection type normal bends or by fixing M.S. painted inspection boxes whichever is more suitable.

No length of conduit shall have more than the equivalent of two quarter bends from outlet to outlet. Additional bends shall be inspection bends/boxes.

The junction boxes for lighting fixture, fans etc. shall be M.S. 16 gauge black enamelled for surface mounting. The boxes shall be complete with covers to be fixed with screws.

The conduit of each circuit or section shall be completed before conductors are drawn in.

Conduit shall not be used as a earth medium. Separate tinned copper earth wire of appropriate size shall run along with each conduit for earthing externally fixed with suitable tinned copper clips with screws.

7.8 WIRES AND FLEXIBLES :

Single core PVC / FRLS / HFFR insulated 650 Volts grade copper wires shall be used for wiring as per S.O.Q. The size of the conductor shall be as specified in the drawings/bill of quantities but in no case it shall be less than 1.5 sq. mm. for lighting circuit and 2.5 sq. mm. for power circuit. Three core insulated and PVC sheathed flexible shall be used from junction box to light fittings/fans. The minimum size of flexible wire shall be 24/0.2 mm. copper conductor. Black colour insulated wires shall be used for neutral conductor. Coloured insulated wires of respective colours shall be used for phase conductor.

The wiring shall be done in looping system. The phase conductor shall be looped at switch box for sub-circuit. The neutral conductor for sub-circuit can be looped either from switch box or from light/fan/socket points. Twisted joints for looping are not acceptable.

Straight through joints shall not be permitted on single core wires and flexible.

Coloured insulated wires of respective colour shall be used for phase conductor and black colours insulated wires shall be used for neutral conductor.

7.8.1 WIRES:

Single core PVC FRLS / HFFR insulated, 650 V grade multistranded copper conductor wires shall be used as per the Design requirements. The size of conductor shall be used as follows.

	<u>Mains</u>	<u>Earth wire to be used for</u>
		<u>PVC conduit/casing & capping</u>
Lighting	1.5 sq. mm/ as per SOQ	2.5 sq. mm.
15 A Power socket	2.5 sq. mm/ as per SOQ	2.5 sq. mm.
A/c / geyser Point	4.0 sq. mm.	2.5 sq. mm.
Submain wiring	6.0 sq. mm.	4.0 sq. mm.
	10.0 sq. mm.	6.0 sq. mm.

7.9 FITTINGS AND ACCESSORIES :

Lighting fixture :

The lighting fixtures shall be as per the schedule of quantities and drawings enclosed. The mounting height and location shall be as specified in the drawings. Unless otherwise specified, the mounting height shall not be less than 2.5 m. The lighting fixtures shall be either supported vertically or mounted on bracket or suspended by a hook, as required.

Plug sockets :

Only three / six pin socket outlets as per the schedule of quantities shall be used. Every socket shall be controlled by a switch which shall be located adjacent to it at operable height and wiring for socket outlet on switch box shall also be included. The switch controlling the socket outlet shall be on the live side. The mounting and location shall be as specified in the drawing. Unless and otherwise specified, the mounting height shall not be more than 1.5 meter above floor level.

Switches :

The switches shall be 6 Amps. rating for lighting sub-circuit. The switches shall be single pole piano/modular type as indicated in bill of quantities/preferred makes of item.

Switch boxes :

The switch boxes shall be totally enclosed made of sheet steel or as specified/M.S. concealed/surface type, location and details shall be as per the schedule and drawings.

Attachment of fittings and accessories :

All necessary materials for mounting and operation of lighting fixtures, sockets, outlets etc. such as M.S. painted down rods, brackets, ball and socket of approved make, M.S. painted junction boxes, terminals strips etc. shall be used.

INTER CHANGEABILITY :

Similar part of all switches, pendants, brackets, conduits and accessories etc. of the same type shall be inter changeable.

EARTHING :

The earth shall conform to IS-3043. Tinned copper earth wire shall be used for earthing as per S.O.Q. The earthing wire shall be run continuously along the conduit. All earthing wires shall be connected to earth bus provided near the distribution board.

7.10 TESTING OF INSTALLATION :

Before the installation is put into service, the following tests shall be completed with :

Insulation resistance :

The insulation resistance shall be measured by applying between earth and whole system of conductors or any section thereof. 500 Volts D.C. for single phase system be means of a megger. The insulation resistance shall not be less than one megaohm.

Testing earth continuity path :

The earthing conductors shall be tested for electrical continuity. The electrical resistance of the same along with earthing lead from connection with earth electrode to any point, in any point in earth continuity conductor in the complete installation shall be less than one ohm.

Testing of polarity of single pole switch :

The test shall be made to verify that all single pole switches have been fitted between phase conductors and light/fan/socket outlet.

7.11 POINT :

A point shall consist of the branch wiring from the distribution on board, together with a switch as required as far as including the ceiling rose or socket outlet or suitable termination. A three pin socket outlet point shall include in addition, the connecting wire or cable from the earth pin to the earth stud of the branch distribution board.

POINT WIRING :

Point wiring shall consist of the branch from the final sub-distribution board together with the controlling switch as far as and including the ceiling rose or any other connected load or socket outlet. In case of more than one light being controlled by one switch the wiring up to the ceiling rose of the first light including the switch shall be considered as a 'Primary' point. Loop wiring from light shall be considered as a secondary point and rates shall be quoted separately including final connection to fixtures and plugs.

In installation, Light & fans may be wired in a common circuit. Such sub circuit shall not have more than a total of ten points of lights, fans & socket outlets. The load of such circuit shall be restricted to 800 W for lighting circuit, 1000 watts for 15 Amp in power circuit & 2500 to 3000 watts for water heater / A.C. point.

7.11.1 PRIMARY POINTS:

Primary point wiring shall include all work necessary in complete wiring of a switch circuit of any length from the tapping point of the distributed circuit to the following via the switch.

- a) Ceiling rose or connector
- b) Back plate (in case of stiff pendants and fluorescent fittings with down rods etc.)
- c) Socket outlets
- d) Lamp Holder
- e) Call ball / Buzzer (In this case the words "via the switch" shall be read as: via the ceiling rose / socket outlet or bell push.

The following shall be treated to be included in the primary point wiring :

- a) Installation of conduit / casing & capping of suitable sizes.
- b) Drawing of copper conductor insulated wire of suitable sizes including connections.
- c) Installation of controlling switch and receptacle boxes including connections, looping.
- d) All accessories such as pressed steel saddles, spacers, reducers, hooks, nails, screws, earthing wire, Phil plug compound, rawal plug, wooden plugs, bend, elbows, couplers, junction boxes, bushes, earthing clamps, check nuts etc. as required.
- e) Loop earthing with 2 mm dia tinned copper wire for fan regulator three pin socket outlet, ceiling or exhaust fans, lighting fixture from the common earthing point. However conduits installation for point wiring shall include continuous earth run 2 mm dia tinned copper wire/insulated copper conductor earth wire in PVC conduit / PVC casing & capping.
- f) Connection to ceiling rose, connector, socket outlet, lamp holder, switch fan regulator etc.

7.12 NUMBER OF WIRES IN A G.I / PVC CONDUIT :

The maximum number of wires that may be laid in any conduit for circuit wiring or point wiring is given below :-

Maximum number of PVC insulated 650 / 1100 Volt Grade Aluminium / Copper conductor cable conforming to IS : 694-1990

Nominal Cross sectional area of conductor in sq. mm.		20 mm		25 mm		32 mm		38/40 mm		50/51 mm		63/64 mm	
		S	B	S	B	S	B	S	B	S	B	S	B
1.50		5	4	10	8	18	12	-	-	-	-	-	-
2.50		5	3	8	6	12	10	-	-	-	-	-	-
4		3	2	6	5	10	8	-	-	-	-	-	-
6		2	-	5	4	8	7	-	-	-	-	-	-
10		2	-	4	3	6	5	8	6	-	-	-	-
16		-	-	2	2	3	3	6	5	10	7	12	8
25		-	-	-	-	3	2	5	3	8	6	9	7
35		-	-	-	-	-	-	3	2	6	5	8	6
50		-	-	-	-	-	-	-	-	5	3	6	5
70		-	-	-	-	-	-	-	-	4	3	5	4

Note:

- 1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.
- 2) The columns headed 'S' apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns headed 'B' apply to runs of conduit, which deflect from the straight by an angle of more than 15 degrees.
- 3) Conduit sizes are the nominal external diameters.

7.13 NUMBER OF WIRES IN PVC TRUNKING :

The maximum number of wires that may be laid in PVC trunking for circuit wiring or point wiring is given below :-

Maximum number of PVC insulated 650 / 1100 Volt Grade Aluminium / Copper conductor cable conforming to IS : 694-1990

Nominal Cross sectional area	16 x 16 mm	25 x 12 mm	25 x 16 mm	38 x 16 mm	38 x 25 mm	38 x 38 mm
1.5	3	5	6	8	12	18
2.5	2	4	5	6	9	15
4	2	3	4	5	8	12
6		2	3	4	6	9
10		1	2	3	5	8
16			1	2	4	6
25				1	3	5
35					2	4
50					1	3
70					1	2

Note:

- 1) Dimensions shown above are outer dimensions of mini trunking.
- 2) Size of mini trunking to be used as per S.O.Q.

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ELECTRICAL SPECIFICATIONS
SECTION - 8 : LIGHTING LUMINARIES

8.1 SCOPE

This specification covers the design, material specification, manufacture, testing at works, inspection and delivery at site of light fittings and their associated accessories.

8.2 STANDARDS

The light fittings and their associated accessories such as lamps / tubes, reflector, housings, ballasts etc. shall comply with the latest applicable standards.

All luminaries, lamps and accessories shall be of same make.

8.3 GENERAL REQUIREMENTS

Fittings shall be designed for continuous trouble-free operation under hot humid atmospheric conditions, at the specified ambient temperature, without reduction in lamp life or without deterioration of materials and internal wiring. Outdoor fittings shall be weather proof and rain proof type.

The fittings shall be designed so as to facilitate easy maintenance, including cleaning, replacement of lamps / starters etc.

Connections between different components shall be made in such a way that they will not work loose by small vibration.

For each type of light fitting the Contractor shall supply the utilisation factor to indicate the proportion of the light emitted by the bare lamp which falls on the working plane.

The fittings shall be supplied complete with lamps.

The fittings and accessories shall be designed to have low temperature rise. The temperature rise above the ambient temperature shall be as indicated in the relevant standards.

All Discharge Lamp fittings shall be complete with accessories like lamps. Ballasts, power factor improvement capacitors, starters / igniters wherever applicable, etc. These shall be mounted as far as possible in the fitting assembly only.

Outdoor type fittings shall be provided with Weather Proof control gear box. The fittings shall be power factor corrected to 0.95 lagging (Maximum).

Each fitting shall have a terminal block suitable for loop-in, loop-out and T-Off connection. The internal wiring shall be completed by the Manufacturer by means of stranded copper wire and terminated on the terminal block.

All hardware used in the luminaries shall be cadmium plated / zinc passivated.

8.4 **EARTHING**

Each light fitting shall be provided with an earthing terminal suitable for connection to the earthing conductor.

All metal or metal enclosed parts of the housing shall be bonded to the earthing terminal so as to ensure satisfactory earth continuity throughout the fixture.

8.5 **PAINTING / FINISH**

All surfaces of the fittings shall be thoroughly cleaned and degreased. The fittings shall be free from scale, rust, sharp edges and burrs.

The housing shall be stove-enamelled / epoxy stove-enamelled / vitreous enamelled or anodised as indicated under various types of fitting.

The finish of the fitting shall be such that no bright spots are produced either by direct light source or by reflection.

8.6 **ACCESSORIES FOR LIGHT FITTINGS**

LAMPS:

The Compact Fluorescent lamps shall be Tri-band phosphor coated with precoating ensuring minimum lumen depreciation during lifetime. The mercury dosage shall not be more than 3mg. The lamp shall have a color-rendering index of 80 and above. The Lamp shall be used in conjunction with radio interference suppression capacitor. To ensure that the lamp provides the designed maximum lumen output regardless of

the ambient temperature it should be equipped with bridge technology circuit. The Type test certificates, Lamp Lumen depreciation curves, etc shall be furnished along with offer to validate these properties.

The lamps shall have a ceramic discharge tube to create high beam intensities. All lamps should have a UV-block quartz outer bulb to reduce health & fading risk. The lamp must provide the same color of light output & should not produce any color shifts during its lifetime. The lamp shall have a color-rendering index of 82 and above. The Type test certificates, Lamp Lumen depreciation curves, etc shall be furnished along with offer to validate these properties.

The fluorescent lamps shall be "Cool Day Light" type unless otherwise specified and shall be provided with features to avoid blackening of lamp ends. The fluorescent lamps shall have a high lumen output of 3250 lumens. The lamp shall have triple coil electrode with an anode ring and a triband phosphor coating.

The lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments / electrodes shall not break under such circumstances.

The lamps shall be capable of withstanding small vibrations and the connections at load in wires & filaments / electrodes shall not break under such circumstances.

Lamps / Tubes shall conform to relevant standards and shall be suitable for supply voltage and frequency specified.

Mercury vapour lamps shall be of high pressure, color corrected type, with a luminous efficiency of 50 lumen / watt. The discharge tube shall be made of high grade quartz.

Sodium vapour lamps are of high pressure type. Metal halide lamp shall be provided with internal diffuse coating and the average lumen output shall be 23000 lumen for 250W and 30600 lumens for 400W and the lamp voltage shall not exceed 100V for 250W and 128V for 400W. The color rendering index of the lamp shall be 69. The lamp shall be suitable for universal burning position and for use in open type luminaries.

The lamps shall be capable of withstanding small vibrations and the connections at lead in wires and filaments / electrodes shall not break under such circumstances.

Lamps / Tubes shall confirm to relevant standards and shall be suitable for supply voltage and frequency specified.

REFLECTORS:

The reflectors shall be made of CRCA sheet steel / Copper / silvered glass as indicated for above mentioned fittings.

The thickness of steel / Copper shall comply with relevant standards. Reflectors made of steel shall have stove enamelled / vitreous enamelled / epoxy coating finish.

Copper used for reflectors shall be anodized / epoxy stove enamelled / mirror polished.

Reflectors shall be free from scratches or blisters and shall have a smooth and glossy surface having an optimum light reflecting co-efficient such as to ensure the overall light output specified by the Manufacturer.

Reflectors shall be easily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be securely fixed to the housing by means of positive fastening device of captive type.

BALLASTS:

The ballasts shall be designed, manufactured and supplied in accordance with the relevant standards. The ballasts shall be designed to have a long service life and low power loss.

Ballasts shall be mounted using self locking, anti-vibration fixings and shall be easy to remove without de-mounting the fittings. They shall be in dust-tight, non combustible enclosures.

The Ballast shall be low loss electronic type and suitable to operate at 180V – 270V. End connections shall be brought out in a suitable terminal block, rigidly fixed to the ballast enclosure.

Separate ballast for each lamp shall be provided in case of Multi Lamp Fittings.
High Performance Electronic Ballast for CFL Lamp:

The ballast should ignite the lamp in less than 2 seconds. In case of mains voltage variation in the range of 202 to 254V the Light output should not change more than +/-2%. It should be able to operate on DC voltage as backup during emergency. The earth leakage current should be less than 0.5 mA per ballast. The over voltage protection should be such that it can operate for 48 hrs & 2 hrs at a voltage of 320 VAC & 350 VAC respectively. It should pass the insulation resistance test of 500 VDC from Line/ Neutral to Earth. (Not between Line & Neutral).

LAMP/ STARTER HOLDERS:

Lamp holders shall comply with relevant standards. They shall have low contact resistance, shall be resistant to wear and shall be suitable for operation at the specified temperature without deterioration in insulation value. They shall hold the lamps in position under normal condition of shock and vibration met with in normal installation and use.

Lamp holders for the fluorescent lamps shall be of the spring loaded bi-pin rotor type, Live parts of the lamp holder shall not be exposed during insertion or removal of the lamp or after lamp has been taken out. The lamp holder contacts shall provide adequate pressure on the lamp cap pins when in working position. Lamp holders for incandescent, mercury vapour & metal halide lamps shall be of Edison screw (E.S) type.

Starter holders for fluorescent lamps shall conform to the relevant standards. All material used in the construction of the holder shall be suitable for tropical use.

The starter holders shall be so designed that they are mechanically robust and free from any operational difficulties. They shall be capable of withstanding the shocks met with in normal transit, installation and use.

Starters shall have bimetal electrodes and high mechanical strength. Starters shall be replaceable without disturbing the reflector or lamps and without the use of any tool. Starters shall have brass contacts and radio interference capacitor.

The starters shall generally conform to the relevant standards.

CAPACITORS:

The capacitors shall have a constant value of capacitance and shall be connected across the supply of individual lamp circuits.

The capacitors shall be suitable for operation at supply voltage as specified and shall have a value of capacitance so as to correct the power factor of its corresponding lamp circuit to the extent of 0.95 lag.

The capacitors shall be hermetically sealed preferably in a metal enclosure to prevent seepage of impregnate and ingress of moisture.

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ELECTRICAL SPECIFICATIONS
SECTION -9 : CEILING FANS & EXHAUST FANS

9.1 Ceiling Fans:

Sr.No.	Description	:	Specifications
1.	Manufacturers name with address & Model.	:	1. M/s. Crompton Greaves 2. M/s. Havels
2.	Type of Motor	:	AC permanent capacitor single phase induction motor
3.	Capacitor type & rating	:	Dielectric MPP-SH dry type, 440 V rating, Aluminium / PVC canister
4.	Class of insulation for motor winding	:	Class E or better
5.	Blade sweep	:	1200 mm / 900 mm
6.	No. of blades	:	3
7.	No. of bearings	:	2
8.	Size of down rod	:	260 mm/ or as per SOQ
9.	Fan colour	:	Stove enamel white paint
II)	Performance Requirement	:	All tolerance shall be as per IS 374
1.	Rated voltage & frequency	:	230 V, 50 Hz, single phase AC
2.	Rated power input at rated voltage frequency	:	70 W for 1200 mm sweep fan.

			60W for 900 mm sweep fan.
3.	Rated air delivery at rated voltage frequency	:	230 cu. m / min for 1200 mm sweep fan. 160 cu. m / min for 900 mm sweep fan.
III)	Other conditions		
	1) Guarantee	:	Fans shall be guaranteed against any manufacturing defects for 2 years from the date of completion of the work.
	2) Delivery	:	At respective site
	3) Tests	:	i) Type test certificate shall be submitted. ii) Routine test, acceptance test and air delivery test (type test) shall be carried out on samples at manufacturers works as per test procedures of IS 374, in presence of Departmental Engineers.
	4) Additional safety	:	Fan shall be supplied with additional safety chain (i.e. 16 SWG GI wires)
	5) Arrangement for installation of safety chain and earthing	:	Suitable holes shall be made on shaft for fixing safety chain & termination of earth wire.

9.2 Heavy Duty Exhaust Fans:

- The exhaust fan shall be capacitor start and run type, continuously rated motor.
- Double ball bearing with Class A and E insulation.
- Dynamically balanced propeller type impeller.
- Silence motor that lasts longer and delivers the maximum output at lower operating cost.
- Low sound level.
- Routine & acceptance tests to be carried out at manufacturers works.

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10.1 Scope:

This specification covers the supply, installation testing and commissioning of earthing system.

10.2 Standards:

IS 3043 : Code of Practice for earthing

Indian Electricity Rules : 1956

Indian Electricity Act : 1910

And Local Electrical Inspectorate Regulations.

10.3 General Requirements:

The plant shall be provided with complete earthing system comprising earth electrodes in conjunction with earth grid.

10.4 Details of Earthing System:

Unless otherwise specified main earthing shall not be less than 50 x 6 mm GI. Flat.

The minimum size of earthing conductor of various equipment shall be as follows:

- | | | |
|-------------------------------------|---|-----------------------------|
| a. Transformer Neutral | - | 2R - 75 x 12 mm Copper flat |
| b. Transformer body & HT Panel body | - | 25 x 6 mm Copper flat |
| c. MPCC Panel body | - | 25 x 6 mm Copper flat |
| d. LT Switch boards body | - | 50 x 6 mm G.I flat |
| f. DG Neutral | - | 50 x 12 mm copper flat |
| g. DG Body | - | 25 x 6 mm copper flat |

10.5 Earth Electrode:

Earth electrodes shall be erected 1.5 Mtrs away from the building edge and minimum spacing between the electrodes 3 Mtrs shall be maintained as per IS: 3043

10.6 Earthing Layout:

Earthing conductors in outdoor areas shall be buried at least 450mm below finished grade level unless stated otherwise.

Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, etc. it shall be laid minimum 300 mm below and shall be re-routed in case it fouls with equipment structure foundations.

Tap-connections from the earthing grid to the equipment/ structure to be earthed shall be terminated on earthing terminals of the equipment/ structure, if the equipment is available at the time of laying the grid, otherwise," earth riser" shall be provided near the equipment foundation/ pedestal for future connections to the equipment earthing terminals.

Earthing conductors along their run on cable trench ladder columns, beams, walls, etc shall be supported by suitable cleating at intervals of 750 mm. Earthing conductors along cable trenches shall be cleated to the wall nearer to the equipment. Cable trays and supports shall be connected to the earth mat at every 10 meters interval. Wherever it passes through walls, floors, etc GI sleeves shall be provided for the passage of the conductor.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building.

10.7 Equipment Earthing:

All electrical power items shall be earthed by two separate and distinct earth connections from main earth bus.

Earthing pads shall be provided by the supplier of the apparatus/ equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by short and direct earthing lead free from links and splices.

Electrical continuity shall be ensured by bonding the different sections of hand-rails and metallic stairs.

Metallic pipes, and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

Metallic conduits shall not be used as earth continuity conductor.

Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, pipes etc. and steel reinforcement in concrete, it shall be bonded to the same.

Cable end boxes, glands, etc. shall be connected to the earthing conductor running along with the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points.

The metallic screens of the single core cable shall be connected to earth at one end only.

10.8 Jointing:

Earthing connections with equipment earthing pads shall be bolted type. Contact surface shall be free from scale, paint enamel, grease, rust or dirt. Two bolts shall be provided for making each connections. Bolted connections, after being checked and tested shall be taped with PVC tape.

Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

10.9 General:

Excavation and refilling of earth necessary for laying of under ground earth bus and earth pipes shall be the responsibility of the Contractor.

All earth electrodes shall be tested for earth resistance by means of standard earth resistance tester.

Earthing resistance of the main bus shall be measured after connecting all the electrodes to the bus and the resistance shall not exceed one (1) ohm.

The exact location of Earth Bus/ conductor, earth electrodes and earthing points on the equipment shall be determined at site in consultation with owner. Any change of methods, routing, and size of conductor shall be subject to approval by Owner.

10.10 Gland Earthing :

The minimum thickness of gland earthing clamp shall be 3 mm thick tinned copper strip or equivalent of GI strip as directed by E.I.C. Clamp shall be in two halves and fastened to the glands by suitable size of brass nuts & bolts & washers (in case of copper earthing system) & GI nuts and bolts and washers (in case of GI earthing system) all as directed by Engineer-in-charge.

10.11 SITE TEST :

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

- i) Each earthing station
- ii) Earthing system as a whole
- iii) Earth continuity conductors

10.12 MODE OF MEASUREMENT :

Providing an earthing station complete with excavation electrode watering pipe, soil treatment, chamber etc. shall be treated as one unit of measurement.

The following items of work shall be measured and paid at unit rate covering the cost of the earth wires/strips, clamps, labour etc :-

- Main equipment earthing grid and connection to earthing station.
- Connection to power panels, distribution boards etc.

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

- Light fittings -form part of installation of light fitting.
- Conduit / PVC casing & capping - should form part of the wiring of cabling.
- Cable glands earthing

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SECTION – 11 : ANALOGUE ADDRESSABLE FIRE ALARM SYSTEM11.1 SCOPE OF WORK

11.1.1 The scope of work shall include designing supplying and installing testing and commissioning of Analogue Addressable Fire Detection cum Alarm System with central monitoring system. This shall conform to relevant latest standards for fire alarm systems.

11.1.2 It shall be possible to trip from the Fire Alarm Panel through the use of Addressable Output Modules, individual AHU activated by the fire signal of specified detectors.

11.1.3 Input modules for monitoring water flow switches and other contacts like magnetic door contacts etc.

11.1.4 The Building shall have a multi zone panel with each area forming of one or more software programmed zones.

11.1.5 All wiring shall be done using 2 nos 1.5 sqmm FRLS-PVC insulated wires in conduits/ 2C 1.5 sqmm FRLS-PVC armoured cable as specified in the SOQ. The communication interconnectivity between Main Fire panel to Repeater panels shall be through 4 Core 1.0 sq. mm armoured Copper conductor multistranded, shielded twisted pair cable.

11.1.6 The communication between Main FACP and FACP of different block will be done with OFC from TMCs backbone fibre network and one core shall be dedicated for fire alarm system.

11.2 GLOSSARY OF TERMS11.2.1 FIRE ALARM PANEL (FACP)

- a) This is a microprocessor-based panel which shall be connected to the various detectors/devices by means of 2 wire loops.
- b) The Fire alarm control panel shall be able to supervise individual detectors for proper performance as well as to give pinpoint location of fire alarm.
- c) The panel shall have hooter alarm as well as facility for cutting off of AHUs and ventilation fans.
- a) The panel shall also have the facility for automatically dialing select phone numbers in case of fire.

11.2.2 LOOP

- a) A loop shall mean a 2-wire circuit connecting minimum 126 addressable detectors/devices
- b) The loop cards shall be of modular construction.

11.2.3 ADDRESSABLE DEVICES

This term indicates the complete group of addressable devices such as detectors, Manual call Stations, addressable output/input modules etc.

11.2.3.1 DETECTORS

- a) The Detector shall be analogue addressable type.
- b) The chamber should be easily removable for the purpose of easy maintenance.
- c) The address programming shall be done by a Base/detector or from the Fire alarm control panel.
- d) The detectors shall have a common base to allow easy interchange of various types of detectors.

11.2.3.2 MANUAL CALL STATION

- a) The Manual Call Station shall be addressable type with input modules to define the device/location.
- b) The Manual call station shall be breakable type with suitable protection and base box. .

11.2.3.3 OUTPUT MODULE

- a) Output module shall mean addressable points from the Fire alarm control panel with potential free contacts for tripping of AHUs, power supply etc. as required.
- b) The system shall also be able to handle separate modules to interface the speakers of the Public Address System.

11.2.3.4 INPUT MODULE

- a) The input modules shall be of dual/single point type.
- b) The dual channel module shall be selectable for Normally Open or closed.

11.2.3.5 SOUNDERS

- a) The sounders shall be of addressable type/connected by addressable module.
- b) The sounders shall be Loop power sounder
- c) It shall be capable of being directly mounted on the wall/ceiling or along with the detector.
- d) The sounder shall have an output of at least 85 db at 1 m. The sounder shall be programmed to get activated in event of an alarm from a single detector/device or a group of detectors/ devices.

11.3 FIRE ALARM SYSTEM

The Fire Alarm System shall give Audio/Visual Alarm Signals when the temperature in case of Heat Detector or smoke density in case of Smoke Detector exceeds the pre-set limit.

The system shall give pinpoint location of fire with warning system.

The system shall have a microprocessor-based control and monitoring facility.

It shall be possible to program each loop with up to minimum 126 /159 detectors/devices.

Annunciation facility shall also be inbuilt into the Fire alarm control panel , the panel being able to initiate alarm signal for any particular zone.

The system shall be fully supervised for all fault conditions with distinctive alarm operated for fault and fire conditions.

Test buttons and software features shall be provided to test the electronic circuits and detector health.

The Fire alarm control panel shall be so programmed that when a particular detector or group of detectors gives a fire signal the Fire alarm control panel should be able to trip AHU/AHU's/Ventilation fans etc

In case of Fire in a area handled by an AHU the Fire alarm control panel shall be able to trigger a Relay that shall shut off the AHU through an additional contact provided in the AHU panel by the AC contractor.

11.4 FIRE ALARM CONTROL PANEL (FACP)

The Fire Alarm Control Panel shall be micro processor based fully Analogue Addressable, Analogue Control Unit with centralized monitoring which shall control all Analogue Addressable Detectors, Manual Call Stations and Switching Systems (for disconnecting AHU and power supply) connected to it.

All addressable units shall be connected to the Fire alarm control panel through the Loop Cards and shall be addressed through individual numbers.

The Fire alarm control panel shall be able to obtain analogue value for all detectors in the circuit through a pulsed digitalized current data.

The Fire alarm control panel shall be able to analyses all analogue inputs from all addressable units, and through its own software and ambient level screening the Fire alarm control panel shall be able to identify fire, possible fire or fault conditions.

The unit supervision shall be dynamic and continuous.

All the events occurring anywhere in building shall be captured in the Main Fire alarm panel provided in the IBMS room.

Also, the all the events capturing by Main Fire alarm panel should be repeated at repeater panel at security Gate.

The Fire alarm control panel shall also give adequate warning signal whenever there is dust accumulation in detectors.

It should be possible to change the level of ambient alarm calibration condition by the use of software program.

Short / Open circuit fault shall also be reported at the Fire alarm control panel.

In such cases, the system through the use of fault isolators shall be able to isolate that segment.

The missing Detectors/Devices shall also be reported at the Fire alarm control panel with identification of the location.

The Fire alarm control panel shall have the facility to set each smoke sensor sensitivity remotely.

It shall also be possible to set the sensitivity to a high level or low level based on night or day time.(time based sensing)

When an alarm condition is sensed at the Fire alarm control panel from a smoke or heat detector, a delay time/alarm verification period shall be started.

If the sensor is still in alarm after the delay time expires, an alarm condition is reported.

The delay time shall be adjustable from 0 to 990 sec's.

The Fire alarm control panel shall have the facility to perform walk test.

In the walk test mode, the performance of each device is checked out by initiating the device.

As each device is placed into alarm the Fire alarm control panel shall print the condition and automatically reset the device .

Audible devices shall be initiated, if required at a preprogrammed time.

If a zone is inadvertently left in walk test mode, it shall automatically reset to normal after the idle time is exceeded.

During the walk test the zones other than the programmed zones shall be under continuous supervision (normal mode).

In case of any alarm initiated by detector/devices the walk test shall get terminated automatically.

Programming functions shall include alarm/trouble type assignment, point descriptor assignment, alarm message assignment, etc.

Programming shall be carried out from the Fire alarm control panel keyboard or utilizing the authorized laptop/desktop computer software.

The Fire alarm control panel shall have a Liquid Crystal Display of Alphanumeric type.

The display should have high resolution, backlit 2 (lines) x 40 character/ or 2 Lines X 20 Characters or ¼ VGA.

In case of testing of the system from the Fire alarm control panel the Display shall be able to give readouts of analogue value of all detectors being tested.

Events login capacity shall be minimum 10000 events.

The Fire alarm control panel shall also be able to carry out continuous self-monitoring when in normal condition.

The Fire alarm control panel shall have either an in-built or external printer coupled to the Fire alarm control panel, which shall log all events with time.

The printout shall clearly indicate the event - Fire/Pre Alarm/Fault etc. With the unit address and time.

The Fire alarm control panel shall also be able to discriminate between false alarms and fire conditions.

The Fire alarm control panel shall carry out priority selection of alarm in case alarm activities in two or more remotely located units simultaneously. In such cases, the manual call stations shall have the highest priority.

The Fire alarm control panel shall also be able to actuate switches automatically in case of Fire condition that of AHU's and power supply or other systems such as piped pressurized gas supply /Access control doors.

The System shall be fail safe and adequate safe guards should be ensured that in the event of a failure of a part of the System it shall not handicap the complete System.

The agency shall be responsible for preparation and installation of System Software into the Fire Alarm Control Panel.

The Software shall be user friendly.

The system shall be secured against Software errors.

The system shall have the ability to be upgraded so as to incorporate more features at a later date.

The Fire alarm control panel shall have its own Battery Backup in normal run and in alarm condition as per IS 2189.

The back up time calculation shall be done as per relevant standards and produced for approval.

The Battery shall be 2*12V (24V) DC and of sealed lead acid rechargeable maintenance free type, housed inside the FACP.

The voltage rating shall be from 14V DC to 31V DC, though the voltage may be change.

The Fire alarm control panel shall be totally enclosed dust and vermin proof type.

The Fire alarm control panel shall be of completely solid state design.

The logic circuitry shall be based on high noise immunity solid state hardware employing modular construction.

The Fire alarm control panel shall have UL or VDS or EN54 approval.

The system shall be designed such that it shall be possible to add atleast 20% of the Detectors for future expansion without extra cost on the panel.

The Fire alarm control panel shall have provision for interfacing with the Public Address System through modules/ or as per manufacturers deisgn.

The panel should have the facility to interface with an automatic two channel programmable speech dialer for verbal reporting of fire through modules/ or as per manufacturers deisgn.

The fire alarm panel should be provided with IP integration card.

11.5 ADDRESSABLE DETECTORS

11.5.1 MULTISENSOR DETECTOR

All detectors shall be fitted with plug-in system type, from the maintenance and compatibility point of views.

An alarm condition should not affect a detector's good functioning.

After resetting the alarm, the detector shall resume operations without readjustment of any kind.

The detector shall have a Multi sensor type integrates photoelectric smoke and fixed temperature heat sensing technology.

It shall be possible to use a single detector type for both above and below false ceiling applications.

The detector shall be capable of detecting fast flaming fires and slow smoldering fires equally well.

The detector shall therefore be a multi technology detector or shall be of unique design whereby a single type/model can be used in applications where either ISD /OSD type would be normally used.

The detector shall be able to sense incipient fire by detecting the presence of visible and invisible products of combustion.

The detector shall be suitable for low voltage (between 13 to 31V DC) two wire supply.

The detector shall be provided with Single/Twin LED indication.

The sensitivity of the detector shall not vary with change in ambient temperature, humidity, pressure or voltage variation, air currents and should not trigger the false alarm due to the above condition.

The detector shall be suitably protected against dust accumulation/ ingress.

The detector shall be free from maintenance and functionally tested at periodic intervals.

All detectors shall be identical in construction design and characteristic to facilitate easy replacement and interchangeable by suitable programming.

The coverage per smoke detector shall strictly follow relevant standards.

The sensitivity of detector shall be set from the Fire alarm control panel to suit the site requirement.

11.5.2 HEAT DETECTOR

Heat detector shall go into the alarm mode when the temperature reaches 34degree Centigrade in normal course.

The operator (users) shall have the option of calling up the temperature measured by the specific detector as and when required.

It shall have in-built locking mechanism to check the removal and pilferage of the detector.

The quiescent current flow must not exceed 400 micro amps and alarm condition current shall be maximum 40 mill amps.

The heat detector shall be Analogue Addressable type and be able to send analogue output to the Fire alarm control panel regarding its condition.

It shall be able to communicate with the Fire alarm control panel by the pulses emitted from the Fire alarm control panel

The detector should be addressed through base/detector and address stored in a non-volatile memory within the sensor or by a decade switch.

The base of the Detector shall be electronics free and interchangeable with other smoke or heat detectors.

The enclosure shall meet as per the relevant protection grade.

The voltage rating shall be between 15V-30V DC though the voltage may be changed depending upon the working voltages of a proprietary FACP.

The Detector shall have UL/ VDS/ EN 54 approval.

It shall be possible to test the Detectors working both from the FACP as well as locally.

It shall be possible to mount the detectors in Duct Casting Unit for sampling of Supplying Air from the AHUs.

Secondary response indicators shall be provided for all the Above False Ceiling Detectors.

The detector shall have twin LED's/Single LED for 380/180 degree viewing angle.

LED on the detector shall blink each time the sensor is scanned by the Fire alarm control panel.

If the Fire alarm control panel determines that the sensor is in alarm, the Fire alarm control panel will command the sensor LED to remain on to indicate the same.

Each sensor shall be capable of being tested for alarm via command from the Fire alarm control panel

Each sensor shall respond to Fire alarm control scan with the information about its type for identification.

11.5.3 MANUAL CALL STATIONS

The Manual call station shall be breakable type/ pull type with suitable protection and base box.

The device shall be red in colour and suitable for surface or flush mounting.

Manual stations shall be interfacable to an addressable input module. The manual station shall have normally open fire alarm and enunciator contacts and these contacts shall close on activation. Contacts shall remain closed until station is manually reset.

The Manual Call Station shall be fully addressable with its own addressable module and operated by digitized signals from the FACP.

The voltage range shall be from 13V -31V.

11.5.4 SOUNDER

The sounder shall be addressable electronic type and shall give discontinuous/ intermittent audible alarm whenever any detector or call box operates.

The sounder shall be complete with strobe light module.

The sound output from the Hooter should not be less than 85 decibels at one meter.

The sounder shall be powered from Main Fire alarm control panel along the loop cable .

11.5.5 LPG detector: (Kitchen / Gas storage area)

- Induced gas : LPG
- Power Input : 9 to 13V DC
- Mounting type : ceiling
- Buzzer level : $\leq 40\text{dB/m}$
- Alarm density : 13% LEL
- Alarm mode : flash and sound alarm, shut off gas valve and network alarm signal
- Detector type : Suitable for integrating with the existing Fire alarm loop.

11.6 Fire Alarm System cable Specification for surface installation :

1	Size / No. of cores	2 Core x 1.5 sq. mm. armored PVC-FRLS cable
2	Conductor	Cu
3	Core Insulation	PVC Insulation
5	Inner Sheath	PVC
6	Outer Sheath	PVC FRLS
7	Color of Outer Sheath	Red

11.7 Fire Alarm System cable Specification for concealed installation :

1	Size / No. of cores	2 nos of 1.5 sq. mm. un armored PVC-FRLS wires
2	Conductor	Cu
3	Core Insulation	PVC Insulation
4	Inner Sheath	PVC
5	Outer Sheath	PVC FRLS
6	Color of Outer Sheath	Red

11.8 FIRE ALARM SYSTEM TESTING11.8.1 FACP:

The FACP shall be visually checked for input voltage and ampere. All zones one by one shall be de wired to check for fault signal indication in the FACP.

The Power Source shall be cut off and checked for stand by Supply from the Batteries. After six hours the FACP Source shall be switched on to check for auto switch over to the Mains mode.

Tests shall be conducted for AC fail, charger fail, DC fail, Battery Disconnect or Battery fail. In all such cases the relevant L E D should glow and the piezo sound shall also give sound output.

Low battery indication, fault indication should be made available at the panel.

11.8.2 SMOKE DETECTOR :

The testing shall be carried out for each loop / zone,

Initially one detector in a zone and subsequently 2 or more disassociated detectors in each zone shall be tested for Alarm Priority, Alarm Queuing and Call Logging with time lapse between detectors.

An identified detector shall be subject to smoke aspiration from burning paper/cigarette puffs, rubber and other materials which give dense smoke held at 0.3 m distance from the detector.

The FACP should indicate increased analogue output for that address and after the programmed delay time, a fire alarm signal shall be indicated. This delay shall be utilized for alarm verification.

11.8.3 HEAT DETECTOR :

The same tests in the same sequence shall be carried out for this detector but with the application of hot air from a hair dryer.

11.8.4 COMBINED TEST :

The combined test shall be in combination of Photoelectric / Heat Detectors simultaneously with time lapse between application of smoke or heat or as required by the client/consultant.

11.8.5 ADDITIONAL TEST:

One detector of each type will be disconnected and subjected to slow dust build - up by means as desired by the Consultant/client and again connected in the circuit.

Any part of the Loop shall be short circuited. The FACP shall indicate the communication failure of all the devices connected in the short circuited segment.

After the short circuit is corrected, the Fault Isolator shall return to its normal status automatically, this being reflected in the FACP.

The Loop shall then be in normal operation again. Any part of the Loop shall be de wired and tested as given above for open fault.

All other tests as required by the client at the time of handing over shall also to be conducted

11.9 Main Fire Alarm Control Panel at Main Block:

The Main Fire alarm panel located in the IBMS room shall have provision for integrating the all Fire alarm panel available in entire campus through RS 485 network communication protocol and same had been connect though building Network through optical fiber cable

11.10 Repeater panel:

The repeater panel construction shall be similar to the main panel. All the alarms and indications in the main panel shall be repeated in this panel. This panel shall be located in the Security Block

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SECTION – 12 : EMERGENCY VOICE EVACUATION (PA) SYSTEM

12.1 The Public Address System shall serve to

- a) Play the music
- b) Make general announcement
- c) Transmit fire tone under fire condition.

12.2 Different levels of priorities as per following shall be allotted to different signals for transmission through the same speaker.

- a) Emergency announcements - highest priority.
- b) Fire tone/Paging - Next
- c) Music - Least

12.3 For the purpose of PA system the zones are grouped into Four groups as follows:

- a. Group One: Corridors in Hospital Block & Radio Therapy block areas and shall have general announcement and paging services.
- b. Group Two: All area in Hospital Block & RT Block areas and shall have general announcement and paging services.
- c. Group Three: Car parking Area and other external common areas and shall have music, general announcement and paging services.
- d. Group Four: Fire Alarm Evacuation Message Board costing all Hospital premises and other external common areas and shall have music, general announcement and paging services.

12.4 All control consoles shall be placed in the IBMS room.

12.5 Announcement and background music shall be played from the BMS room and Repeater announcement console available in Security Block

12.6 A signal from FA panel shall initiate announcements of pre-recorded message in all the groups/zones in case of fire. This emergency announcement shall have highest priority.

12.7 The system shall have a chime module for paging.

The chime module shall generate two types of signals consisting of either a two-note chime or a single gong tone to capture attention before paging.

12.8 The speakers shall be distributed in the entire building and configured in different zones.

12.9 The announcement shall be made in Individual mode i.e. one zone at a time or to all zones simultaneously in ALL CALL mode.

12.10 Public Address system comprising of

- a) Metal Cabinet.
- b) Ceiling ring speakers
- c) Wall Mounted speakers.
- d) External Horn type speakers for Car Parking area
- e) Public Addressing Amplifiers
- f) Central Control Console.
- g) Repeater Zone selector Console 2nos for Security Block

All samples shall be produced for approval before placement of order.

12.11 Speakers :

1. Speakers shall be in metal enclosures with their line matching transformers. They shall be interconnected in the zone configurations.

2. The types of speakers to be used in various areas shall be as follows

- a. Lift lobbies and Corridor area 6W ceiling speakers.
- b. External -Horn Type Weather proof – 30 W
- c. Electrical room, Service room,AHU room etc – 6 W wall mounted speaker.

The Ceiling Speakers shall be as follows:

- a. The speaker shall be of high quality flush mount ceiling speaker.
- b. 6" dia suitable for max. of 3/6W/100V
- c. Metal grill with powder coated and attractive design.
- d. Tap selection with matching transformer – 1.5W/3W/6W

Column / wall mounted speakers shall be as follows:

- a. The speaker shall be with metal cabinet with suitable paint finish.
- b. Terminal strip at rear side for connections.
- c. 100V line matching transformer with 1.5W/3W /6W/10W/30W.

Horn type Speakers shall be as follows:

- a. The speaker shall be with horn type with suitable paint anti corrosion resistant finish.
- b. Terminal strip at rear side for connections.
- c. 100V line matching transformer with 1.5W/3W /6W/10W/30W.

12.12 Public Address Amplifiers :

1. These amplifiers shall be designed to accept the input sources i.e., Microphone/CD player/Fire tone generator.
2. The output is having a 100 Volts line to take care of line drop.
3. The Amplifiers shall be stacked in the rack system.
4. Tone control circuit is provided to alter the quality of the output as per the user's requirement.
 - a. Minimum 3 mic inputs
 - b. Minimum 2 Aux inputs
 - c. Resettable circuit breaker for protection against overload and short circuit
 - d. Tone controls : Bass and Treble
 - e. Amplifier Outputs for speakers– 4/3 ohm and 40/100V
 - f. Input power supply: 220-240V, 50 Hz

12.13 RACK ASSEMBLY :

1. Rack assembly shall stack the public addressing amplifiers.
2. Rack shall be factory wired and shall have different channels for AC mains cable and Audio signal Cables.
3. Rack shall be provided with wheels and with one lockable rear door.
4. The rack shall be operating on 230 VAC.
5. Internal power strip shall be provided.

12.14 CONTROL CONSOLE :

1. The heart of the entire public addressing system is the Console.
2. One microphone given for announcements.
3. The selection of Music or Announcements shall be done by console through a hardware or software switching facility.

4. The system shall make provision for dual channel output i.e both music and audio announcement shall be made for the entire system.
5. The control console shall make announcement such as Music, Fire one or announcements zone wise.
6. The console shall have keypads on a sloped surface. The switches are having respective LED's.
7. Construction materials shall be of Hard PVC.
8. Additional two repeater call station to provide in security operations
The different modes of transmission in P.A System are as follows:

12.15 MUSIC :

1. The music is through the CD Players can be fed to the amplifiers.
The music transmission is having the least priority.
2. If FIRE condition occurs, then the Alert tone overrides the music in the speaker.
3. In case any announcement is made, then the music will be stopped till the time of announcement and music shall continue after pressing key.
4. To play music a separate switch for MUSIC shall be provided and by operating this switch, the music is transmitted to all specified zones.

12.16 ANNOUNCEMENTS :

Announcements can be made through the microphone and by selecting the required zones.

Announcements can be made in following modes:

1. Individual mode
2. All Call mode

12.17 KEY SWITCHES :

The following key switches are provided for different operations.

- i) : Number Keys : 0 to 9 NUMBERS
- ii) : MUSIC

- iii) : ALLCALL
- iv) : RESET
- v) : ENTER

12.18 SYSTEM INTERCONNECTION :

- a. The speakers in each zone are connected in parallel and are connected to the relay and switching unit.

12.19 TECHNICAL SPECIFICATION :

1. CD Player - DVD/MP3
The Player shall be supplied with remote control and suitable for 220-240V AC supply operations. The system shall be capable of playing 'DIVX' files.
2. Dual auto reverse cassette deck

Type: Auto reverse 4 – track, 2 channel recording and playback setup, double cassette deck.

Heads : Recording/playback : Hard perm alloy

Erase : Double gap tenite

Motors : DC servo motors

Voltage : 220-240V AC and 12V/24V DC

12.20 WIRING:

- 12.21 Microphone level circuits, line level circuits, loudspeaker circuits and power circuits shall run in separate conduits. The conduits shall be medium duty PVC when run concealed and GI conduit when run exposed.
- 12.22 All audio lines, including microphone, line level and loud-speaker lines shall be floating with respect to ground, neither side of the audio lines shall be grounded. No equipment employing single ended input shall be used in the system. If equipment has a single ended input, it must be provided with an input transformer to provide for floating condition.
- 12.23 Cables for remote operations of call stations supply, laying, termination of CAT-6 E UTP cable with PVC pipe as per the technical specification for Repeater call station at security blocks (1&2) from main building PA rack.
- 12.24 Cables for both internal wiring and external connections shall be of high conductivity stranded annealed copper conductor. PVC insulated, Extruded PVC inner sheathed, overall extruded PVC sheathed conforming to applicable standard. Voltage grade, size, no. of cores and screening shall be consistent with circuit requirements and shall be furnished by the CONTRACTOR. All outdoor cables shall be armored with conduits.
- 12.25 The cables shall be run in cable trays in the communication shaft and in conduits up to the handsets/loudspeakers in all blocks. The installation of the external cables to be provide with cable trays and conduits shall be in line with the requirements given in the installation write-up.

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PREFERRED MAKES OF MATERIAL

Sr. No.	Description	Preferred makes
1.	HT VCB Panel	ABB / Siemens / Schneider Electric Infrastructure Ltd.(Areva) / L&T
2.	HT RMU	ABB / Siemens /Schneider / L&T
3.	Oil filled Transformer	Crompton Greaves / Schneider Electric Infrastructure Ltd. (Areva) / Siemens / Voltamp / Kirloskar Electric
4	Dry type Transformer	Schneider Electric Infrastructure Ltd. (Areva) / Voltamp / Kirloskar Electric / Raychem
5.	Package (Unitized) Substation	Schneider / ABB / Siemens / Schneider Electric Infrastructure Ltd.(Areva)
6.	HT Cable	Universal / Torrent / Polycab / KEI / Havells
7.	LT & HT Cable jointing kit	Raychem / 3M
8.	Compact Sandwich type Bus duct / Rising mains	Zucchini / L&T (Henikwon) / C & S
9.	LT Cable	Universal / Torrent / Polycab / Finolex / KEI / Havells
10.	Cable glands	Braco / Comet
11.	Cable Socket (Lugs)	Dowells / Gripper
12.	Terminal Strip / Connector	Connectwell / Elmex
13.	G.I Ladder/ Perforated Cable trays	OBO/ Indiana / Asian / Profab
14.	Wire mesh cable tray	Legrand / OBO
15	Al wall raceway / Floor raceway	Legrand / MK Electric /OBO / Profab
16.	Floor Access box & Pop up box	Legrand / MK Electric / OBO / Profab
17.	LT Panel	L&T / Siemens / Jackson / Arrow Engineers
18.	Air Circuit breakers	Schneider (Merlin Gerlin) / Siemens / ABB / L&T
19.	MCCB	Schneider (Merlin Gerlin) / Siemens / ABB / Legrand / L&T / (D-sine)

20.	Switch Disconnecter Fuse / Switch Disconnecter / HRC fuses	Schneider / Siemens / ABB / L&T
21.	MCB / MCB type isolator / ELCB /Timers / DB's	Legrand / Schneider / Siemens
22.	Power / Control Air break Contactors	Schneider / Siemens / ABB / L&T
23.	Numerical / Static / Electromagnetic Relays	Areva / ABB / L&T / Siemens/ Schneider/ Ashida / Alstom
24.	APFC Relay	Epcos / Beluke / Meher
25.	CT / PT	Kappa / AE / Pragati / ECS / Precise / Indcoil
26.	Analogue Ammeter / Voltmeter / P.F meter	AE / Rishab / L&T / Mecos / Imp
27.	Digital Panel meters	Conzerv / AE / Rishab / Schneider / L&T
28.	Energy meter / Trivector meter	Secure / ABB / L&T / Schneider
29.	Annunciation Panel	Minilec
30.	Indication Lamps (LED Heavy duty type)	Siemens / L&T(ESBEE) / Teknik / Schneider
31.	Push Buttons	Siemens / L&T(ESBEE) / Teknik / Schneider
32.	Selector Switches	Kaycee / Siemens / L&T (Slazer)
33.	Battery Flooded / SMF	Exide / Amar raja
34.	Battery Charger	Chabbi / Calydyne (Chloride) / Emerson/ Amar raja/ Universal
35.	Capacitors	Universal / Epcos / Meher
36.	PVC (HMS) Conduits & accessories	Precision Plastics / Modi
37.	G.I Conduits Pipe	AKG / Vimco / Bharat /Gupta
38.	FRLS PVC insulated Cu conductor Wires	Finolex /Polycab / Havells
39.	Modular Switches / Sockets	Legrand (Britzy) / Crabtree (Havells)
40.	Bell / Buzzer (with Polycarbonate enclosure)	Vinay

41.	Light fixtures	Philips / Wipro / Crompton Greaves / Bajaj / as per SOQ
42.	Lamps	Philips / Osram / GE
43.	Ceiling Fans	Crompton Greaves (High Speed) / Havells (Velocity) / Orient
44.	Exhaust Fans	Crompton Greaves / Havells / Almonard
45.	Industrial Switch sockets & Plugs	Legrand / Crompton Greaves / L&T/ Siemens
46.	Water Heaters	Racold / Crompton Greaves / Bajaj / Cascade/Ketko
47.	RG-6 & RG-11 Co-axial cables	Finolex / Delton/ RPG / Polycab
48.	Cat-6 UTP cable/Patch cords/connectors/Patch Panels / RJ-45 I/O	Systemax / Panduit / Legrand / Molex/ D-Link
49.	Optical fibre cable	Sterlite / Unifiex / Vindhya Telelinks / Aks / Finolex
50.	19" rack for LAN system	APW President / Rittal / Legrand / Valrack
51.	Telephone cable	Finolex / Delton / RPG / Polycab
52.	Telephone Tag Block (TTB) with enclosure	Krone / Pouyet
53.	Fire Alarm system detectors	Esser – Honeywell/ L&T- Schrack / Simplex / Bosch / Siemens / Edwards / Notifier/ Johnson Controls as per NFPA std.
54.	Fire Alarm Panel	Esser – Honeywell/ L&T- Schrack / Simplex / Bosch / Siemens / Edwards / Notifier/ Johnson Controls as per NFPA std.
55.	Break Glass station / Sounder strobe	Esser – Honeywell/ L&T- Schrack / Simplex / Bosch / Siemens / Edwards / Notifier/ Johnson Controls as per NFPA std.
56.	PA system equipment	Bosch / Ahuja / Honeywell / ATIES
57.	DVD players	Philips / Sony / Panasonic
58.	CCTV Cameras	Bosch / Honeywell
59..	Speech processor (Voice recorder)	VISONIC or approved equivalent

60.	D.G. set assembler	Powerica / Jakson / Sudhir / Kirloskar
61	Octagonal Poles & High Mast	Bajaj / Surya Roshni
62	Alternator for DG	Stamford (CGT) / KEC
63	Engine for DG	Cummins / Wartsila / Kirloskar / Caterpillar
64	Passenger Elevators	Otis / Schindler / Kone / Johnson / Mitsubishi
65	Acoustic enclosure for DG	Powerica/ Jakson / Sudhir / kirloskar
66	AMF panel	Powerica / Jakson / Sudhir / L&T / Siemens / Jakson / Arrow Engineers
67.	Fire Extinguishers	Minimax / Ceasefire / Safex
68	Octagonal Poles & High Mast	Bajaj / Surya Roshni
69.	UPS	APC/Emerson/Schneider/Numeric
70	Elevators	Otis / Schindier / Kone / Johnson / Mitsubishi / Omega
71.	Nurse Call system	MDD Medical / RD Plast/ System Tek/ Palm Technology
72.	Earthing Electrode	Ashlok/ Galaxy/ Universal
73.	Advanced Lightning Terminals	Erico / Indelec/ LPI
74.	Transient Voltage Surge Suppressor	OBO/ Phonix Contact/ Trinityt Touch.
75.	PLC	Allen Bradely/ Siemens/Schneider
76.	Pumps & pump sets	Kirloskar / mather & Platt / Becon / Crompton Greaves / Jyoti / Kalama / Shehara

Signature of Tenderer

Seal & Date