



OIL AND NATURAL GAS CORPORATION LIMITED

**REVAMPING OF LPG RAIL GANTRY & REVAMPING /
AUTOMATION OF ROAD GANTRY AT PRODUCT TERMINAL AT
ONGC, HAZIRA PLANT**

PART II

TECHNICAL BID DOCUMENT

ANNEXURE III - ELECTRICAL

DOCUMENT NO.

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**ESSAR PROJECTS (INDIA) LIMITED
ENGINEERING & PROJECT MANAGEMENT**

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CHAPTER NO – 3.1

SCOPE OF WORK



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1.0 INTRODUCTION

This specification is prepared for Electrical equipment required for the Revamping of LPG Rail Gantry & Revamping / Automation of Road Gantry at Product Terminal at ONGC, Hazira Plant.

2.0 SCOPE

- 2.1 The scope of LSTK Contractor shall include Design, Engineering, Procurement, manufacturing, shop fabrication, assembly, testing and inspection at supplier's works including stage inspection in presence of the Company representative, packing, dispatch, shipping, delivery/unloading at project site, for indigenous equipment, unloading and storing at site, insurance up to time of provisional take over, handling at site, complete erection, start-up, commissioning, successful performance testing and handing over of Electrical equipment required for the project.
- 2.2 For Brief scope of work please refer general technical requirement document in main section.
- 2.3 The job shall include all associated mechanical works and design and detail engineering of civil works required for the complete installation.
- 2.4 The job includes obtaining all statutory permissions, clearances and liaisoning with state/Local/central government authorities.
- 2.5 The job shall include Co-ordination with Different package Contractors for adequacy and completeness of system and equipment design.
- 2.6 The major equipment / systems included under scope of contractor's work shall be as following, but not limited to the same:
- 2.6.1 Extension of Existing PMCC-315 on both side with Air Circuit Breaker feeder to supply New MCC for additional loads/Consumers.
- 2.6.2 New MCC (415V Switchgear) to fed additional loads/consumers/systems covered under revamping work.
- 2.6.3 DC System (Battery, Battery Chargers & DCDBs) for Critical Lighting in control room area, switchgear room, rail and road gantry area
- 2.6.4 UPS System to supply new batch controllers under revamping job as well as existing UPS loads. This includes shifting of loads from existing UPS located near loading gantry to New



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UPS.

- 2.6.5 3 years extended warranty in addition to one year warranty for UPS system.
- 2.6.6 Earthing and Lightning Protection for the equipment/system covered under the job.
- 2.6.7 Illumination/Lighting System including;
- a. Replacement of 310 nos. FLP 160W MLL with 125 W, FLP, HPMV lamps with complete fitting, control gear and separate copper ballast.
 - b. Installation of 250 nos. 4 way lighting junction boxes with socket head arrangement.
 - c. Replacement / installation of 7 nos. of minimum 12 way FLP lighting distribution board with incomer arrangement of MCCB / MCB and MCB in outgoing circuit.
 - d. Replacement of 6 nos. 250 W FLP HPMV lamp fitting with control gear with copper ballast.
 - e. Installation of 2 nos. 30 meter high mast (identical to the existing high masts) light with 2 X 400 W, HPSV, 18 nos. light fittings with flame proof lighting feeders for road gantry. PCC area shall be approximate 75 sq. mm. around high mast and it shall cover feeder pillar also. Each Lighting mast shall be fed through separate lighting transformer.
 - f. Shifting of the existing power source for lighting in the Gantry area from existing location to the new MLDB located at new control room.
 - g. New MLDB with 2X100% rated lighting transformers to supply lighting loads in new control room and in existing gantry area.
- 2.6.8 LV Power & Control cables as following;
- a. For all New equipment covered under scope
 - b. Between equipment and source where either source or equipment will be relocated to meet project requirement.
- 2.6.9 Cable carrier system including cable trays, cable tray support, cable tie, cable tray cover, etc., for the cables in scope.
- 2.6.10 Flame proof welding and lighting receptacles in rail gantry and road gantry area.
- 2.6.11 Extension of existing Fire detection and Alarm system for new control room and switchgear room with required cards and detectors.
- 2.6.12 Electrical Miscellaneous items including Junction boxes (JB), local push button station, Cable termination kits, jointing kits, cable glands and lugs, Cable trays, safety rubber mate, fire proof cable sealing system, Erection material etc.
- 2.6.13 Special tools and tackles required for installation, commissioning, operation and maintenance of



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electrical equipment included in scope.

- 2.6.14 Measuring equipment for AC & DC supply measurement, IR measurement, Lux level measurement – 04 Set
- 2.6.15 Mandatory spares for 01 years of trouble free operation of the equipment supplied.
- 2.6.16 Essential and Start-up spares
- 2.6.17 Erection hardware including but not limited up to touch-up paints, foundation bolts, Support structure, nut, bolt washers, clamps etc. required for successful erection of supplied equipment or system, whether specifically mentioned or not mention in equipment specific specifications attached under various annexure. Foundation bolts shall be supplied well in advance to facilities civil work progress at site.
- 2.6.18 Type tests – Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier (up to 5 years earlier only) on similar rating of equipment shall be furnished. Type testing shall be conducted without any cost implication to the purchaser if type testing is not already carried out for any equipment supplied. For the various bought out items test certificates from equipment manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards whether specifically mentioned or not. Specific type tests are to be carried out as specified in individual equipment specifications enclosed under various annexure. The charge of carrying out each type test/ special test, if any, shall be given separately.
- 2.7 The scope shall include preparation and submission of all required drawings including Electrical equipment layout, Cable tray/trench layout, Earthing and lightning layout, Equipment installation drawings, etc., for Company approval.
- 2.8 Studies: Studies including Relay Setting calculations relay Co-ordination studies, furnishing recommended relay settings, insulation Co-ordination studies, short circuit studies, largest motor starting study for the system in scope.
- 2.9 The scope shall include preparation of Cable and interconnection schedule where either end or one end equipment are supplied by Contractor.
- 2.10 The scope shall include submission of design calculations for all equipment supplied by Contractor.
- 2.11 Scope of work includes drawings & documents required to prepare for submission to local authorities for various approvals or as a part of statutory requirement as per local regulations.



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- 2.12 Data Sheets for all equipment shall be included in the Contractors scope and shall be submitted to Company for approval.
- 2.13 Test Reports which include type test, special test and routine tests at manufacturing works and site shall be submitted after completion of inspection of all the equipment to Company. QAP, FQP for all equipment shall be submitted for approval.
- 2.14 The technical requirement of the plant equipment involved as per the scheme is covered in appropriate sections of this specification

3.0 TERMINAL POINTS

- 2.1 For 415V System: At Existing PMCC-315 panels for Extension of bus-bar.

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CHAPTER NO – 3.2

GENERAL ELECTRICAL REQUIREMENT



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1.0. GENERAL REQUIREMENT:

- 1.1. The design, manufacture, assembly, shop testing, erection, testing & commissioning as well as performance of the equipment shall conform to the latest edition of relevant IS standards, IEC & IEEE specifications.
- 1.2. Grid code, Indian Electricity acts and CEA guidelines are applicable for design and selection of equipments. All equipment supplied and all work carried out including design and detailed engineering shall comply with the statutory requirements of the Government of India, the Government of Gujarat, the Indian Electricity Rules and all other statutory bodies as applicable for the plant location.
- 1.3. The engineering, design and the installation shall be in accordance with the latest revision of Project Specifications and the established codes, sound engineering practices and must conform to the statutory regulations applicable in the country.

The current version of following statutory regulations shall be followed:

- a) Indian Electricity Act, 2003
 - b) Indian Electricity rules, 1956
 - c) The Petroleum rules , 1976
 - d) Requirements of other statutory bodies e.g. CEA / State Electrical Inspectorate, OISD, PESO, as applicable
- 1.4. Before starting manufacture of any equipment the Contractor shall have to take approval of relevant drawings and data from the Company.
 - 1.5. Makes of all Electrical equipment are subject to prior approval by the purchaser. Similar equipment and components shall be of same make. Equipment of same type and rating shall be interchangeable.
 - 1.6. Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Type testing shall be conducted without any cost implication to the purchaser if type testing is not already carried out for any equipment supplied. For the various bought out items test certificates from equipment manufacturer shall be furnished. Specific type tests / Special tests are to be carried out as specified in individual equipment specifications.
 - 1.7. Unless otherwise specified in the respective section, Electrical design ambient for all equipment sizing shall be considered as 50°C. For specific hot areas, the ambient temperature conditions



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shall be taken into consideration and equipment suitably derated where necessary. In hot areas of higher temperature conditions, the equipment shall be adequately protected against damage from radiant heat and hot air.

- 1.8. Unless otherwise specified, at least 20 % margin shall be considered in equipment sizing over and above the calculated load current, fault current and power requirements.
- 1.9. Unless specified in respective sections, all electrical equipment shall be suitable for voltage variation of $\pm 10\%$, Frequency variation of $\pm 5\%$ and combined voltage and frequency variation of 10%.
- 1.10. For the load estimation, Load factor shall be considered 0.8 for continuous load and 0.3 for intermittent loads.
- 1.11. Motor shall be capable of starting and accelerating the load with the DOL starting without exceeding acceptable winding temperature when supply voltage is 85% for LV motors.
- 1.12. In Switchgear for Motor feeders rated 30kW & above an ammeter & transducer shall be provided. All transducers will be of dual output type.
- 1.13. LT motors of rating below 100kW shall be controlled by air break, electromagnetic type contactors, backed up by MCCB. Motors of rating 100kW and above shall be controlled by breakers.
- 1.14. Spare contacts of breakers and relays shall be wired up to feeder terminal. Minimum 2NO+2NC contacts shall be provided for future use by Company.
- 1.15. Size of power cables shall not be less than 2.5sq.mm for copper and 6 sq. mm. for aluminum. For CT circuit, minimum cable size shall be 2.5sq.mm copper. Minimum size of control cables shall be 1.5sqmm copper. 20% spare cores shall be provided in all control cables. The maximum no. of cores shall be limited to 27.
- 1.16. Voltage Levels shall be as follows:

DESCRIPTION	VOLTAGE	PHASES/WIRES	AC FREQUENCY/ DC	SYSTEM EARTHIN G METHOD
Plant utilization	415V	3Ph, 4W	50 Hz	Solid

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Electric motors:

Motor rated above 0.18kW up to and including 160 kW	415 V	3Ph, 3W	50 Hz	--
Motor rated below and including 0.18 kW	240 V	1Ph, 2W	50 Hz	--
Lighting, small power, etc.	415V / 240 V	3Ph, 4W & 1Ph, 2W	50 Hz	Solid
Hand lamps	24 V	1Ph, 2W	50 Hz	--
LV contactor feeders (Control & metering)	230 V (UPS)	1Ph, 2W	50 Hz	Solid
LV Circuit Breaker feeders- Closing, Trip, Protection, Auto transfer schemes	230 V (UPS)	1Ph, 2W	50 Hz	Solid
C.B. Spring Charging Motor LV Boards	240 V	1Ph, 2W	50 Hz	Solid
F&G,SG systems,	230 V (UPS)	1Ph, 2W	50 Hz	Solid
Batch Controllers system	110V (UPS)	1Ph, 2W	50 Hz	Solid
Critical lighting in Control room & substation	110 V	2W	DC	--

1.17. Design short circuit level shall be as follows:

a)	Three phase symmetrical short circuit ratings of 415V System	:	50 kA for 1 sec
b)	Short circuit rating of 240V AC System	:	20 kA for 1 sec
c)	Short circuit rating of 110V DC System	:	25 kA for 1 sec


1.18. Insulation level at various voltages shall be as follows:

415V Systems

One minute Power Frequency withstand voltage: 3kV (RMS)

1.19. Assumptions to cover lack of information are not allowed. Contractor is obliged to obtain reliable information from Company.

1.20. In case of any conflict/contradiction between the requirement of referred standards/this specification/Datasheets and statutory regulation, following order of priority shall govern,

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1. Statutory Regulations
2. Datasheet provided by Company
3. This Specification
4. Referred Codes and standards

1.21. The Contractor shall establish an identification numbering system to provide consistent numbering throughout the generating unit. All electrical devices, control and instrumentation equipment, and other items of similar nature shall be permanently identified with the identification number. The Contractor's identification numbers shall be included on the project drawings.

1.22. Unless specified in respective sections, Paint shade for all electrical equipments shall be RAL 7032.

2.0. AREA CLASSIFICATION AND EQUIPMENT SELECTION:

2.1. All the areas within the battery limits shall be classified for the degree and the extent of hazard from flammable material. The basis for hazardous area classification recognizes the differing degrees of probability, with which flammable atmosphere may arise in installation, in terms of frequency of occurrence and the probable duration of existence on each occasion.


2.2. The area classification shall show the sources of gas explosion hazards.

2.3. The selected electrical apparatus shall be adequately protected against corrosive and solvent agencies, water ingress, thermal and mechanical stresses as determined by the environmental conditions.

2.4. Following factors shall be considered for proper selection of electrical equipment in hazardous area.

- Area classification
- Gas Classification
- Dust classification
- Temperature Classification, The ignition temperature of the gas or vapor present in the area or the lowest value of the ignition temperature if more than one combustible material present.
- The selected electrical equipment shall be adequately protected against corrosive atmosphere if present, water ingress or from thermal & mechanical stress.

2.5. General guidelines for type of protection for electrical equipment in hazardous areas are enumerated below in Table1.

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- 2.6. The area classification shall be in accordance with IS: 5572 & OISD- 113. For undefined cases the IEC 60079 and/or API RP 500 shall be applied.
- 2.7. In the presence of combustible dust IS-15142 shall be used as a guide line for area classification & selection of electrical equipment.
- 2.8. The electrical equipment and installations shall be selected for suitability of use in the classified areas in accordance with IS: 5571.
- 2.9. It is recommended that, where reasonable practicable, electrical apparatus in general, switch and control apparatus in particular shall always be installed in safe area. All materials installed inside a hazardous area:
 - Shall be certified by CIMFR/ CPRI/ ERTL or equivalent recognized independent test house such as BASEEFA/ LCIE/ PTB/ UL/ FM.
 - Shall have valid statutory approvals i.e. CCOE/ DGMS as applicable for use in specified hazardous area.
 - Shall have valid BIS marking and license as required by statutory authorities.


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TABLE: 1
ADEQUATE TYPES OF PROTECTION

AREA CLASSIFICATION	DESCRIPTION	SYMBOL
Zone 0	Intrinsic safe category "ia"	ia
	Other electrical apparatus, specifically designed for zone 0	S
Zone 1	Any type of protection adequate for zone 0 (not preferred)	
	Flameproof enclosure	d
	Intrinsic safe category "ib"	ib
	Oil immersion(see note 2)	o
	Pressurization (see table 2)	P
	Sand filling	q
Zone-2	Other electrical apparatus specifically designed for zone 1	s
	Any type of protection adequate for zone 0 or zone 1 (not preferred)	
	Increased safety (see note 1)	e
	Non sparking apparatus (see note1)	n

Notes:

- For all outdoor installations, including the apparatus with type of protection "e" and type of protection "n", the degree of protection shall be in accordance with section 8.
- Oil-immersed apparatus may be used only in case its security will not be impaired by tilting or vibration of the apparatus.
- Selection of electrical equipment in classified area shall be as per the specification related to the area classification drawings.



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TABLE-2
MINIMUM ACTIONS ON FAILURE OF PROTECTIVE GAS FOR TYPE OF PROTECTION "P"

AREA CLASSIFICATION	ENCLOSURE DOES NOT CONTAIN IGNITION CAPABLE APPARATUS	ENCLOSURE CONTAINS IGNITION CAPABLE APPARATUS
ZONE 1	Alarm	Alarm and switch off
ZONE 2	No action required	Alarm

3.0. CODES AND STANDARDS

INDIAN STANDARDS:

IS: 325	Three-phase Induction Motors (non-mandatory)
IS: 732	Code of practice for Electrical wiring Installation.
IS:1255	Code of Practice for Installation and Maintenance of Power Cables up to and including 33 KV Rating.
IS: 1554	PVC Insulated (Heavy Duty) Electrical Cables (parts I and II).
IS: 1646	Code of Practice for Fire Safety of Buildings (General).
IS: 1777	Industrial Luminaire with Metal Reflectors.
IS:1944	Code of Practice for Lighting of Public Thoroughfares(Part I,II)
IS:1944	Code of Practice for Lighting of Public thorough fares (part V)
IS: 2148	Electrical Apparatus for Explosive Gas Atmospheres-Flameproof Enclosure-"d".
IS: 2206	Flameproof Electrical Lighting Fittings (Part 1).
IS: 2206	Flameproof Electrical Lighting Fittings (Part 2).
IS: 2309	Code of Practice-Protection of Buildings and Allied Structures against Lightning.
IS:3034	Code of Practice for Fire safety of Industrial Buildings Electrical Generating and Distribution Stations.
IS: 3043	Code of practice for Earthing.
IS: 3646	Code of Practice for Interior Illumination (Parts I, II and III).
IS: 4012	Dust-proof Electric Lighting Fittings.

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IS: 4013	Dust-tight Electric Lighting Fittings.
IS:4722	Rotating Electrical Machines (non-mandatory)
IS: 5571	Guide for Selection of Electrical Equipment for Hazardous Areas.
IS:5572	Classification of Hazardous Areas (other than Mines) having Flammable Gases and Vapours for Electrical Installations.
IS: 6381	Electrical Apparatus for Explosive Gas Atmospheres-Increased safety "e"
IS: 6665	Code of Practice for Industrial Lighting.
IS:7098	Cross- linked polyethylene Insulated PVC Sheathed Cables (Parts I, II and III)
IS: 8224	Electrical Lighting Fitting for Division 2 Areas.
IS: 9334	Electric motor-operated Actuators.
IS:10028	Code of Practice for Selection, Installation and Maintenance of Transformers (parts I, II and III).
IS:12360	Voltage Bands for Electrical Installations, including Preferred Voltage and Frequency
IS: 13234	Guide for Short-circuit Calculations in Three-phase systems.
IS: 13346	General Requirements for Electrical Apparatus for Explosive Gas Atmospheres.
IS:13408	Code of practice for the Selection, Installation and Maintenance of Electrical Apparatus for Use in Potentially Explosive Atmospheres (other than mining applications or explosive processing and manufacture).
IS: 5	Colors for ready mixed paints and enamels
IS: 1248	Direct acting indicating analogue electrical measuring (Part 1, 2, 4 and 9) instruments and their accessories
IS: 2147	Degree of protection provided by enclosures for low voltage switchgear and control gear
IS: 3700	Essential ratings and characteristics of semi-conductor devices (Part 1 to 11)
IS: 3715	Letter symbols for semi-conducting devices (Part 1 to 4)
IS: 441 1	Code for designation of semi-conductor devices.
IS: 5001	Guide for preparation of drawings of semi-conductor devices and (Part 1& 2): integrated circuits.
IS: 5469	Code of practice for the use of semi-conductor junction devices (Part 1 to 3)
IS: 7204	Stabilized power supplies D.C. output (Part 1 to 4)
IS: 12021	Control transformers for switchgear and control gear for voltages not exceeding 1000V AC



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IS: 13314	Solid state inverters run from storage batteries
IS: 13703	Low voltage fuses for voltage not exceeding 1000V AC or 1500V DC (Part 1 to 4)
IS: 13947	Specification for low voltage switchgear and control gear (Part-41 Sec-1)
SP-30	National Electric Code – BIS Publication
OISD-STD-110	Recommended practices on static electricity
OISD-STD-113	Classification of Area for Electrical installation at Hydrocarbon and Handling facilities
OISD-STD-147	Inspection and safe practices during electrical installations
OISD-STD-149	Design Aspects for safety in Electrical Installations
OISD-STD-173	Fire Protection System for Electrical Installations
OISD-STD-180	Lightning Protection

INTERNATIONAL STANDARDS:

API RP 500	Recommended Practice for Classification of Locations for Electrical Installations at Petroleum Facilities.
API RP 651	Cathodic Protection of Aboveground Petroleum Storage tanks.
ANSI/EIA/TIA 329-B	Minimum Standards for Communication Antennas part I ,Base Station Antennas
ANSI/EIA/TIA 603	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
BS EN 13636	Cathodic protection of buried metallic tanks and related piping
NACE RP0169	Standard Recommended practice; Control of External Corrosion on Underground or submerged Metallic Piping System
NACE RP0186	Standard Recommended Practice - Application of Cathodic Protection for External Surfaces of Steel Well Casings.
NACE RP0193	Standard Recommended practice, External, Cathodic Protection of on-grade Metallic Storage Tank Bottom
NACE RP0290	Standard Recommended Practice; Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structure
NACE RP0388	Standard Recommended Practice; Impressed Current Cathodic Protection of Internal Submerged Surface of Steel Water Storage Tanks

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IEC 60034	Rotating Electrical Machines
IEC 60050	International Electro technical Vocabulary
IEC 60071	Insulation Coordination
IEC 60073	Basic & Safety Principle for man-machine Interface, marking & identification-coding principle for indicators & actuators.
IEC 60076	Power Transformers
IEC 60079	Electrical Apparatus for Explosive Gas Atmospheres
IEC 60083	Plugs and socket.
IEC 60099	Surge Arresters.
IEC 60120	Dimensions of Ball and Socket Coupling of String Insulator Units
IEC 60182	Preparation of documents used in electro-technology
IEC 60204	Safety of machinery - Electrical equipment of machines.
IEC 60227	Polyvinyl Chloride Insulated Cables of Rated Voltages up to and including 450/750 V
IEC 60309	Plugs, Socket Outlets and Couplers for Industrial purposes.
IEC 60332	Tests on Electric and Optical Fibre Cables under Fire Conditions
IEC 60364	Low Voltage Electrical Installation.
IEC 60383	Insulators for overhead lines with a nominal voltage above 1000 V. Ceramic or glass insulator units for a.c. systems - Definitions, test methods and acceptance criteria
IEC 60433	Insulators for overhead lines with a nominal voltage above 1000 V-Ceramic Insulator for AC System-Characteristic of Insulator units of Long rod type.
IEC 60439	Low-voltage Switchgear and Control Gear Assemblies
IEC 60489	Methods of Measurement for Radio Equipment used in the Mobile -Services
IEC 60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC 60546	Controllers with analogue signals for use in industrial-process control systems.
IEC 60549	High-voltage fuses for the external protection of shunt power capacitors
IEC 60623	Secondary cells and batteries containing alkaline or other non-acid electrolytes - Vented nickel- cadmium prismatic rechargeable single cells.
IEC 60688	Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals
IEC 60815	Selection and dimensioning of high-voltage insulators for polluted conditions.
IEC 60831	Shunt power capacitors of the self-healing type for a.c. systems having a rated voltage up to and including 1000 V
IEC 60871	Shunt Capacitors for AC Power Systems having a Rated Voltage above 1 kV
IEC 60896	Stationary Lead-acid Batteries.
IEC 60931	Shunt capacitors of the non-self-healing type for AC power systems having a



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	rated voltage up to and including 1000 V
IEC 60947	Low-voltage Switchgear and Control Gear
IEC 61000	Electromagnetic Compatibility.
IEC 61089	Round Wire Concentric Lay Overhead Electrical Stranded Conductors
IEC 61260	Electro-acoustics - Octave-band and fractional octave-band Filter.
IEC 61558	Safety of power transformers, power supplies, reactors and similar products
IEC 62271	High-voltage Switchgear and Control gear
IEC 61007	Transformers and Inductors for use in Electronics and telecommunication equipments.
IEC 61085	General considerations for Telecommunication service for Electric Power System
IEC 60146	Semiconductor Converters-
IEC 60445	Identification of equipment terminals and conductor terminations numeric System
IEC 60446	Identification of Conductors by Colors or Numerals
IEC 60478	Stabilized Power Supplies, DC Output
IEC 60686	Stabilized Power Supplies, AC output
IEC 61000-4	Electromagnetic Compatibility (EMC) Part 4-2 Testing &measuring techniques
IEC 62040-1-1	Uninterruptible Power System (UPS) Part 1-1 General and safety requirements for UPS used in operator access areas
IEC 62040-1-2	Uninterruptible Power System (UPS) Part 1-2 General and safety requirements for UPS used in restricted access locations.
IEEE 519	IEEE recommended practices and requirements harmonic control in electrical power system.

4.0. POWER DISTRIBUTION PHILOSOPHY

- 4.1. Main source of power supply for the revamping project shall be arranged by extending the existing PMCC-315 located at SS-9. One no. of ACB feeder with all necessary protection and metering will be installed on each bus of PMCC-315. These additional feeders will supply power to new 415V MCC. If required, dummy panel for coupling with existing busbar of PMCC-315 shall be envisaged. Necessary copper flexible busbar with same rated current and short circuit capacity as PMCC-315 shall be provided for coupling with extension panel.
- 4.2. A New 415V MCC shall be provided to cater additional loads. This 415V MCC will be provided with two incomers and a bus coupler with auto and manual changeover facility without power interruption. This 415V MCC shall be located in new control room.
- 4.3. From New 415V MCC, 2 nos. outgoing feeder shall be provided for lighting transformer/MLDB to cater lighting loads in control room, surrounding area, rail and road gantry area.
- 4.4. From New 415V MCC, 2 nos. outgoing feeders shall be provided for lighting transformers of


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new high mast lights. Lighting transformers shall be Dry type, panel mounted.

- 4.5. From New 415V MCC, Required necessary nos. of motor feeder for sump pump etc. shall be provided.
- 4.6. From New 415V MCC, 4 nos. (2 nos. for 110V AC and 2 nos. for 230V AC) outgoing feeder shall be provided for 2x100% redundant UPS. Bypass supply (stabilizer incomer) for both the UPS shall be provided from S/S-3.
- 4.7. 110V AC and 230V AC, both the UPS shall be 2x100% hot redundant. These UPS system will fed new batch controllers under revamping job as well as existing UPS loads. Shifting of loads from existing UPS located near loading gantry to New UPS system shall be carried out with minimum shutdown time.
- 4.8. UPS shall be feeding the 110V & 230V UPS DBs. These UPS DBs shall be supplying the power to respective loads in the field/gantry area.
- 4.9. Required number of outgoing feeders for welding receptacles shall be provided from new MCC. Minimum two welding receptacles shall be provided in road gantry area. in rail gantry area, welding receptacles shall be provided at every 40 meters.

5.0. QUALITY ASSURANCE, TESTING & INSPECTION

- 5.1. All materials, components and equipment covered under this specification shall be procured, manufactured, erected, tested, and commissioned at all the stages, as per approved Quality Plan.
- 5.2. All tests shall be conducted as per relevant IS standards, IEC/IEEE standards and shall be performed in the presence of purchaser's representative, if so desired by the purchaser. The Contractor shall give at least 15 days advance notice of the date when the tests are to be carried out.
- 5.3. Equipment offered shall be of type tested and proven type. Type test certificates for test conducted earlier on similar rating shall be furnished. Type testing shall be conducted without any cost implication to the purchaser if type testing is not already carried out for any equipment supplied. For the various bought out items test certificates from equipment manufacturer shall be furnished. Routine tests shall be carried out for all the equipment as per applicable standards whether specifically mentioned or not. Specific type tests are to be carried out as specified in individual equipment specifications.

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5.4. Copies of certified reports of all tests carried out at the works shall be furnished. The equipment shall be dispatched from works, only after receipt of Purchaser's written approval of the test reports.

5.5. The charges for carrying out all routine tests shall be deemed to be included in the Bid price. The charge of carrying out each type test/ special test if any shall be given separately.

6.0. MAKE AND INTERCHANGEABILITY


The make of major equipment shall be limited to preferred makes indicated in List of preferred (approved / recommended) makes. If the

Contractor prefers to supply other than from the Preferred Makes list, it should be with the prior approval of the Company.

Makes of all other equipment and accessories are subject to prior approval by Company and shall be without commercial / delivery implications.

Similar equipment and components shall be of same make, equipment of same type and rating shall be interchangeable.

Company has the option of selecting the manufacturers of electrical equipment, instruments and controls and any other specialized items in the interest of standardization and the Contractor shall have to supply equipment of the particular make, if so required.

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CHAPTER NO – 3.3

LV SWITCHGEAR



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1.0 General Requirement:

MCC shall be of 3-phase 4 wire system type suitable for solidly earthed system.

Power will be fed to various Motors, lighting transformers and UPS panels from this PMCC.

Switchgear shall be provided with two bus sections, two incomers & a bus coupler rated for 100% of the loads connected to the switchgear. Incomer & outgoing feeders of this PMCC shall be as per the attached Key one line diagram, Drg. No.- 9242-M-GAN-ELE052-00001.

The incomer, bus coupler and bus bar rating of all 415V switchgears/MCCs getting power supply feed from switchgear shall be rated for full load current of the entire connected load plus 20% margin, rounded off to the next standard rating. This shall also include the full load currents of the spare feeders. Incomers, bus bars & bus coupler shall be same rating.

An appropriate load factor with a minimum of 0.8 for continuously running loads & 0.3 for intermittent loads shall be considered for load estimation. The rating established shall also take into account the load variations that may occur during the course of detailed engineering. Diversity on incomer & bus bar sizing shall not be applicable. Required de-rating factors shall be considered while sizing the bus bars & breakers for switchgears. The sizing selected shall be such that the currents shall be carried safely by the bus bars & breakers inside the panel without injurious temperature rises, considering a design ambient temperature of 50°C. EPC Contractor shall submit calculations for bus bar sizing.

Control, protection, metering and protection requirement shall be followed as shown in typical Schematic of various feeders in following drawings as a minimum requirement,

- 2.6.1 9242-M-GAN-ELE056-00002
- 2.6.2 9242-M-GAN-ELE056-00003
- 2.6.3 9242-M-GAN-ELE056-00004
- 2.6.4 9242-M-GAN-ELE056-00005
- 2.6.5 9242-M-GAN-ELE056-00006
- 2.6.6 9242-M-GAN-ELE056-00007
- 2.6.7 9242-M-GAN-ELE056-00008
- 2.6.8 9242-M-GAN-ELE056-00009

2.0 Type of Construction:

2.1 All PMCC's & MLDB's shall be of free standing self-supporting structure. Enclosure protection shall be IP 42 with gasketed doors for indoor cabinets.



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- 2.2 For outdoor electric panels and junction boxes installed locally (in the field) enclosure protection shall be IP 55 (If needed).
- 2.3 All 415 volts switchgear panel shall be of single front.
- 2.4 All the ACB panels shall be provided with draw-out modules and all other LV switchgear modules (all MCCB/MPCB incoming & outgoing feeders) shall be of FIXED type modules only.
- 2.5 All the panels located in electrical room & field mounted shall be painted with shade RAL 7032.
- 2.6 The outgoing motor feeders shall be DOL and the rating shall be as per the attached SLD, Drg. No.- 9242-M-GAN-ELE052-00001.
- 2.7 Space Heater suitable for 230V, I Phase 2Wire, AC of suitable rating will be provided for Motors of rating 30kW and above. 10A SPN MCB shall be provided in MCC for Motor Space Heater. (Proper interlock shall be given so that Motor Space Heater will be 'ON' only when Motor is OFF)
- 2.8 The panel space heater and motor space heater shall be of 240 V AC, 1 Phase shall be separated out from the control supply for motor starter.
- 3.0 Busbars:**
- 3.1 The horizontal and vertical bus bars shall be of Aluminium, adequately sized to withstand mechanical and short circuit forces. The insulation for bus bars shall be heat shrinkable FR PVC sleeves.
- 3.2 The maximum rating of the main horizontal busbars in MLDB's, PDB's and other freestanding panels shall be preferably limited to 800 amps. The maximum rating of vertical busbars shall be limited to 300 amps.
- 4.0 Arrangement of internal wiring:**
- 4.1 All internal wiring shall be of FRLS stranded copper conductor PVC insulated 1100 V wires of adequate size. The minimum conductor size for power circuit shall be 2.5 sq mm and that for control circuit shall be 1.5 sq mm.
- 4.2 Each wire shall be marked with the wire number in accordance with the wiring diagrams at both ends by white marking strips.

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4.3 All wiring shall run in the plastic wire ducts.

4.4 The following color code shall be used for the wiring:-

WIRES / CONDUCTORS	COLOR
Three Phases	Red, Yellow, Blue
Line, Load & Control Circuits at line voltage	Black
AC Control Circuits	Red
DC Control Circuits :	
Positive	Blue
Negative	Blue with white stripe
Neutral	Black
Ground	Yellow Green
Interlock control circuits wired from an external power source	Yellow

4.5 In case color coded cables for power are not available, cables having black color insulation with printed numbers shall be used

5.0 Cable entry and terminations:

5.1 All switchgear panels shall have bottom cable entry.

5.2 The terminal blocks shall be physically grouped and located suitably for termination of the cables.


5.3 All terminal blocks shall be furnished with white marking strips marked with terminal numbers in accordance with the wiring diagrams.

5.4 Terminal blocks in all draw-out units shall be furnished with pull apart terminals to connect all outgoing wires.

5.5 The terminal blocks shall be furnished with minimum 20% spare terminals.

5.6 All spare contacts of relays / Contactors shall be wired up to the terminal block.

6.0 Grounding

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- 6.1 Each switchgear panel shall be provided with continuous ground bus bar of uniform size at the bottom of the panel.
- 6.2 Each wall mounted non-power distribution panel as well as each junction box shall be provided with grounding post.
- 6.3 All non-current carrying metal parts of each panel shall be effectively connected to the ground bus bar or grounding post at two separate points.
- 6.4 All grounding bus bar shall be copper not less than 75 mm² (3mm x 25 mm).

7.0 Control Circuits

The control supply for switchgear panels shall be through suitable sized 415/240 volt Control transformer. The panel and motor space heater supply shall be derived internally from incoming supply to switchgear.


8.0 Interfacing to PLC/DCS:

- 8.1 All electrical panels shall be furnished with separate terminal blocks for connections to PLC/DCS or other instrument panel.
- 8.2 Each and every shipping section of the PMCC & MCC's verticals, shall be furnished with separate marshalling compartment furnished with terminals or interconnections to PLC through multicored control cables. Internal wiring between all the outgoing feeders and marshalling compartment in every shipping section are factory pre-wired. Separate terminal strips & cables for indication, PLC/DCS start / stop (Hard wired).

9.0 Switches, Circuit breakers, Contactors, etc.

- 9.1 In PMCC's all outgoing feeders to MCC's shall be provided with Moulded Case Circuit Breakers (MCCB's) of applicable current ratings.
- 9.2 Incomer of the New MCC panel and the outgoing of the existing panel (extension of the existing PMCC-315 panel) shall be provided with ACB (Air Circuit Breaker) as per attached SLD.
- 9.3 Utilization category of contactors shall be AC-3. Utilization category of load break switch shall be AC-23.

10.0 Protective Relays:

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For motor feeders, the natures of the protective devices to be provided are as follows:-

- 10.1 For all the motors upto and including 30 kW , Motor Protection Circuit Breakers (MPCB's) with air break contactor that are suitable for Type – 2 co-ordination shall be provided.
- 10.2 For all the motors 30 kW & above and upto & including 200 kW, Moulded Case Circuit Breaker (MCCB), air break contactor and Bi-metal thermal overload relay with single phasing preventor (SPP) that are suitable for Type – 2 co-ordination shall be provided.
- 10.3 However either case motor switching & O/L trip shall be through power contactor only.
- 10.4 Motor feeders shall have circuit breaker / contactor of rating at least 125% of the maximum continuous rating of the connected load.

The other features of the protective relays are as follows:-

- 10.5 All protective relays and associated accessories shall be furnished complete in all aspects to suit the requirement of protection, interlocking and annunciation of individual applications as per attached SLD.
- 10.6 The relays shall have stable characteristic to perform the required protective functions.
- 10.7 Protective relays used in ACB's of LV switchgear shall be provided with microprocessor based O/C, S/C and E/F releases. All MCCB's shall be provided with thermo-magnetic releases.
- 10.8 Setting and resetting points shall be easily adjustable and accessible.
- 10.9 All relays shall be Microprocessor based / electromagnetic type as applicable.

Auxiliary relays and timers

- 10.10 The auxiliary relays and timers shall be rail mounted type.
- 10.11 All relay contacts shall be rated 10 Amps, 240 V AC.

11.0 Indication lamps & Push buttons:

- 11.1 Indication lamps shall be cluster of LED's. Voltage rating of bulbs shall be equal to voltage rating of control circuit.



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11.2 Each MCC outgoing motor feeder shall be furnished with three indicating lamps.

- Motor Off – Red
- Motor Run – Green
- Overload Trip – Amber

11.3 Each PMCC, MCC, MLDB and PDB incoming feeder and each panel shall be furnished with R, Y, B indication lamps

11.4 Color coding of push buttons shall be as follows :-

- Push Buttons
- Start or On - Red
 - Stop or Off - Green
 - Alarm Reset - Yellow
 - Acknowledge - Black
 - O/L Reset - Blue

12.0 Measuring Instruments:

12.1 Ammeters shall be provided on PMCC's for all motor rated 55 kW and above (for Non-VFD driven Motors).

12.2 For MCCB'S and SFU Incoming/Outgoing units the following shall be provided:-

- a) Ammeter, Voltmeter, kWh Meter (Digital Type) wherever required and switch shall be installed for each MCC incomer.
- b) Each switchgear incoming feeder shall be furnished with Voltmeter and selector switch to measure line-to-line voltages and with Ammeter and selector switch to measure current on each phase.

13.0 Designations:

13.1 Each panel shall be designated by means of nameplates with item number and inscription of service name on front side of the panel.

13.2 Each device and component installed inside the panel shall be designated with device Identification corresponding to those used in applicable drawings.



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13.3 All terminal blocks within the panel shall be clearly designated with identification corresponding to those used in applicable drawings.

13.4 Each panel shall be furnished with applicable drawings.

Nameplates

13.5 Each switchgear and any other electrical panel shall be furnished with nameplates.

13.6 Nameplates shall be of anodized aluminum with white background and black letters.

13.7 Nameplates shall contain the following information :

- a) Manufacturer
- b) Basic technical data such as rating voltage, rating -current, etc.
- c) Country of origin
- d) Certification data such as UL certificate number, etc

14.0 Feeder Details:


All incoming and outgoing feeder as per shown in SLD shall be provided as a minimum requirement. Further, feeder for HVAC system shall be provided as per requirement.

In addition, following feeders shall be provided in each switchgear panel.

- a) Spare feeders: SPARE feeders: 10 % of each type OR one rating of each. (above quantity is the minimum requirement, at the time of handing over the plant. Any additional quantity required for any increase/changes during detailed engineering stage also shall be duly considered).
- b) Bus VT module: 1 No. on each bus
- c) Switchgear 240V, 1 phase control supply and panel space heating: 1 No. on each bus.
- d) 240V, 1 phase essential supply module with five Nos. 1 phase outlets: 1 No.

15.0 Circuit Breakers:

15.1 Circuit Breakers shall be of the Air break, fully draw out type. All air circuit breakers (ACBs) shall be of short circuit performance category P2 as per IS 2516 parts I & II and shall be of the horizontal draw-out type.

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- 15.2 Circuit breakers shall comprise three separate identical single pole units operated through a common insulated shaft by the operating mechanism. Breakers of identical ratings shall be interchangeable without any adjustment. Air circuit breakers with releases are not acceptable.
- 15.3 Circuit breaker along with its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement. Plugs and sockets for power circuits shall be silver faced and shall be insulated with suitable insulating material shrouds.
- 15.4 Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts, when these are provided. Arcing contacts shall be easily accessible for inspection and replacement.
- 15.5 Each breaker shall be provided with auxiliary contacts of 6NO + 6NC directly operated from breaker operating mechanism. These contacts shall be in addition to those used in circuit breaker internal wiring. These contacts shall be rated for 10A at 240V AC and 5A (inductive breaking) at 110V DC. If more breaker auxiliary contacts are required, latched type relays shall be used to multiply the contacts. All these contacts shall be wired to terminal box for Company use.
- 15.6 There shall be 'Service', 'Test' 'Fully withdrawn' positions for the breakers. In the 'Test' position the circuit breaker shall be capable of being tested for operation without energizing the power circuits, i.e. the control circuits shall remain undisturbed while the power contacts shall remain disconnected. Separate limit switches, each having a minimum of 2NO+2NC contacts shall be provided for both 'Service' and 'Test' positions of the circuit breakers for Company use. These contacts shall be rated for 10 amps, 240 V AC and 5 amps (inductive breaking) at 110V DC.
- 15.7 The circuit breakers shall be provided with the following:
- a. Mechanically operated targets to show 'Open', 'Closed', 'Service' and 'Test' positions of the circuit breakers.
 - b. Mechanically operated, red 'trip' push button, shrouded to prevent accidental operation.
 - c. 'Red', 'Green' and 'Amber' indicating lamps to show 'Closed' 'Open', and 'Auto-trip' conditions of the circuit breaker.
- 15.8 Closing and trip coil shall operate satisfactorily under the following conditions of supply voltage variation:
- a. Closing coils - 85% to 110% of rated voltage.



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- b. Trip coils - 70% to 110% of rated voltage.

Circuit Breaker Operating Mechanism

- 15.9 The operating mechanism shall be motor operated spring charging stored energy type. Alternate means must be provided to charge the closing springs manually. Necessary handles shall be supplied with circuit breakers (one for each switchgear). The operating mechanism shall be trip-free and non-pumping electrically. An anti-pumping relay to achieve electrical anti-pumping feature even if the breaker has provision for anti-pumping by mechanical arrangement shall be provided. For spring charged mechanism, 'spring charged' indication shall be provided.
- 15.10 Circuit breakers shall be provided with facilities for remote closing and opening operations wherever specified.
- 15.11 Power operating mechanism shall be provided with following additional features:
 - a. Closing of the circuit breaker shall automatically initiate recharging of the spring ready for the next closing stroke.
 - b. The motor shall be mechanically decoupled as soon as the emergency manual charging handle is inserted.
- 15.12 Mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and will not cause tripping or closing operation of the power operated closing devices. When the circuit breaker is already closed, failure of any auxiliary spring shall not cause damage to the circuit breaker or endanger the operator.
- 15.13 Working parts of the mechanism shall be of corrosion resistant material. Bearings which require grease shall be equipped with pressure type grease fittings. Bearing pin, bolts, nuts and other parts shall be adequately pinned and locked to prevent loosening or changing adjustment with repeated operation of the breaker.
- 15.14 As long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply to the motor, at least one open-close-open operation of the circuit breaker shall be possible.
- 15.15 Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring.



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15.16 Motors shall be rated for 240 V AC and shall operate satisfactorily at all values of voltage between 80% to 110% of rated voltage. Motor shall be protected against overloads and stalling.

16.0 Moulded Case Circuit Breaker (MCCB):

16.1 Moulded case circuit breakers (MCCBs) shall be provided as called for in the Data Sheet and shall conform to the latest applicable standards.

16.2 MCCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Remote operation shall be provided for motorized MCCBs. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF and TRIP positions of the MCCB shall be clearly indicated and visible to the operator and one contact of each shall be brought out for Company use. Handle for operating MCCBs from door of the switchgear shall be provided.

16.3 The instantaneous short circuit release shall be so chosen by the Bidder as to operate at a current in excess of the peak motor inrush current and a range of settings shall be provided for the Company selection.

16.4 MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.


16.5 All MCCB Power feeders shall have earth leakage protection if feeding outdoor loads.

17.0 Motor Protection Circuit Breakers (MPCBs):

17.1 MPCBs in AC circuits shall be of four pole construction arranged for simultaneous four pole manual closing and opening. Operating mechanism shall be quick-make, quick-break and trip-free type. The ON, OFF and TRIP positions of the MPCB shall be clearly indicated and visible to the operator and one contact of each shall be brought out for Company use. Handle for operating MPCBs from door of the switchgear shall be provided.

17.2 The instantaneous short circuit protection shall be so chosen by the BIDDER as to operate at a current in excess of the peak motor inrush current and a range of settings shall be provided for the Company selection.

17.3 MPCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

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18.0 Miniature Circuit Breakers (MCBs):

Miniature circuit breakers for use on motor space heater control circuits shall comply with the requirements of applicable standards, unless otherwise mentioned in Data Sheet.

19.0 Motor Starters:

19.1 Contactors

19.1.1 Motor starter contactor shall be of the electromagnetic type rated for uninterrupted duty as defined in applicable standards unless otherwise specified in Data Sheet-1.

19.1.2 Operating coils of contactors shall be suitable for operation from the control supply system specified in Data Sheet.

19.1.3 Class of coordination for starter module shall be class '2' as per IS-13947.

19.2 Direct-on-line Starters

Direct-on-line starters shall be suitable for Class AC 3 utilization category as specified in applicable standards, unless otherwise mentioned in Data Sheet-1.

19.3 Thermal Overload Relays

19.3.1 Starters shall be complete with a three element, positive acting, ambient temperature compensated, time lagged thermal overload relay with adjustable settings and built in single phasing preventer. The setting range shall be properly selected in accordance with the rating of the motor.


19.3.2 Thermal overload relays shall be settable for either to manual or auto reset type.

19.3.3 'Stop' push button of the starter and hand reset device shall be separate from each other.

19.3.4 Overload relay hand reset push button shall be brought out on the front of the compartment door.

20.0 Safety Interlocks & Features


20.1 Withdrawal or engagement of circuit breakers or switch (isolator) shall not be possible unless it is in the open position.

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- 20.2 Operation of circuit breaker shall not be possible unless it is fully in service position or withdrawn to test position. It shall not be possible to close electrically the circuit breaker in service position, without completing the auxiliary circuit between the fixed and moving portions.
- 20.3 It shall be possible to padlock the circuit breaker in service, fully drawn out and test position.
- 20.4 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the circuit breaker carriage, to cover the exposed live parts when the breaker is withdrawn. Padlocking facilities shall be provided for locking the shutters positively in the closed position. It shall, however, be possible to open the shutters intentionally against spring pressure for testing purposes.
- 20.5 The circuit breaker/MCC feeder compartment door shall be interlocked to prevent access when in service position. It shall however be possible to defeat the interlock during an emergency.
- 20.6 Physical contact wear indicator shall be provided to indicate the erosion of the contacts.
- 20.7 A mechanical indicator shall be provided on the front face of the circuit breaker such that it indicates the OFF condition when contacts are separated by proper distance such that circuit breaker is suitable for isolation.
- 20.8 Caution nameplate, "Caution Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end, i.e. incomer to the switchgear.

21.0 DATSHEET


Sl. No.	Description	Specific Requirement
1.	Rated voltage, phases & frequency	415V, 3 ph, 4 wire, 50 Hz, system.
2.	System neutral earthing	Effectively earthed.
3.	Maximum system voltage	433V
4.	1 minute power frequency voltage	
	i) Power & Control circuits	3kV & 1.5kV respectively.
	ii) Aux. circuits connected to secondary of CTs.	2.0kV
5.	Reference ambient temperature	50°C
6.	Maximum temperature of bus bars, droppers and contacts at continuous current rating under	90°C for bus bars having non-silver plated joints and 105°C for bus

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	site reference ambient temperature.	bars having silver plates joints.
7.	Short circuit withstand for bus bars and droppers	
	i) Short time (1sec.) at 415V.	50kA (R.M.S)
	ii) Dynamic rating	105kA (Peak)
8.	Thickness of sheet steel	
	i) CRCA	Frame-2.0, Doors-1.6, Covers-1.6
	ii) HR Sheet	Frame-2.5, Doors-2.0, Covers-2.0
9.	Degree of protection as per IS: 13947	IP52
10.	Color finish shade	RAL 7032 for exterior & glossy white for interior.
11.	Earthing Bus material	G.S.
12.	Earthing Bus size	*
13.	Clearances in air of live parts	Phase to phase: 25.4mm, Phase to earth: 19.4 mm
14.	Metal enclosed bus duct/bus trunking entry to cubicles. (If required.)	Top & Indoor
	Starters:	
15.	Type	DOL
16.	Contacting category as per IS: 60947	AC3 for DOL.
17.	Utilization category as per IS: 60947	*
18.	Single phasing preventer requirement	Yes required.
19.	Control transformer:	Yes required.
	i) Separate for each module	Not required.
	ii) Common for each switchgear with 100% Standby.	Yes required.
20.	Thermal over load relay reset	Suitable for either to manual or auto.
	Breakers:	
21.	Circuit breaker type	ACB
22.	Voltage, frequency & no. of phases	415V, 3 Ph, 50Hz.
23.	Short circuit with stand current for 1 sec. duration	50kA.
24.	Rated making current	105kA. (peak)
25.	Type of operating mechanism	Spring charged motor & also spring assisted manual.
26.	Requirement of key interlocking	Yes required.

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27.	Requirement of shunt trip coil	Yes required.
28.	Requirement of under voltage release	Not required.
29.	Minimum no. of auxiliary contacts.	6 NO + 6 NC.
30.	Annunciator required.	Yes required.
31.	Emergency manual operation required in addition to electrical operating devices:	
	i) For spring charging & closing	Yes required.
	ii) For tripping	Yes required.
32.	Control Voltages	
	i) For spring charging motor	240V AC
	ii) For closing/tripping	110V DC
	MCCBs:	
33.	Moulded case circuit breakers to be provided	
	i) For MCC & other circuits.	Yes required.
34.	Voltage, frequency & no. of phases	415V, 3 Ph, 50Hz.
35.	Rated operating duty	As per IS.
36.	Rated breaking capacity (at 415V, 0.25p.f)	50kA. (r.m.s)
37.	Rated making current	105kA. (peak)
38.	On/Off operation	
	i) For manual	Yes required.
	ii) For remote power operated	Yes required.
39.	Releases required	
	i) Overload inverse time & Under voltage	Yes required.
	Current Transformer:	
1	Service	Indoor
2	System	415V, 3 phase, 4 wire, 50Hz, Solidly earthed neutral.
3	Type	Resin cast.
4	Rated voltage	415V, ±10%.
5	Quantity required	As per requirements of individual feeders and as mentioned in the specification drawings.
6	Ratio and burden	As required, C.T. secondary rating shall be 1 AMP.
7	Power frequency withstand voltage	2.5kV (r.m.s) for one minute.
8	Rated short time current	
	a. Short time withstand current for 1 sec	50kA (r.m.s)
	b. Dynamic current	105kA (peak)

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9	Mounting	Inside switchgear cubicle in stationary portion.
Potential Transformer		
1	Service	Indoor
2	System	415V, 3 phase, 4 wire, 50 Hz Solidly earthed neutral.
3	Type	Cast resin
4	Rating- Voltage ratio	415/ $\sqrt{3}$ / 110/ $\sqrt{3}$
5	Rated burden	As specified
6	Accuracy class	As per requirement, to be indicated in the contract.
7	Power frequency withstand voltage	3.0kV for one minute primary 2.0kV for one minute secondary.
8	Mounting	Fixed Type
9	Quantity	As per requirement
Numerical Relay		
1	Purpose	Protection, Metering and Monitoring of all switchgears and MCCs with synchro check facility for Incomers, Bus couplers
2	Auxiliary Supply	110V DC for ACBs and 240V AC for MCC only
3	CT Secondary Current	1Amp
4	PT Secondary Voltage	110V AC, 3 Phase
5	Ambient Temperature & degree of protection.	50°C & IP 54 respectively.
6	Communication	Compatible with DCS system through suitable connectivity & suitable software
7	Input & Output	Required number of analog and digital inputs/outputs as per scheme requirement with spare
8	Metering	Instantaneous and Integrated values as indicated
9	Protection	Complete protection for Incomer, Tie, Bus coupler, feeders as indicated
10	Monitoring	Self-diagnostic facility
11	Facilities to be made available in the relay	• Programming keys for complete access without computer (built

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		in).
		• Provision for external programming unit through suitable software and communication ports.
		• Display unit.
		• Read/Write set points.
		• Time & date stamping
		• Current & Voltage actual values and any other analog measurement.
		• Event recording with Pre-trip data with starting characteristics.
		• Statistical data.
		• Output relays.
		• Tamper proof security system.
** – Information shall be furnished by bidder along with offer.		

22.0 INSPECTION AND TESTING

All individual pieces of equipment as well as the complete assembly shall be routine and type tested in accordance with the relevant IEC / IS standards.

Type test: (shall be conducted only if specified in requisition, however Contractor shall furnish valid test certificates for all the equipment / components offered) as per following list:

- Verification of temperature-rise limits.
- Verification of the dielectric properties.
- Verification of the short-circuit properties.
- Verification of the continuity of the protective circuit.
- Verification of clearances and creepage distances.
- Verification of mechanical operation.
- Verification of the degree of protection.

Routine test (shall be witnessed & test reports shall be furnished as per following list):

- Inspection of the ASSEMBLY including inspection of wiring and, if necessary, electrical operation test.



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- Dielectric test.
- Checking of protective measures and of the electrical continuity of the protective circuit.

Any other test if required / specified by the manufacturer.

The switchgear and control gear assembly shall be routine tested in accordance with IEC 60439 including interchangeability test of identical withdraw able units.

Minimum clearance / creepage distance between live parts shall be indicated (in line with relevant IS/IEC) in the offer document & the same shall be maintained in the equipment.

The intention of witnessing the tests and eventual supplementary inspection items will be specified in the requisition documents.



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CHAPTER NO – 3.4

UPS SYSTEM



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1.0 GENERAL TECHNICAL SPECIFICATION

The Uninterruptible power supply system (UPS System) shall have adequate capacity to supply clean power to new batch controllers under revamping job as well as existing UPS loads for a period of 60 min in case of mains power failure. The output shall conform to stringent requirements in respect of voltage & frequency regulation, harmonic content & transient recovery.

There shall be 2 Nos. of 2x100% UPS systems. The output voltage level of one shall be 1-ph 230V and that for the other shall be 1-ph 110V.

The UPS shall be of "parallel redundant with static bypass" type with 2x100% chargers and inverters and 2x100% battery bank, bypass line transformer and voltage stabilizer, AC distribution board, other necessary protection devices and accessories. Each UPS shall be capable of supplying 100% load with 25% design margin for future load. Typical Schematic diagram for UPS system, Drg. No.-9242-M-GAN-ELE056-00001 is enclosed elsewhere with the specification.

The UPS shall include AC distribution board with air break switch, fuses, current transformers, meters, alarm and indications. It shall incorporate complete circuit protection against all types of abnormal conditions that the system is likely to encounter while in service. Minimum feeders as shown in UPS power distribution scheme, Drg. No.-9242-M-GAN-INS664-00001 shall be provided in UPS DB.

The UPS system offered shall be suitable for normal operation, emergency operation with required protections for IGBT/Thyristor, Automatic synchronization etc. The UPS system shall be provided with necessary meters (accuracy class 1.0 or better), mimic diagram, status of operation, indications and alarms. UPS shall have communication facilities with DCS for faults indication & UPS status. Group alarms and analog parameters of each branch of parallel redundant UPS shall be made available on DCS. The UPS shall be suitable for hardwire & serial PC connectivity and necessary hardware and software shall be included.

The UPS system shall be based on latest generation technology having proven performance of satisfactory operation for similar applications.

The Power section of the UPS shall mainly consist of the following components viz :

- A) Ni-Cd SMF type batteries.
- B) Thyristor rectifier/Battery charger
- C) DC link circuit to which the battery shall be connected



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- D) IGBT static inverter which converts the DC voltage into a sinusoidal AC voltage
- E) Static bypass switch which can provide an immediate direct connection between the output and the 2 winding isolating transformer without any compensating current in case if both Inverters fail.
- F) Service bypass or maintenance (manual override) which can be used to isolate the UPS equipment for maintenance manually without interrupting the supplied load.
- G) (415V/230V) or (415V/110V) , Dry type 2 winding isolation transformer along with servo controlled voltage stabilizer for the bypass mode

The UPS shall have battery back-up time of 60 (sixty) minutes.

Suitable isolation transformers shall be provided at the inputs to prevent switching transients entering the 230V and 110V system from the UPS.

Manual interconnection between two battery bank shall be provided.

The bottom channels with nuts & Bolts shall be delivered early as will be indicated during detailed engg. Channels, Bolts & Nuts shall be Zinc plate & passivated. Two coats of premier, black color paint shall be applied.

Removable cover plates with locking facility shall be provided

Fluorescent lamp of 40 W shall be provided from one end of the panel to the other end at continuous length and shall be operated by the door switches as well as by manual switches.

Nameplates shall be provided for all instruments/Inserts with tag no. & short descriptions of services engraved. This shall be phenolic overlays (2 MM thick) background with white lettering & shall be fixed to the panel.

Alternatively, panels can be painted with polyurethane paint. The selection & approval list subject to purchaser`s/consultant`s approval.

Contractor has to provide the fabrication drawing of base channel for UPS & UPS DB/ACDB along with related accessories.

Panel shall be delivered totally wired. All instruments, inserts and annunciation windows shall be mounted & wiring connection at this hardware shall be terminated at site by Contractor.



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All panel mounted instruments shall be suitable for flush mounting with the panel. Hardware alarm windows shall be mounted at the top.

Contractor shall indicate all applicable codes and standards.

Suitable Analogue Meters shall be mounted on the front of the panel along with digital display.

2.0 MODE OF OPERATION

The system shall have a combination of two inverters (UPS modules) operating in synchronism, each having isolating facility from the critical bus by a static switch.

AC UPS control logic shall be such that the load will be fed through batteries only after failure of both the inverters. Under normal condition, the rectifier-cum-charger shall feed the inverter and charge the battery bank. If the inverters malfunction the load shall be instantaneously transferred to the bypass line through the static switch. Normally the inverter shall be operated in synchronized mode with bypass in line.

In addition to the two inverter systems, a back-up from a regulated AC supply through transformer and voltage stabilizer derived from a standby AC supply shall be provided. The system shall have a selector switch. In the 'Normal' position, both the inverters share 50% load each, with output of both inverters being automatically synchronized with each other. If one inverter fails, the healthy inverter shall supply the full 100% load by the operation of the static switch. When any one of the UPS is under maintenance, the selector switch shall be suitably changed (manual & automatic mode) and the branch circuit supplying 100% load shall be synchronized with the frequency of the standby source.

If the frequency of the standby source is beyond the preset limit, the inverter frequency control shall get disconnected from the standby synchronizing signal. The operating inverter shall continuously monitor the frequency of standby source and upon restoration of proper frequency of the standby source; the inverter shall use the frequency of the standby source as the synchronizing signal.

When the selector switch is in bypass position the standby source shall cater 100% load, isolating both inverters from the critical load bus.

The output of the UPS shall feed all the essential loads through the ACDB. The connection from the UPS to ACDB shall be through a switch and fast acting semiconductor fuses, trip fuses and micro switch with alarm contacts. The feeders shall be designed by the Contractor to suit the load requirements.



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3.0 POWER SUPPLY TOLERANCE REQUIRED

The system shall have the power tolerance of 25 milliseconds for interruption +10% voltage levels and frequency - 3 Hz to 6 Hz.

4.0 IMPORTANT COMPONENTS

4.1. THYRISTOR RECTIFIER

4.1.1 The Thyristor rectifier used shall be a fully controlled three phase bridge (6 Pulse or above) with mains commutation choke and this shall be protected on the AC side by current limiting circuit breaker rated for the short circuit current. The rectifier shall be provided with control features to maintain battery charging at an optimum requirement and shall have constant current/constant voltage mode of operation as well as charge current limiting function shall be provided on the rectifiers to protect against overloading of rectifiers.

4.1.2 Each of the rectifier elements shall be protected by means of fast acting thyristor fuses adequately rated as well as surge suppressors on the input and across the device Filter capacitors and inductors shall be provided on the DC output side of the charger to minimize the ripple content on the output waveform.

4.1.3 Output of the rectifier bridge shall be provided with battery circuit breaker for isolating the battery circuit for maintenance of battery. However, the status of all the isolators / fuses shall be annunciated on the front panel of the UPS.

4.1.4 The rectifier shall be capable of boost charging the battery.


4.2. INVERTER

4.2.1 The inverter power circuit shall comprise of Transistor bridge circuit (IGBT's), dry type, 2 winding output transformer and capacitors for waveform improvement using PWM control.

4.2.2 The IGBT's used shall be adequately rated for the overload current rating specified as well as the peak inverse voltage considering the output voltage specified for the UPS. The distortion in the output voltage waveform under most severe operating condition shall be within the value specified in the data sheet. Further this shall be applicable even while supplying non-linear load like computers etc.

4.2.3 The salient features of the control system used shall be as follows :

- a) Highly dynamic voltage control (<5 ms)

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- b) Current limiting
- c) Very accurate frequency control (with tolerance < 0.1 Hz)
- d) Soft synchronization without frequency jumps and wide synchronization range for load transfer in case of unstable mains.
- e) Precise synchronization with mains and with parallel UPS units.
- f) No current surge during switch over
- g) Instantaneous value control shall be provided on the inverter section to ensure low output voltage distortion, even for non-linear loads and for high peak currents.
- h) Very fast dynamic response of less than 5-msec.

4.2.4 The transistor section of the inverter shall be protected by fast acting transistor fuses for O/C, S/C and by means of capacitor type surge suppressor for over voltage/surges.

4.2.5 The 2 winding output transformer shall be suitable for the output voltage specified and shall provide isolation with electrostatic shield. On the output of the transformer, a suitably rated current limiting type circuit breaker shall be provided with static/microprocessor based overload/short circuit and earth fault releases.

4.3. STATIC BYPASS SWITCH


4.3.1 Static Bypass Switch shall be provided to ensure uninterrupted switching of the loads to the mains under the following circumstances.

- a) Inverter Overloading
- b) Short circuit
- c) Inverter fault
- d) When the inverter is switched off by hand.

4.3.2 Static Bypass Switch shall comprise of continuously rated thyristor switch protected with fuses and surge suppresser and shall be rated for the normal loads and overloads specified.

4.3.3 The change over time shall not be greater than 5 msec. Change over shall be automatic, bi-directional operation, programmable synchronous and asynchronous modes, programmable frequency and voltage limits.

4.3.4 The current rating of the static switch shall be not less than the continuous full load rating of the branch circuit and short time rating of 750% for 1.0sec.

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4.4. SERVICE BYPASS SWITCH (MAINTENANCE)

Service Bypass Switch shall be provided to manually isolate the UPS. This switch shall be suitable to connect the load to the supply system bypassing the UPS and isolating the UPS for the purpose of maintenance without load shutdown and can be reconnected without load shutdown. Service bypass switch shall be fuse protected.

4.5. BATTERY SYSTEM FOR THE UPS

4.6.1 The Battery System of the UPS shall comprise of Ni-Cd SMF type Batteries.

4.6.2 The batteries shall be rated for the specified rating for duration not less than one hour at the end of which, the battery voltage shall not drop below the minimum voltage specified.

4.6.3 The cells of battery system shall be able peak discharge current up to 3.0 to 3.5 times the rated current without causing a voltage drop below the limit necessary for the loads to be sustained. Further the battery shall be designed for a high/quick rate of charge to revive the discharged battery to its fully charged state within four hours.

4.6.4 The necessary double row/multitier battery stands, stand/cell insulators, lead coated copper inter cell/Inter tier/ interbank connectors shall be supplied along with the battery.


4.6.5 The battery system shall be suitable for remaining on float/trickle charge for a very considerable period of time before it is called upon to supply loads in the event failure of normal power supply. The interval between two discharge periods while the battery is on float charge may be several years. This aspect shall be taken into account while selecting the battery system.

4.6.6 While sizing the Battery AH capacity, the following factors shall be taken care.

- a) End Voltage (at the end of back up time) – 1 hr – 1.75 V/cell
- b) Highest voltage
- c) Ageing factor of 1.0
- d) 10% design margin
- e) Load amperes
- f) Backup time (60 minutes)
- g) Temperature correction factor, minimum ambient temperature of 170C

4.6.7 Battery sizing calculation shall be furnished for approval.

4.6. ISOLATION TRANSFORMER ALONG WITH SERVO CONTROLLED VOLTAGE STABILISER

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FOR BYPASS MODE

- 4.6.1 Isolation transformer shall be dry type suitable for indoor installation.
- 4.6.2 Transformer shall be suitable for operation on 3 Phase, 415 V, 50 Hz, 3-wire supply and output of 230 V AC (and 110V AC for 110V UPS), 50 Hz, 2 wire.
- 4.6.3 Transformer shall be double wound, natural air-cooled.
- 4.6.4 Particular attention shall be given to the suppression of harmonics
- 4.6.5 Insulation of windings and connection shall not deteriorate when transformer is operated continuously at its specified rating.
- 4.6.6 An isolating triple pole switch of adequate rating at 500V capable of breaking full load current of transformer shall be included on primary side of the transformer.
- 4.6.7 Transformer shall be provided with taps at the primary side.
- 4.6.8 Hot spot temperature rise shall be within allowable limit of the class of insulation.
- 4.7. **Servo Controlled Voltage Stabilizer**

(On the output side of the Bypass transformer)

By pass transformer (VEE connected), 415V, 3 Wire input and 230/110V, 2 Wire Output

1	Input Voltage	:	415V, 3 Wire
2	Input frequency	:	50HZ +/- 5%
3	Output voltage	:	230 or 110V AC as applicable, 2 wire, 1PH, +/- 1%
4	Output rating	:	Same as UPS rating
5	Controls	:	a) Voltage selector switch (input and output)
			b) Auto manual (Voltage control selector switch)
			c) Auto volt adjust pot
6	Indications	:	a) Input 'R' ON
			b) Input 'Y' ON
			c) Input 'B' ON
			d) Output ON
7	Metering	:	AC Voltmeter for Output voltage
8	Type of cooling	:	Air Natural



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5.0 CONTROL AND INDICATION SYSTEM FOR THE UPS

The control and indication system for the UPS shall be based on the latest concept of the microprocessor and microcontrollers using industrial grade electronics ensuring highest possible reliability and operational integrity. Further it shall meet the latest IEC standards for immunity to electromagnetic interference. Monitoring and diagnostic system shall include.

- a) Data for current measured values which can be retrieved.
- b) Currently available battery bridging time.
- c) Storage of analog and digital values.
- d) Event recording before and after a fault.
- e) Recording of faults.
- f) Statistical data of UPS such as operating hours, number of mains failures, load distribution of the inverter, load distribution of the battery.

Controls shall ensure the following:-

- a) No paralleling and common control circuit for Inverter
- b) Both UPS (Primary and hot standby) can be isolated to operate as independent unit.
- c) Normally primary UPS shall feed load and in the case of failure of primary, stand-by shall take over, changer over shall be rated for 100% capacity.
- d) It will automatically provide a boost voltage whenever the supply voltage is restored, this will also be manually selectable.
- e) Timed walk in circuits will be included to allow the unit to load gradually after the input voltage is applied.


6.0 MECHANICAL DESIGN OF THE UPS

Mechanical design of the UPS shall be totally enclosed floor mounting, free standing with gland plate and knock outs at the Bottom for cable connection.

Control panel with LED, LCD display and membrane keyboard shall be installed on the door.

All live components shall be shrouded even after opening the door and control shall be accessible after opening the door.

The sub assembly racks housing the power and control electronics shall be hinged and shall open outwards. Further the hinge shall be sufficiently robust to handle the combined weight of

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Power and Control electronics. Necessary base frame for the panel shall be provides for grouting in the floor.

Redundant low noise fans shall be provided for heat dissipation from inside the panel.

As the panel is to be located indoor environment, dust filter pads along with condensation traps shall be provided for the air inlets in the doors.

Painting shall be epoxy based and shade will be as per approved drawings.

Anti condensation heaters and cubicles illumination lamps along with sockets shall be provided in the panels. Necessary control supply for the UPS shall be obtained using control supply transformer.

UPS panel enclosure shall be made up of CRCA sheet of 2mm (min) thickness suitable for protection class minimum IP-42.

Layout and dimensions of battery racks shall be submitted for approval

7.0 MECHANICAL DESIGN OF THE UPS DISTRIBUTION BOARD (UPS DB / ACDB)

UPS distribution board shall be dust and vermin proof.

Bus bars shall be rated in accordance with service conditions and the rated continuous and short time ratings.

Bus bars are either sleeved with flame retardant heat shrinkable sleeve or epoxy encapsulated.

All doors and covers shall be gasket all round with neoprene gaskets.

Panel enclosure shall be made up of CRCA sheet or 2mm (min) thickness suitable for protection class IP52.

Cable compartments shall be fitted with removal plates for fixing cable glands.

Mild steel angles of suitable size shall be supplied along with anchor bolts for mounting the cubicle.


Panels shall be supplied with earthing studs on either side of the panel.

Distribution board shall be same of same height of UPS panels.

Other construction requirement and component requirements shall comply with the requirements specified under the technical specification of "LV Switchgear" mentioned elsewhere in the specification

8.0 CABLES

Cables used between Rectifier / Battery charger and battery, UPS and UPS Distribution board shall be armoured, FRLS-PVC of suitable size.

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Scope of cabling between UPS & Battery bank and UPS to UPS DB shall be in Contractor scope.

All the cables shall comply with the requirements specified under the technical specification of "LV Cables" mentioned elsewhere in the specification.

9.0 ALARM, CONTROL, INDICATION AND METERING REQUIREMENTS

If not specified otherwise in the data sheets, following schedule shall be followed for alarm, control, indication and annunciation. Any additional devices features considered necessary for reliable operation and maintenance shall also be included in various panels and same shall be highlighted separately. An illuminated one line diagram indicating operational status shall be provided on the front of the panel. Metering, indications, audio-visual alarm shall be provided. Parameters information indicated shall be available by menu driven LCD display or by other means directly or indirectly.

9.1. Metering Requirements

I. Rectifier

- a) Incoming line voltages (For all the three phases).
- b) Input line currents.(For all the three phases)
- c) DC voltage at each rectifier output.
- d) Battery current.

II. Inverters


- a) AC voltage at each inverter output (AC voltages for 3 phase inverter)
- b) AC current at each inverter output (AC currents for 3 phase inverter)
- c) Frequency meter at each inverter output

III. Stabilized bypass supply

- a) Frequency meter for incoming supply.
- b) Voltmeter with selector switch for incoming supply.
- c) Ammeter with selector switch for incoming supply.

IV. ACDB

Following shall be provided for each of the ACDB incomers:

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- a) Voltmeter (voltmeter selector switch shall also be provided for 3 phase inverter).
- b) Ammeter (ammeter selector switch shall also be provided for 3 phase inverter).
- c) Power factor meter

9.2. Indications

All indicating lamps shall be LED type. LEDs provided for indication shall be cluster type with adequate brightness and minimum 2Nos LEDs chips per light. LEDs shall be connected in parallel and each LED chip having diameter not less than 3mm. LEDs shall be provided for following:-

- I.
 - a) AC mains 'ON' - Rectifier.
 - b) AC mains 'ON' - Bypass.
 - c) AC mains "ON"- ACDB
 - d) Outgoing feeder supply "ON"- ACDB


- II. Rectifiers (for each rectifier)
 - a) Rectifier output 'ON'
 - b) Battery on float charge
 - c) Battery on rapid charge

- III. Inverters (for each inverter)
 - a) DC input 'ON'
 - b) Load on inverter.
 - c) Inverter synchronized with mains.

- IV. Load on bypass.

9.3. Audio-Visual Alarm (separately for each circuit)

- a) Mains failure
- b) Battery charger failure
- c) Battery fault
- d) Inverter temperature high
- e) Low voltage from inverter
- f) Load on bypass
- g) Inverter overloaded

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- h) All power Fuse failures
- i) DC earth fault
- j) Cooling fan failure

2 nos. changeover contacts shall be wired to the terminal strip, 1 no for common remote alarm of 'UPS fault' in Company panel and 1 no for 'load on bypass supply' annunciation.

9.4. Controls

Controls for following shall be provided as minimum requirements,

- a) All the switches for starting, shut down and testing sequence.
- b) Primary input circuit breakers for feeding chargers, bypass line and dc bus from battery including backup protection.
- c) Inverter ON/OFF switch (to initiate inverter operation)
- d) Static switch transfer test Push Button.

10.0 WIRING

All wiring shall be carried out with 1100 volts grade single core wires having stranded copper conductor.

Conductors' not carrying substantial current shall be 1.5 Sq.mm copper and current carrying conductor shall be min.2.5 Sq.mm copper.


All control wiring shall be terminated using eye type tinned copper lugs on to the stud type terminals. More than two wires shall not be terminated on to a single terminal. No joints shall be made in wires between terminals.

All holes or tubes for wiring runs shall be bushed and shall have room for reasonable future additions. All cable runs shall be clear of injurious gases and heat emitted by the equipment during its working or adequately protected from them.

The wires shall be identified by numbered ferrules at each end. all in accordance with the connection diagram. Equipment terminals shall have the same ferrule numbers. All ferrules shall be made of non-deteriorating materials. Ring type ferrules shall have the character engraved on it. The ferrules shall be firmly located on each wire so that they cannot move freely on the wire Ferrules shall be interlocked type.

For all wires and conductors, individual terminals shall be provided unless terminals are specially made for more than one (I) conductor. The wiring shall be continuous and without joints between terminations.

Internal wiring shall be bundled or installed in plastic ducts.

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All interconnecting cables shall enter the UPS from bottom. Undrilled gland plates, cable entries, clamping, earthing, supporting devices and terminals shall be part of the supply.

These shall be suitable to accept the type, size and number of cables specified in the requisition. Cable glands shall be of brass double compression type. The design shall foresee sufficient connection space between cable gland and terminals by considering bending radius of cable also. All exposed bus bar position shall be shrouded.

11.0 TERMINAL BLOCKS

All terminal blocks shall be rated for 1100V and a min. current rating of 10A. Power terminal blocks shall have current rating of 200% of maximum rated termination.

Terminals carrying different voltages shall be logically grouped and separated by barrier plates.

All terminals shall have insulated barriers. All power terminals shall be stud type with brass studs/screws. All terminals shall be numbered and number plates shall be permanently fixed to the terminal block minimum 10% terminals shall be kept spare in each terminal block for future use at site. Min number of spare terminals for Company future use shall not be less than 10.

Power, control. CT. PT terminal blocks shall be segregated control terminals shall be suitable for terminating two numbers of 2.5 sq.mm copper wires.

Shorting links shall be provided for CT terminals.

Control terminals shall be clip-on type.

12.0 NOISE

The UPS system shall meet the sound pressure limits, as specified in the requisition and specification under any load condition.


13.0 CODES AND STANDARDS

AC UPS system shall be in accordance with the requirements of this specification, relevant Indian standards and IEC/IEE standards amended till date.

14.0 INSPECTION AND TESTING

The UPS system shall be routine tested in the manufacturer's workshop in accordance with the test schedule given in IEC 60146 / IEC62040-3.

Functional tests shall be executed to ensure that all control and signal functions are as specified in the requisition.

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Tests specified shall be executed in accordance with the applicable clauses of IEC 60146/IEC62040.

The intention for witnessing the tests and eventual supplementary inspection items shall be as specified in the requisition.

Following system acceptance tests shall be conducted on each UPS system:

14.1 Insulation tests

Insulation tests shall be performed as per IEC 60146-1-1.

The insulation tests shall be carried out using an AC power frequency voltage or by using DC Voltage at the choice of the Contractor. In the case of AC power frequency voltage test, the test voltage at the frequency available in the test facility or at the rated frequency, but not exceeding 100 Hz, of the full value starting at a maximum of 0.5 pu. The unit on test shall withstand the specified voltage for 1 minute. In case DC voltage is used for the test, the value of DC voltage shall be equal to the crest value of the test voltage specified in the table.

14.2 Interconnection cable check

The interconnection cables are to be checked for correct wiring, insulation and quality of the terminations

14.3 AC input failure test


The test is performed with the test battery and carried out by tripping AC incoming circuit breakers or by switching off rectifiers and bypass supply at the same time. Output voltage and frequency variations are to be checked for specified limits.

14.4 AC input return test

The test is performed by closing AC incoming circuit breakers or is simulated by energizing rectifiers and bypass supply. Proper operation of rectifiers starting and voltage and frequency variations of output are to be checked.

14.5 Simulation of parallel redundant UPS fault

The test is applicable for UPS with parallel redundant configuration. Fault of rectifier or inverter are to be simulated and output transients are to be recorded.

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14.6 Transfer test

Transients shall be measured during load transfer from inverter to bypass supply caused by simulated fault and load retransfer after clearing the fault.

14.7 Regulation test

This test shall be carried out by measuring input voltage, input current, output voltage, output current, DC link voltage, output distortion, input active power, output active power and frequency at no load, 50% load and 100% load at 0.9 and unity pf.

Following parameters of rectifiers and inverters are to be measured:

Measurement shall be carried out in the 'rectifier float charge mode and in rapid charge mode. Measurement shall be at nominal a.c. voltage and at no load, 50% load and 100% of rectifier full load.

Rectifier measurement shall comprise of :-

Input voltage, frequency, phase current and input power.

DC output voltage and current.

Ripple current at the DC link bus shall be recorded after isolating the test battery.

Inverter measurement shall also be at no load, 50% load and 100% load of inverter rated output current and shall be repeated for inverter DC input voltages corresponding to battery float charge operation as well as rated inverter maximum and minimum input DC voltage. Measurement shall comprise of:

- a) Input voltage,
- b) Input current.
- c) Output voltage,
- d) frequency and waveform distortion,
- e) Output power and current.

14.8 UPS efficiency

This shall be determined by the measurement of the active power input and output at rated pf. for 50%, 75% and 100% load.

14.9 Current division in parallel UPS



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Load sharing between UPS units shall be measured with a dummy load under parallel redundant UPS configuration.

14.10 Light load test

The test is to verify that all functions of the UPS system operate properly. The load applied is limited to some percentage of rated loads. The following points are to be checked.

- a) Output voltage and frequency and correct operation of meters.
- b) Operation of all control switches and other means to put UPS system into operation.
- c) Functioning of protective and warning devices

14.11 Burn-in test for Printed circuit boards

PCB's and other electronic components sub-assemblies shall undergo a burn- in test for 96 hours at 50°C at a voltage varied between the maximum and minimum supply voltage. In case of failure of any component during testing, the tests shall be repeated after replacement of the faulty component. Supplier's test certificates are also acceptable for this test.


14.12 Continuous full load test at unity power factor with temperature rise measurement

The test is required to be performed by connecting resistive load or resistive and inductive load to the UPS system output. The load shall be placed outside the test room to avoid influences of its heat upon UPS ventilation. Supplier's test certificates are also acceptable for this test. UPS system in this test shall undergo a complete full load test for 32 hours at unity power factor. Out of these 32 hours, each inverter section shall be subjected to full load test for 8 hours, both invertors sections operating in parallel shall be subjected to full load test for 8 hours and the remaining 8 hours; the bypass section shall be subjected to full load test. Steady state temperature of rectifier transformer, rectifier set, D.C. choke, inverter set, static switch etc. shall be recorded during the test. The temperatures of all UPS panels are also to be recorded.

14.13 Auxiliary equipment and control circuit tests

The correct functioning of all measuring instruments, alarms, indications, protection devices and controls are to be verified. The functioning of auxiliary devices such as lighting, cooling fans, annunciation etc. should be checked.

14.14 Synchronization test

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Frequency variation limits of inverter are to be tested by feeding bypass supply incoming line by variable frequency generator and inverter synchronization limit is to be checked as specified.

14.15 Overload capability test

Specified values of short time overload are to be applied for specified time interval. Values of output voltage and output current are to be recorded.

14.16 Short circuit current capability test

Specified short circuit current capability is to be tested by application of a short circuit to UPS output if necessary via a suitable fuse. Short circuit current is to be recorded.

14.17 Short circuit fuse test

Fuse tripping capability of the UPS system is to be tested by short circuiting the UPS system output via a specified rating of fuse. The test is carried out at an appropriate UPS load under normal operation.

14.18 Restart

Manual restart to be tested after complete shutdown of UPS system

14.19 Output over voltage

Operation of output over voltage protection is to be checked.

14.20 Dynamic response test

Output recording at different loads and operating condition to be done.

14.21 Harmonic components

Harmonic components of output voltage are to be recorded at no load, 50% load and 100% load conditions. Harmonic voltages caused by UPS system components in the AC incomer side shall be recorded at site.

14.22 Earth fault test

An earth fault is to be applied to the output terminal of UPS system. UPS output transients are



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to be measured. An earth fault is also to be applied to the battery terminal and UPS system output transient shall be measured.

14.23 Audible noise test

The audible noise is required to be measured at 1 meter distance from UPS system in at least 4 to 5 locations and its value shall not exceed 82dB + 3dB tolerance.

The detailed test schedule and test procedure shall be formulated in line with above. Before giving call for the witness of the tests, Contractor shall get Company approval on the test procedures. Contractor shall also indicate the maximum allowable tolerance for each test result, along with the test procedures. If tests show that certain requirements of the specifications are not met, 'Contractor' shall make necessary corrections to the equipment so that it satisfies all the requirements before acceptance is made.

15.0 DATSHEET

Sr. No.	Specification	Requirements
General		
1.	Type	Parallel Hot Redundant UPS with static bypass for regulated & uninterrupted power supply. (With battery back-up of sixty minutes)
Features		
2.	Application	Uninterruptible Power supply for Instrumentation & Control System and DCS loads.
3.	Number required	1 Nos. with 110V Output and 1 Nos. with 230V Output.
4.	Ambient temperature	50 deg. C
5.	Output Voltage	230V, 1-phase, 50 Hz. – for one UPS system 110V, 1-phase, 50 Hz – for one UPS system
6.	Output rating at 0.8 p.f lagging load.	*kVA
7.	Degree of protection	IP 42
8.	Cable entry	Bottom Entry



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Sr. No.	Specification	Requirements
9.	Input Supply Voltage	415V, 3 Phase, 3 wire, 50Hz supply from switchgear and for bypass from station service switchgear.
10.	Installation / paint shade	Indoor, Paint color shall RAL 7032 exterior & Glossy white interior
11.	Digital meters	* Volt / Ampere / Frequency
12.	Mimic diagram	Required
13.	Status of operation, Indications, Alarms, etc.	Required
14.	Load Requirements	*
15.	Heat Dissipation	*
16.	Material of Enclosure	2.0mm thick Cold rolled sheet steel
17.	UPS Sizing Calculation	Required
INVERTER FEATURES		
18.	Type	Static
19.	Technology	IGBT based.
20.	Type of Modulation	*
21.	No. of pulses	*
22.	Number required	2 Nos
23.	Suitable for parallel operation	Yes
24.	Service	Indoor
25.	Output rating of each	*kVA
26.	Output Voltage	230V / 110V AC As applicable, 50 Hz, Single phase
27.	Voltage regulation	Combined Voltage regulation \pm 2% from 0 to 100%



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Sr. No.	Specification	Requirements
		load at 0.8 power factor within 50 milli seconds
28.	Frequency regulation	± 5% for 0 to 100% load variation (continuous or step load change) and full range of input variation
29.	a) Transient voltage regulation on application or removal of 100% load b) Time to recover from transient-to normal voltage	± 8% 50 msec.
30.	Total harmonic content	5% RMS maximum with not more than 3% distortion in any single harmonic
31.	Duty	Continuous
32.	Overload capacity	125% for 15 minutes at 0.8 p.f, 150% for 1 Minute
33.	Short time rating	1 second for short circuit at inverter output terminals
34.	Short circuit current with standability	Shall be capable of withstanding short circuit current for the largest fuse to clear the fault in less than ¼ cycle
35.	Efficiency	Not less than 90% at rated load
36.	Cooling	Natural air cooled
37.	Synchronization with alternate source required	Yes
STATIC TRANSFER SWITCH FEATURES		
38.	Capacity Continuous	Make and carry full load current of inverter at 0.8 p.f
39.	Type	Make before break
40.	Voltage	230V & 110V AC as applicable, 50 Hz, single phase



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Sr. No.	Specification	Requirements
41.	Short time rating	Short circuit rating of the inverter for 1 second 150% of full load current for 2 min.
42.	Frequency	50 Hz
43.	Transfer time	Less than 5 milli sec.
44.	Retransfer	Automatic retransfer shall occur after approximately 2 sec time delay during which normal source voltage must remain at 240V \pm 2%
45.	Indication protection	i) Indicating lamp for static switch in normal position. ii) Indicating lamp for static switch connected to alternate source iii) Protection of all semiconductor devices against short circuit and transients
46.	Annunciation	Annunciations for the following conditions. a) Static switch connected to alternate source b) Alternate source voltage deviation greater than \pm 2% from nominal.
BYPASS SWITCH		
47.	Capacity Continuous	Make and carry full load current of inverters at 0.8 p.f
48.	Type	Make before break
49.	Short time rating	Short time rating of the inverter for 1 second and 150% of full load current for 2 minutes.
STANDBY AC SUPPLY WITH ISOLATION TRANSFORMER AND SERVO CONTROLLED VOLTAGE STABILISER		
50.	Number	One
51.	Rating	Same as UPS rating

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Sr. No.	Specification	Requirements
52.	Single or poly phase unit	*
53.	Type	Dry type double wound
54.	Voltage ratio at no load	*
55.	Type of cooling	Natural Air cooled
56.	Winding insulation class	Class-H
57.	Location	Indoor
58.	Voltage regulation	± 2% from 0 to 100% load at 0.8 p.f
59.	System fault level on 415 V side	50KA
60.	Output voltage setting range	± 1% of nominal voltage
61.	Output frequency regulation	± 1% of nominal freq.
62.	Synchronizing between inverter and standby supply	Required Within ± 2.5 Hz
HARDWIRE & SERIAL CONNECTIVITY		
63.	Potential free Hardwire contact outputs to control system	* To be finalized during detailed engineering
64.	Redundant Serial link to control system	* To be finalized during detailed engineering for type of protocol
65.	ACDB : Fully draw out/ Semi draw out/ fixed	Fixed
66.	Dimensions of the ACDB	*
67.	Type of protection	*



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Sr. No.	Specification	Requirements
		a) MCCB b) Semiconductor Fuses
68.	Bus bars	FR PVC Insulated, Copper
69.	Earthing	Redundant
70.	Degree of protection	IP52
71.	No. of Tests	*
‘*’ – Information shall be furnished by bidder along with offer.		



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CHAPTER NO – 3.5

DC SYSTEM



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1.0 GENERAL REQUIREMENT

110V DC systems comprising of battery, battery charger and DCDB shall be provided as the most reliable source of power supply for critical lighting of control room area, switchgear room, rail and road gantry area. For arranging the 110V DC supply for the above, the following shall be provided. 2 x 100% rated high discharge type stationary VRLA battery with associated 2 x100% float cum boost charger and DC switchboard for the lighting loads. Incoming supply for DC system shall be from new 415V MCC. Typical schematic for DC system is enclosed as Drg. No.- 9242-M-GAN-ELE056-00010. The final scheme shall be prepared by the contractor and the same shall be subject to approval by Company.

1.1 Sizing

1.2.1 The 110V DC Battery shall be sized to cater for the following loads with minimum duration as indicated. The voltage at the end of duty cycle shall be 1.85 V / cell for battery.


- a. Momentary Load (For duration up to 1 minute)
 - i. Tripping load of 415V breakers.
- b. Emergency load (For 2 hours duration)
 - i. Critical lighting around rail and road gantry.
- c. Continuous Load (For duration up to 10 hours)
 - i. Indicating lamps on switchgear and control & relay panels.
 - ii. Control room emergency lighting.
 - iii. Numerical relays and auxiliary relays.

1.2.2 The battery shall be sized in accordance with the IEEE 485-1983 considering temperature correction factor and design margin of 10%. For the battery sizing, 20 Deg. C design ambient temperature shall be considered.

1.2.3 Float charger shall be rated to cater the following:

- a. Trickle charging current of the battery
- b. Continuous load on the DC bus.
- c. Full load current of the largest DC motor.
- d. 25% spare capacity over above loads

1.2.4 The boost charger unit shall be rated such that the battery can be charged from fully discharged condition within 8 hours. Tap cell shall be provided for Boost charging.

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1.2 Under normal conditions, the float charger connected to the DC switchboard and battery shall cater to the continuous load of DC system plus trickle charging current of battery. In case of AC supply failure in the plant/to charger, battery shall meet the DC load. After restoration of power supply, the float charger shall continue to supply the loads as well as trickle charge the battery. If required, depending on the battery condition, same shall be put to boost charge. If during boost charging, should the main supply fail, the battery shall supply the DC loads through the tap cell of the battery.

2.0 SPECIFIC REQUIREMENTS

2.1 Batteries

2.1.1 The batteries shall be sealed maintenance free VRLA type.

2.1.2 The battery shall be closed top or sealed in type. Open type cells are not acceptable.

2.1.3 Lead coated copper connectors shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion

2.1.4 All the terminals and cells interconnectors shall be fully insulated or have insulation shrouds. All connectors and lugs shall be capable of continuously carrying the 60 minute discharge current of the respective batteries and through fault short circuit current which the battery can produce and withstand for the period declared. Contractor shall furnish necessary sizing calculations to prove compliance to the same.


2.1.5 All the accessories required for testing and maintenance shall be supplied with the batteries. These shall also include + 3 volts DC voltmeter with suitable leads for measuring cell voltage.

2.1.6 The battery shall be suitable for automatic charging & several charging / discharging cycles.

2.1.7 Construction of positive & negative plates shall ensure maintenance free service. The polarity of terminals shall be clearly marked.

2.2 Battery Charger

2.2.1 The float and boost charger offered shall be static type with silicon controlled rectifiers and diodes, complete with resistor/capacitor network for surge protection, connected in three phase full wave bridge circuit.

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2.2.2 Charger shall have provision for manual control if the auto mode fails. Load limiting features shall be provided.

2.2.3 The chargers shall be provided with automatic voltage regulation in float mode and automatic constant current regulation in boost mode.

2.2.4 The charger shall essentially comprise the following items:

- One (1) moving coil DC voltmeter and ammeter of size 96x96 mm of suitable range for float and boost chargers. Necessary shunts for local and remote metering shall be provided.
- One (1) moving coil centre zero ammeter, with shunt, size 96 x 96 mm to read discharge / charge current of the battery.

2.2.5 Fault indicating lamps shall be provided on the charger cubicle and following initiating contacts shall be provided for remote alarm for each of the float and boost chargers. The alarms shall be provided on the CRT in the common control room.

- Main AC failure
- AC input fuse blown
- DC output fuse blown
- U/V and current limit protection
- Over voltage protection
- Over current protection
- Filter condenser fuse blown
- Rectifier fuse blown

In addition to the above, any additional indication/alarms considered necessary during the detailed engineering shall also be provided.


2.2.6 The external cooling fans shall be provided to dissipate the heat developed within the panel.

2.2.7 Battery charger shall be placed in air-conditioned room.

3.0 TESTS FOR BATTERIES

3.1 All type, routine and acceptance tests shall be conducted as per the relevant standards.

3.2 Capacity test and test for voltage during discharge shall be carried out at site on completion of installation and commissioning and immediately prior to putting the battery in service.

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4.0 Tests for Battery Chargers

4.1 The following routine tests shall be conducted at Contractor's works :

- a. Visual checks for dimensions and general arrangement.
- b. Wiring checks
- c. Functional checks
- d. Voltage regulation for rated input supply for loads from 0-100%.
- e. Load test to show the charger can deliver the rated duty without the current limiter device operating.
- f. Ripple measurement by oscilloscope at different loads.
- g. Demonstration of guaranteed efficiency and power factor.
- h. Insulation test (with 500V megger).
- i. High voltage test, excluding electronic controller, at 2kVAC for one min.

4.2 Heat run test shall be conducted as a type test at the factory.

4.3 Test certificates shall be submitted for bought out items.

5.0 Data / Documents to be furnished along with the bid

5.1 Battery sizing calculations indicating relevant assumptions & characteristic curves.

5.2 Schematic drawings of charger showing main components and basic schemes.

5.3 Data as per Technical particulars table given below.

5.4 Experience list of battery and battery charges offered.

6.0 DC Switchboards

6.1 For feeding the 110V DC loads, 110V DC switchboard shall be provided.

6.2 The switchboard shall be provided with suitably rated incomers, required quantity and type of outgoing feeders for the auxiliaries, control supplies to various panels / systems in accordance with the number of 110V DC supplies enumerated in the respective equipment specification for each load and auxiliary separate feeders shall be provided. In addition, the following feeders shall be provided in each switchboard.

- a. Minimum of two nos. feeders of each type and rating as spare. The same is the minimum



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quantity at the time of handing over the plant. Any additional quantity required for increase/adjustment during detailed engineering stage shall also be duly considered.

- b. 1 No. of feeder of rating 230V, 1 phases space heating modules.
- c. 1 No. Alarm module for common alarm of outgoing feeder fault.

6.3 Current Ratings

- 6.3.1 The short circuit current rating of the switchboard shall be arrived considering the contribution from charger and battery with 10% margin.
- 6.3.2 The continuous current rating of the bus bars, incomers, ties for 110V DC switchboards shall be the maximum DC load (excluding the momentary load) on the bus due to any operating condition plus 20% margin rounded off to the next higher standard rating.

6.4 Specific Requirements

- 6.4.1 The constructional features of all DC switchboards shall comply with the requirements as per the IS.
- 6.4.2 Positive and negative bus bars in the DC switchgear shall be completely segregated from each other by partitions

Module details

a. Incomer

- i. The incomer modules shall be breaker controlled. Each incomer shall be provided with:
 - Ammeter & voltmeter.
 - Earth fault relay.
 - Under voltage relay with timer.
 - Indicating lamps for ON, OFF, EARTH FAULT, UNDER VOLTAGE conditions.
 - Current and voltage transducers for remote indication.
 - Necessary hardware and circuitry for fault alarm, lamp test and alarm rest.

b. Outgoing switch fuse feeders and tie feeders/bus coupler

- i. These feeders shall be provided with suitably rated switch-fuses on positive and negative sides with feeder on and fault indicating lamps.
- ii. The feeders rated 200 Amps and above shall be provided with a shunt and ammeter.



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c. Space Heating Module

230V, 1space heating module shall be provided with incoming side switch fuse, suitably rated 415/230V cast resin type transformer (expected heating loads of the switchgear and the connected motors + 30% margin), secondary fuse, supply indicating lamp and connection to space heating buses. The 415V power supply for these modules shall be obtained from the unit service switchgear.

d. Alarm module

- i. Alarm module for outgoing feeder faults shall be provided with switch fuse, alarm accept, reset PBs, supply ON' lamp, 'fault detected' lamp, hooter, necessary auxiliary contactors, control circuit for detecting, annunciating, accepting, resetting the fault in any module of the particular bus section. Contacts from this module for common feeder fault and its own module supply failure shall be provided and used for annunciation in control desk.
- ii. Alarm module for incomers/bus coupler faults shall be similar to the above except that it shall work on 230V AC supply.


6.5 Control room alarms/indications/SER points

6.5.1 Following indications/alarms shall be available in the control room.

- i. Incomer, bus coupler, ties – ON & OFF.
- ii. Incomer current
- iii. Alarm module supply failed
- iv. Outgoing feeder fault
- v. Incomer alarm supply fail
- vi. Bus under voltage
- vii. Bus earth fault
- viii. Bus voltage.

DATASHEET

Sl. No.	Description	Requirement
1.0	General	
1.1	Type of charger	Combined float cum boost charger
1.2	DC system voltage (Nominal)	110V
1.3	DC System earthing	Unearthed for 110V
2.0	Battery Details	
2.1	Maximum time for boost charging	

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	of batteries	8 hrs
2.2	Battery type	VRLA battery
2.3	Minimum End Cell Voltage	Min 1.85V per cell.
2.4	Discharge capacity for 10 Hour	* Ah
2.5	End cell Voltage	1.85V,
2.6	Float Voltage	2.2V
3.0	Battery Charger Details	
3.1	DC voltage setting	±10% of nominal adjustment of AVR for voltage float charging
3.2	Voltage stabilization for constant voltage regulator	+ 1% of set DC voltage with + 10% variation in supply voltage. +5% during transients
3.3	DC current adjustment for boost charger	30% to 100% of max. Boost charger boost charger current.
3.4	Current stabilization for constant current regulator for boost charger	+2%
3.5	Min. Permissible p.f.	0.8 rated continuous load.
3.6	Permissible ripple content	1% max. at rated continuous load
4.0	DC Switchboard	
4.1	Reference ambient air temperature	50°C
4.2	Degree of Protection	IP-54
4.3	Type of construction	Compartmentalized, Fixed type
4.4	Paint Shade	RAL 7032



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CHAPTER NO – 3.6
ILLUMINATION SYSTEM



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1.0 General requirement

Contactors shall provide normal lighting in control room building and its periphery. Critical lighting shall be provided in control room and rail & road gantry area. Also, 2 Nos. of high mast lighting tower shall be provided in the rail gantry area & road gantry area.

Contactors shall also replace the light fittings in the rail & road gantry area as mentioned in scope of work.

Flame proof fittings and junction boxes shall be provided wherever required as per hazardous area classification layout.

The plant lighting system shall comprise the following two (2) categories:

- a. Normal 240V AC Lighting System.
- b. Critical 110V DC Lighting System.

1.1 NORMAL 240V AC LIGHTING SYSTEM

In this system, the lighting circuits shall be fed by the 3 phase, 4 wire normal AC supply from the normal lighting distribution boards. All the lighting fixtures connected to this system shall be available as long as supply is available from normal source through lighting transformer.

1.2 CRITICAL DC LIGHTING SYSTEM


During station emergency involving total AC failure, incandescent lamp DC lighting fixtures shall be provided for movement of personnel in Control & Switchgear Building at strategic locations viz., near entrance, staircase, landings etc. and for walkways in rail and road gantry areas.

These fixtures shall be connected to lighting panels supplied from 110V DC battery. These lighting fixtures shall be normally kept 'OFF'.

Lighted exit signs shall be provided and installed in the control & switchgear room, relay room, maintenance area etc.

2.0 Technical Specification

2.1 Normal AC System

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For these systems, the distribution will be by 415V, 3 phase, 4 wire, 50 Hz supply with effectively earthed neutral. Supply will be derived from various 415V, 3 phase, 4 wire, 50 Hz switchgears located nearby through delta/star,415/433V lighting transformer with MCCBs in primary and secondary sides. Respective 415V, 3 phase, 4 wire AC Main (MLDB). The MLDBs will be provided with of two nos. 4-Pole MCCB as a Incomer, one no. 4-Pole MCCB as bus coupler and Twelve number of 2 Pole MCB in outgoing feeders to feed the lighting panels distributed in and around the plant as well as to directly feed three phase street lighting and yard lighting panels.

2.2 Lighting Transformers:


The lighting transformers will be of cast resin dry type and shall be housed inside the MLDB/EMLDB. The Primary of Lighting transformer shall be consist of an off load switch for easy removal of transformer. Outgoing MCB's shall be with solid aluminum neutral link. MCCB used shall be with thermo magnetic release with S/C & O/L protection The output rating of the transformers will be either 50 kVA or 100 kVA. The name plate particulars of the transformers will be as follows:

- i. Voltage ratio : 415 / 433 V
- ii. Vector group : DYn11
- iii. Rated impedance : 4%
- iv. Voltage taps : $\pm 2.5\%$, off-circuit taps

The transformer shall be dry type, ANAN cooled suitable for indoor installations. Transformer shall be housed in freestanding enclosures of welded sheet steel frames with expanded metal screens of suitable size or louvers backed by wire-mesh. Transformer and the enclosure shall be suitably reinforced to prevent distortion during handling. Base channels shall be provided with skids and pulling eyes to facilitate handling. Tag plate shall be provided.

The transformer shall be double wound core type with cold rolled grain oriented silicon steel insulated laminations and clamped to minimize vibrations and noise. Core fastening bolts shall be insulated to reduce losses and to avoid hot spots. All parts of the magnetic circuit shall be effectively connected to earth system.

The winding shall be of copper and shall be designed for full load current and to withstand the thermal and electromagnetic stresses arising due to the through fault current. The current carrying winding joints shall be electrically brazed. Insulation process for winding insulation should be VPI. The winding insulation shall be Cast resin/Resin Impregnated/Varnish Impregnated.

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The winding insulation for transformer up to 100 KVA shall be class F with temperature rise restricted to class B and transformer above 100 KVA the winding insulation shall be class H with temperature rise restricted to class F.

Different parts of transformers shall be connected by copper flexible for earth continuity purpose.

All the fasteners and bolts shall be hot dip galvanized as per IS: 802 or zinc passivated.

All surfaces to be painted shall be thoroughly cleaned, de-scaled, made free from rust and shall be epoxy painted.

Winding temperature indicator shall be digital type with RS 485 port and 4-20mA output Signal.

The enclosure protection class should be IP 42(Minimum).

Windings shall be brought out and terminated in cable boxes.

Cable boxes shall be supplied with cable lugs and glands. For PVC/XLPE power/control cables single compression cable glands and crimped type tinned copper cable lugs shall be supplied. Gland plate shall be removable type. For single core cables, gland plate shall be of non magnetic material.

For 200kVA & above transformers shall have busbar arrangement to terminate the cables.

Tapings and control gears shall be provided on the primary side. Tap changer shall be off-circuit type. Under conditions of external short circuit, the tap changing equipment shall be capable of carrying the same current as the winding. Unless specified otherwise, tap changer regulation range shall be +5% with each step of + 2.5%. Tap changing mechanism shall be easily accessible and it shall be possible to change the taps without opening the main transformer enclosure.

Audible noise level for lighting transformers shall be as below:

KVA	Average sound level decibel (At 30cm from transformer)
0-50	50
51-150	55
151-800	65



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Company representative shall be given free access in the works from time to time for stage wise inspection and progress reporting. Four weeks advance notice shall be given to witness the final routine test as per IS-11171. These tests shall be performed on the complete assembly at manufacturer's works. Test certificates duly signed by Company representative shall be issued as a part of final document.

Lighting transformer shall be high efficiency with tapping at 380V.

2.3 Lighting Panel

AC lighting panels shall have single phase incomer controlled by earth leakage miniature circuit breaker (ELMCB) and number of single phase outgoing circuits controlled by MCBs. Lighting fixtures in indoor areas will be controlled from the respective lighting panels. The control of all outdoor lighting such as transformer yard, boiler area and street lighting will be done automatically through contactor controlled lighting panels provided with timers (off –Circuit) along with Manual switching 'ON and OFF' facility will also be provided for these panels. Emergency AC/DC lighting fixture will be marked in the lighting layout and in the field.


AC Normal Lighting Panels are of two type:

Indoor Type: The lighting panel (LP) shall have one no. 4 pole MCB as incomer and 18/12/09 nos. of 2 pole MCB MCB outgoing for controlling the lighting circuits. The Lighting panel shall also feed 5/15A socket outlets.

Outdoor Type: The Outdoor type lighting panel (LP) shall have one no. 4 pole MCB as incomer and 18/12/09 nos. of 2 pole MCB/MCB outgoing for controlling the lighting circuits. The Incomer of such panel shall be provided with a100A/63A TP contactor, Astro timer to operate such panel automatically. Such panel shall be used in boiler, building periphery lighting and other outdoor area for building periphery lighting, circuits may be tapped from the nearby street lighting panels wherever possible. Lighting panels mounted in outdoor areas will be weather proof outdoor type with canopy sloping on the rear side of the Lighting panel.

2.4 110V DC Lighting System

Emergency DC lighting supply distribution will be on 110V DC, 2 wire unearthed system. This power supply shall be obtained from the nearest 110V DC switchboard. DC Emergency lighting distribution board (DCELDB) shall be provided for distribution of lighting supply. This panel shall have an incoming MCCB, under-voltage relay and number of outgoing circuits controlled by DC MCBs. On failure of AC supply connected to the panel, under- voltage relay shall drop out

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and will switch 'ON' the incomer DC contactor and establish DC supply to lighting circuits. Each DCELDB shall have 9/6 nos. 10A DP MCB outgoing feeders to feed DC Lighting

3.0 DESIGN CRITERIA

3.1 The lighting system design shall comply with the acceptable norms and the best engineering practices. The system design shall consider principles of lighting specified in following paragraph. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

3.2 Adjacent fixture shall be connected to different feeder circuits, or phases.

3.3 The Lighting system shall be designed to provide a sustained and uniform illumination level of not less than the values given in Table below, taking into consideration a maintenance factor of 0.6 for outdoor and 0.8 for indoor lighting system.

3.4 The lighting fitting in zone 2 areas shall be in accordance with IS: 8224 / 5572

3.5 Selection of circuits shall take the inrush currents under the worst condition into account.

3.6 Indoor and Outdoor lighting circuits should be separate and the design should be such that blackout conditions can be met during emergency. Also switching off provision during blackout condition should be designed such that it can be done in minimum time, at the same time maintaining reliability.

3.7 The lighting system shall have the facility to switch off (black out) the complete outdoor lighting from a central point in the control room.

3.8 Indoor Lighting


In control rooms LED type lighting fixtures shall be installed as per OISD.

In control room, etc., with computer terminals installed, attention shall be given to glaring.

Initial circuit loading shall not exceed 80% of rating of the protective device.

3.9 Outdoor Lighting

T8 fixtures, having high lumens with average 15000 burning hours, with individual electronic ballast (twin tube light, P.F. > 0.98, THD < 10%), shall be used to the maximum extent, fixed to

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steel work. For lighting in hazardous areas Mercury vapour lighting fixtures/lamp shall be applied. As much as possible floodlighting shall be applied. For the type of lighting fixture in different location see Table 7 and note 3.

All lighting fitting for outdoor use shall be weatherproof (IP 55W) as a minimum and, where located in hazardous area shall be certified for use in the appropriate classified area and gas group in accordance with the relevant Indian standards.

2nos. of 30 meter high mast (identical to the existing high masts) light with 2 X 400 W, HPSV, 18 nos. light fittings with flame proof lighting feeders shall be installed for road gantry. PCC area shall be approximate 75 sq. mm. around high mast and it shall cover feeder pillar also. Each Lighting mast shall be fed through separate lighting transformer.

The peripheral lighting of the control room shall be achieved through 1X150W HPMV flood light fitting.

Mounting height, spacing of flood lights shall be based on lamp wattage, uniformity of illumination and vertical angles. Ratio of minimum to average illumination shall not be less than 0.3 and for minimum to maximum shall not be less than 0.05.


Automatic switching ON/OFF shall be through Astor timers. For road illumination inside the battery limit lighting poles shall be provided every 30m.

Indoor and Outdoor lighting circuits should be separate and the design should be such that blackout conditions can be met during emergency. Also switching off provision during blackout condition should be designed such that it can be done in minimum time, at the same time maintaining reliability.

3.10 ILLUMINATION LEVELS AND CHOICE OF LIGHTING FIXTURES

The area-wise distribution of average illumination levels and type of luminaries shall be as indicated below:

LOCATION DESCRIPTION	AVERAGE INTENSITY LUX
Main control room ¹	400
Other control rooms/panels ¹	300
Office areas ¹	300 ²
Stair	50
Corridor	70
Switchgear rooms	150 - 200
Battery room	150

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UPS /Charger room	300
Cable cellar/room	100
Toilets and locker rooms	100
Ladder/stairs/operating platforms	20 ~50
Process areas	60
Street lighting	10
Working area in remainder plant areas	100

NOTE:

1. Measured 1 m above floor level. (For walkway/staircase, work plane height is considered at floor level)
2. Minimum illumination level. Specific areas and operating/work spots to have an adequate higher level.
3. The color designation of fluorescent lamps shall be 84.

Sl. No.	Area/Structure	Type of fixture	Type of Luminaire
A	Building		
1	Switchgear & Control room	Industrial type with vitreous enamel reflector.	LED
B	VAROVS OFF-SITE		
1	Rail Gantry walkway area	DC light FTL type for hazardous area	36W FTL.
2	Road Gantry	DC light FTL type for hazardous area	36W FTL.
C	GENRAL		
1	Building periphery lighting	Floodlight fitting safe area.	1X150W HPMV floodlight
2	High mast structure	Flood light fitting, Flame proof,	2X400W HPSV

4.0 LIGHTING MAST

- I. The system (high mast and light fittings) shall have a guaranteed design life of 25 years minimum in the given environment.



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II. The environmental and ambient conditions shall be as described in general site and utility data and units of measurement. The Mast shall in all respects be suitable for operation under the service conditions stated in this specification.

EQUIPMENT SPECIFICATION

MAST

The mast shall be of continuously tapered, polygonal cross section presenting a good and pleasing appearance based on proven in-tension design conforming to standards listed. It shall be fabricated from steel plates cut and folded to form a polygonal section and shall be telescopically jointed and welded. The welding shall be in accordance with BS 5135 / AWS. No site welding or bolted joint shall be done on the mast.

The mast foundation design & structural design should be suitable for seismic zone specified in site and utility datasheet.

The mast shall be provided with fully penetrated flange, which shall be free from any lamination or incursion. The welded connection of the base flange shall be fully developed to the strength of the entire section. The base flange shall be provided with gussets and high tensile anchor bolts. The entire fabricated mast shall be hot dip galvanized, internally and externally, having a uniform thickness of galvanization for bottom and top sections.

An adequate door opening shall be provided at the base of the mast at suitable height to permit clear access to equipment like winches, cables, plug and socket etc and also facilitate easy removal of the winch. The door shall be close fitting, dust, vermin proof and watertight.

It shall be provided with heavy duty double locking arrangement. Size of door opening shall be such as to avoid buckling of the mast section under heavy wind conditions. The mast shall have earth boss (terminal) suitable for connection with 75 x 10 mm GI strip

LANTERN CARRIAGE

The Lantern carriage shall be of steel tubular construction designed to accommodate the specified number of luminaries radially symmetrical. All hardware like bolts, nuts etc shall be of stainless steel to avoid corrosion.

It shall have proper arrangement to avoid swing and to prevent damage to mast surface or other installed parts during lowering/raising operation of carriage. Weather proof junction box, made of cast aluminum shall be provided on the carriage assembly as required, from which the



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interconnection cables to the designed number of flood light luminaries and associated control gears fixed on the carriage shall be made.

WINCH ASSEMBLY

For the installation and maintenance of the luminaries and lamps, it will be necessary to raise/lower the lantern carriage assembly. To enable this, a suitable winch arrangement shall be provided, with the winch fixed at the base of the mast and specially designed head frame assembly at the top.

The winch shall have provision to be operated manually and electrically. The winch shall be suitable to handle the weight of the lantern carriage assembly with all fittings and accessories, with safety factor not less than two unless noted otherwise. It shall be of self-sustaining type with positive locking arrangement without the need for brake shoe, or clutches. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be clearly marked on each winch.

Minimum two no of winch drum shall be provided for the winch assembly. The seller in support of the maximum load operated by the winch shall furnish a test certificate of OEM for each winch.

The suspension wire rope system shall essentially be without any intermediate joint and shall consist of only non-corrodible stainless steel of AISI 316 or better grade. It shall have factored of safety not less than five times the working load of the winch.

Particular care shall be exercised in all aspects of design, manufacture, testing and installation arrangement of the system to ensure safety under all operating conditions.

HEAD FRAME

The head frame which is to be designed as a capping unit of the mast shall be of welded steel construction galvanized both internally and externally after assembly. The top pulley block shall be made of non-corrosive material like die cast LM-6 aluminum alloy with self-lubricated bearings and stainless s steel shaft. The Design shall ensure the operation of pulleys is maintenance free.

POWER TOOL FOR THE WINCH

An integral power tool with each mast shall be provided. A suitable, high powered, electrically driven power tool with manual over ride shall be supplied for the raising/lowering operations.



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The capacity and speed of the electric motor used in the power tool shall be suitable for lifting of the design load installed on the lantern carriage. Manual handle shall also be provided for hand operation of winches.

FEEDER PILLAR

Each high mast shall be supplied with one feeder pillar distribution box, which shall be located near it. The feeder pillar box shall be metal enclosed, free standing type made out of 2mm thick MS sheet steel, powder coated and IP-55 weather protected. Additional canopy for rain protection shall be provided as an integral part of feeder pillar distribution box. The box contains incomer switch fuse/MCB, ELCB, motor starters for winch drive, timer switch for lighting control.

Motor starter shall be complete with contactor, bimetal relay with single phasing preventor.

Feeder pillar shall have adequate space to receive incoming and outgoing cable terminations for 415V, TPN supply loop in and loop out arrangement. The feeder pillar shall have two numbers external earthing terminals.

The feeder pillar-box shall have start/stop push button for raising/lowering the carriage. The feeder pillar shall be installed on a raised concrete foundation block and the foundation shall be up to the level of minimum 300mm above ground level.

The power tool for winch drive and feeder pillar box for high mast shall be suitable for unclassified area. However, the provision shall be kept to replace these with FLP type of electrical items if required.

LIGHTING FIXTURES AND CONTROL GEAR

Non Integral flood light luminaries of flameproof type, 2X400W HPSV, 230V, 1Phase, 50 Hz, weatherproof (IP55) shall be provided with the mast.

The details of lamps (exact no. of narrow beam and wide beam lamps) shall be provided by seller depending upon his design.

Separate control gear box in weatherproof IP55, LM6 enclosure shall be provided as per wattage of the lamp. It should house low loss copper ballast & capacitor duly wired to terminals.



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The types, makes and catalogue numbers of various types of flood lighting fixtures are covered in the data sheets attached with material requisition for lighting mast.

MISCELLENOUS REQUIREMENTS

Each high mast shall have two number of aviation obstruction lighting fixtures with low intensity LED type lamps. Lightning protection shall be provided for the masts.

CABLES AND CABLE CONNECTION

All power and control cables including flexible trailing cables shall be supplied, laid and terminated by the high mast Contractor.

The electrical connection from the base compartment to the junction box on the lantern carriage shall be made through special multi core trailing cable of minimum 4 sq mm copper conductor, EPR insulated and sheathed in heavy duty poly chloroprene. Separate core shall be used for lighting fixtures and one dedicated core shall be kept for earthing.

All power and control cables shall be 1100V grade and shall conform to IS-1554 and all flexible trailing cables shall also comply to requirement of IS -9968. The trailing cable shall be terminated by means of metal cased plug and socket, which shall be provided at the base compartment to-enable easy disconnection. The exposed end of trailing cable at the top shall be taken in flexible metal conduit.

All cabling from feeder pillars to high mast shall be laid directly buried trenched.

LABELS

High Mast shall be identified by labels. Label designation shall be in accordance with the material requisition. All removable components shall have a circuit label.

A main nameplate shall be affixed in a prominent position giving the following information with characters written to a minimum size of 12mm in height:

- Manufacturers Name and Type
- High Mast Tag Number
- System Voltage, Phases, Wires and Frequency
- Rated Power
- Year of Manufacture
- BUYERs Name



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- BUYERs Purchase Order Item No.

Labels shall have black characters on a white background and be made of a non-corrodible material. Danger/warning labels on feeder pillar shall be engraved with black letters on a yellow background, in both English & Hindi languages.

Labels shall not be affixed by adhesive.

FINISH

Mast shall be galvanized. The amount of galvanizing shall be 610 gm per sq. meter unless and otherwise specified.

The color and finish shall be as specified in the Data sheet enclosed, for the service conditions specified.

SPECIAL TOOLS

A complete set of any special tools required for the installation, operation, maintenance and testing of the masts shall be provided. The seller shall provide a list of special tools, individually priced. A suitable storage box or wall mounted rack shall be provided.

SPARES


The seller shall provide, separate priced lists or recommended commissioning and operating spares.

5.0 INSPECTION & TESTING

5.1 INSPECTION AT WORKS

5.1.1 All routine and acceptance tests shall be carried out at the seller's works under his care and expense. The seller shall provide internal test certificates before calling for inspection. Tests shall be those listed in the relevant standard specification and any additional as specified in the material requisition and this specification.

5.1.2 Purchaser's representative shall be given free access to the vendor's works from time to time for stage wise inspection and progress monitoring.

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- 5.1.3 The seller shall give minimum 15 days notice period to the purchaser regarding the date of testing at vendor's works to enable client's representative to witness the tests.
- 5.1.4 Contractor shall furnish their detailed Q.A.P for high mast and other components for purchaser's review.
- 5.1.5 Routine Tests shall be carried out on motor for winch drive. Tests shall be carried out on winch, wire rope for conformity to assigned ratings as per specifications in line with applicable BS or international standards. The luminaries shall be tested, as per Indian standards and test reports shall be submitted.
- 5.1.6 BUYER reserves the right to waive off the inspection; in that case material shall not be dispatched unless the test certificates have been approved by the buyer.


5.2 TESTING / COMMISSIONING AT SITE

Installation, testing and commissioning shall be carried out by seller experienced and trained engineer/supervisor. Seller at no extra cost to the purchaser shall rectify any defect pointed out by purchase. Before any part of the High mast system is energized, the pre-commissioning test shall be carried out. This shall include and not limited to following:

- Insulation resistance test
- Continuity test
- Earth continuity check and measurement
- Load current in all phases shall be measured in each mast
- All safety interlock
- Feeder pillar wiring schematics and functional requirements

All pre commissioning checks and tests both for power distributions and lighting system shall be carried out by Contractor in presence of site engineer. After completion of job, Contractor shall carry out, the measurement of achieved illumination level in different areas and shall furnish the test reports.

Minimum and maximum lux level values to be noted and recorded. It is seller's responsibility to demonstrate compliance with approved lux level software calculations. The focusing angle of fixture shall be changed/ adjusted where required. The focusing angle of fixture shall be changed/ adjusted where required.

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All test results shall be recorded and submitted to purchaser in triplicate in bound volume as part of the system documentation. Tests on feeder pillar shall include insulation resistance tests & functional checks.

The operating mechanism of winch shall be tested as a functional check. Seller shall demonstrate winch self-sustaining & positive locking arrangement without the need for brake shoe, or clutches.

6.0 TECHNICAL DATASHEET

Sl. No.	GENERAL		
1.	Normal supply voltage, phase & frequency	AC/DC	240V, 1Ph, 50Hz, 220V DC.
2.	Variation in supply		
	a) Voltage	%	±10
	b) Frequency	%	±5
	c) Combined voltage & frequency	%	10
3.	Design Ambient Air temperature	°C	50
4.1	Luminaire Terminal Suitable for		
4.1.1	Indoor non hazardous area		
	a) Conductor Material		Copper
	b) Wire size		During detailed engineering
4.1.2	Indoor hazardous/outdoor area		
	a) Conductor Material		Copper
	b) Wire size		During detailed engineering
5.	Luminaire Earthing terminal suitable for		
	a) Conductor Material		GI
	b) Conductor size	SWG	12



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CHAPTER NO – 3.7

EARTHING & LIGHTNING SYSTEM



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1.0 GENERAL REQUIREMENT

The Contactor shall carry out earthing for all equipment supplied including equipment in control room building area, rail gantry area and road gantry area.

Earthing shall consist preparation of earth grids and electrodes buried in soil / embedded in concrete inside the buildings to which all the electrical equipments and metallic structures are connected to have earth continuity for safety reasons.

The earth grid for new control room building shall be connected with existing earth grid of the plant.

Lightning protection system shall consist of vertical air termination rods, horizontal roof conductors, down comers, test links and pipe electrodes.

2.0 EARTHING SYSTEM

2.1 Earthing shall meet the requirement of IS: 3043 and Indian Electricity rules. All electrical equipment shall be suitably earthed. Earthing system shall, in general cover the following:

- i. Equipment earthing for personal safety.
- ii. System neutral earthing.
- iii. Protection against Static discharges.
- iv. Separate earth system for instrumentation, DCS, ECS etc. as per specified requirements.

2.2 The earthing system shall have an earthing network with required number of earth electrodes connected to it. The following shall be earthed as required by the codes.

- i. System Neutral.
- ii. Current and Potential transformer secondary neutral.
- iii. Metallic non-current carrying parts of all electrical apparatus such as transformers, earthing resistor, switchgear, motors, lighting/ power panels, terminal boxes, control stations, lighting fixtures, receptacles etc.
- iv. Steel structure, loading platform etc.
- v. Cable trays and racks, lighting poles.
- vi. Cable shields and armor.
- vii. Flexible earth provision for wagon, truck.

2.3 The earthing systems shall be arranged to permit periodic testing of earth resistance from earth connection at major equipment. All frames of equipment shall be earthed by two (2) earthing terminals with two (2) connections to the grid.



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- 2.4 Electrical system and equipment. A value that ensures the operation of the protective device in the electrical circuit and not in excess of 1 Ohm. Static electricity 10 Ohm.
- 2.5 The earthing system shall consist of earthing electrodes, a number of earthing loops or grids and connections to all equipment requiring earthing.
- 2.6 For earthing of remotely located (where no earth loop or grid is available) motor up to and including 55 kW and other 415 V and 240 V electrical equipment, a green/yellow colored insulated earthing conductor shall be included in the multi conductor feeder cable.
- 2.7 Connections to main earth grid underground, all joints and taps in underground cables, connections to the steel or iron bases of non-removable equipment to be earthed shall be by "cold weld or thermo weld" welding process. Normal welding procedures with bitumastic treatment are acceptable.
- 2.8 Earthing connections to motor frames and housing of equipment which may have to be removed during maintenance shall be made by soldered cable using metric screws for fastening to the housing or by other suitable means.
- 2.9 The methods of earthing equipment and devices for computers and for instrumentation shall comply with the specific earthing requirements for the particular equipment. In general, a separate earthing system is required and no other equipment shall be connected to it.
- 2.10 Buildings shall be protected against lightning in accordance with Indian standard code of practice for the protection of buildings and allied structures against lightning: IS: 2309.
- 2.11 Where an electronic Earth Providing Unit (EPU) is specified for loading or unloading facilities, the system shall prevent the electrically-driven pump unit from starting if the specified earth loop resistance value is not achieved. Both local and remote alarm facilities shall be provided.
- 2.12 Inside hazardous areas, all in-line instruments and valves that are clamped between non-conductive packing shall be bonded with a conductor. For this purpose adequate lugs shall be provided on both the instrument (valve) and the pipeline.
- 2.13 Final connections to equipment and earth bus bar shall be with the aluminum cable in accordance with Table shown below.


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BARE GI STRIP / ALUMINIUM CABLE	APPLICATION
16mm ² Single Core Aluminum Cable, PVC insulated	Motors up to 18.5 KW, Small equipment and instruments, Push-button stations, Street lighting poles, Cable tray Inter, links, Junction Box, Single phase Sockets.
35mm ² Single Core Aluminum Cable, PVC insulated	Motors up to 37 KW, Welding receptacles, High mast poles, Local Panels (MLDB, LDB, PDB and Instruments), IRC/IFC Panels.
70mm ² Single Core Aluminum Cable, PVC insulated	Motors up to 75 KW,
185mm ² Single Core Aluminum Cable, PVC insulated	Motors up to 160 KW.
40 x 5 strip	Building columns, Storage tanks (vertical and horizontal), Pipe racks, Heat exchangers and Loading racks.
75X10 mm GI strip	LV switchgears, power transformer, earth grid around sub-station, Main grid process units.
50X 6 mm GI strip	Rectifier, Lighting Transformer, UPS, MCC room, etc.

- 2.14 The armor of power cables shall be used for earthing continuity in combination with the earthing grid, i.e. Connected to the distribution panel earth bar and in motors to the earth bolt inside the main connection box. This earthing connection is additional to the normal safety earthing connections.
- 2.15 Lightning protection shall when required, follow the requirements of IS: 2309. OISD-STD-180 may also be referred for details on lightning protection.
- 2.16 Metal parts of the cable racks and trays shall be bonded and connected to the common earthing grid at every 25 meter intervals.
- 2.17 Lighting fixtures and convenience outlets may be earthed via an earthing lead of the supply cable. The earthing lead shall have a minimum cross section in accordance with IS: 3043.
- 2.18 Static Electricity: Adequate provisions wherever necessary for control of static electricity shall be made in accordance with IS: 7689.

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- 2.19 Earthing system shall be designed in a manner that provides a means to safely discharge lightning strokes to earth, reduce step and touch potential to safe level and confine dangerous soil currents. The BIDDER shall submit supporting calculations along with layout as per methods described in above referred standards. The BIDDER shall also submit the earthing layouts to electrical Inspector for his approval. Necessary modification wherever required shall be carried out by the contractor and got approved by the Inspector at no extra cost to the Purchaser.
- 2.20 After installation, the resistance of the ground grid shall be tested in presence of PURCHASER as per IE rules. If the resistance is observed to be not less than 1 ohm, the Contractor shall derive additional earth pits such that resistance is less than 1 ohm. After the test, report shall be submitted to Electrical Inspector for approval. The submission of Earthing layouts, drawings and obtaining final clearance & approval from Electrical Inspectorate shall be within the scope of the BIDDER.
- 2.21 Metallic frames of all equipments, supporting structures adjacent to current carrying conductors, lightning protection system conductors and neutral points of various systems shall be connected to a single earthing system. Two earthing leads shall be used if rated voltage of equipment is above 250V. If the rated voltage is 250V or below, one earth lead shall be provided. Metallic structures adjacent to electrical equipment shall be earthed by one earthing lead.
- 2.22 Earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm.
- 2.23 All cable trays in the building as well as inside the trenches shall be connected to earth grid at an interval of about 10 m.
- 2.24 All fences (if any) shall be earthed.
- 2.25 The earth grid of the control room shall be connected to the existing earth grid of the plant.
- 2.26 The following points shall be noted while preparing Earthing and Lightning protection layout for different areas.
- a. Main earthing conductors shall be laid in the form of a grid. Spacing between conductors, number of parallel conductors, etc., shall be decided such that step and touch potential are within safe limits.
 - b. The maximum permissible step and touch potentials shall be calculated in accordance with IEEE 665 for control building auxiliary areas.
 - c. Earthing conductors shall be provided around the outside edge of fences at a

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- distance of approximately 1000mm. This shall be connected to the main earthing grid.
- d. Lightning protection down conductor shall be directly connected to a separate earth electrode. All earth electrodes in turn shall be connected to main earthing system. The earth grids of different areas of the plant shall be interconnected through test pits to enable measurement of earth resistance for each area separately.
 - e. Earthing grid design shall be done in such a manner that the grid resistance is less than one (1) ohm.
 - f. Main earthing conductors shall be buried in earth around the building. Minimum two taps-off from this earthing loop shall be taken inside the building and connected to the earthing grid embedded in the floor slab with approximately 50 mm concrete cover.
 - g. In case, the building has more than one floor, each floor shall be provided with earth grid. Floor earthing grids shall be interconnected.
 - h. Each RCC / Steel column of the building shall be interconnected to the floor earthing grid in the ground floor.
 - i. Cable trays, steel pipes /conduits, steel columns, etc., shall not be used as earth continuity conductors.
 - j. Instrumentation system , computer system & PLC shall be provided with a dedicated redundant electronic earthing system suitable for the equipment and shall conform to DCS manufacturer's specification.
 - k. Earthing grids of all the buildings, outdoor yards shall be interconnected to form a single grid for the plant.
 - l. Earthing grid design shall be done in such a manner that the grid resistance is less than one ohm.
 - m. All electrical equipments shall have double earthing in general.

2.27 Soil resistivity measurement test shall be carried out by EPC contractor.

2.28 Average soil resistivity shall be calculated based on soil investigation report which will be furnished to the BIDDER during detailed engineering stage. Earthing conductor shall be designed to carry maximum earth fault current and hence 50 kA shall be considered for the design of entire earthing system for 1 sec duration withstand time.

3.0 LIGHTNING PROTECTION SYSTEM

The lightning system design and installation shall generally comply with IS: 2309 – code of practice for protection of building and allied structures against lightning. Each down conductor shall be connected to a rod electrode which in turn shall be connected to the station earthing system through test links.

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NEED FOR LIGHTNING PROTECTION

The need for providing the lightning protection system shall be established by calculating risk index value for each building structure, etc., as per procedure given in IS-2309 and any building whose risk index is more than value specified in IS shall be provided with lightning protection.

4.0 MATERIAL & CONSTRUCTION

The earthing system conductors & accessories shall be as follows:

- (a) Conductors above ground level & in trenches: Galvanized steel
- (b) Conductors buried in ground or embedded in concrete: Mild Steel.
- (c) Electrodes: GS pipe/Rod
- (d) Lightning protection air termination & down conductors for buildings: GS flat

Size of conductors:

- (a) Main earthing conductors

The earthing conductors sizes shall be calculated based on IS 3043 & the earthing system shall comply with IE rules & IEEE-80 . The calculated size shall be suitably (depending on the resistivity of soil) increased as per table below to account for the loss of material (steel) due to corrosion in soil. The calculation for the earthing conductor size and step & touch potential shall be submitted for PURCHASER's / ENGINEER's approval.

Resistivity of soil (ohm-metre)		Increase in thickness/diameter of earthing conductor (mm).
	<10	8.0
>10	<25	7.0
>25	<50	5.5
>50	<75	4.5
>75	<100	3.0
>100		1.5

- (b) Rod Electrodes

Galvanized steel rod electrodes of suitable diameter and length shall be used



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as per the recommendation of IS-3043. For test pits, electrodes shall be heavy duty type (Class – C) GI pipe of suitable diameter with perforations. Electrodes installed in the test pits will have disconnecting facilities.

(c) Equipment Earthing Leads

The size of the earthing leads shall be decided based on the type of equipment and structure to be earthed and shall be provided generally as per IS-3043. Number of sizes shall be standardized to simplify procurement.

(d) Conductors for lightning protection system

The size of conductors for lightning protection system shall be decided based on mechanical strength.

5.0 INSTALLATION SYSTEM

The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.

Earthing conductor running exposed on column, walls, etc., shall be supported by suitable cleating, at intervals of 750 mm.

The earthing conductor crossing the road / track shall be laid in cable duct banks at a greater depth to avoid damage.


When earth conductor passes through floors, walls, etc., suitable pipe sleeves shall be provided and the same shall be sealed after installation.

The connection between earthing/pads/terminal to the earth grid shall be made short & direct & shall be from Knicks/splices.

Metallic conduits & pipes shall not be used as earth continuity conductor.

Street lighting poles, flood light poles & towers, their junction boxes etc. shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.

Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles etc.

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Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound.

Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

The cable sheaths, screens armor shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.

All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.

The fences shall be grounded in the areas of high personnel movement and where the fence crosses the ground grid. All fence gates shall be provided with grounding jumper.

BIDDER shall demonstrate the effectiveness of earthing system by measurement of earth resistance, step and touch potential at different locations.



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CHAPTER NO – 3.8

FDA SYSTEM



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1.0 GENERAL REQUIREMENT

Contactors shall provide complete fire detection and alarm system for the control room building including the switchgear rooms and battery rooms.

The contractor shall hook-up detectors and other FDA equipments with existing integrated microprocessor based intelligent addressable, digital FDA panel.

The system shall comprise of but not limited to the following:

- a) Multisensor detector, Spark/Ember type detector etc. as mentioned elsewhere in the specification and manual call points.
- b) Fault Isolator modules, monitor modules & control modules as required.
- c) Response Indicator.
- d) Fire warning siren.
- e) Cabling (including power & control) & any other special cable required for complete fire detection and alarm system. Cable carrying / supporting wherever Purchaser's cable trays are not provided.
- f) Earthing of complete fire detection and alarm system.
- g) Accessories for mounting and supporting all equipment covered in this specification.
- h) All minor civil works such as chipping, boring, making openings, grouting, cementing, embedding foundation bolts for installation of all electrical equipment supplied under this contract shall be carried out by the Contractor within the contract price.
- i) Audio hooters with and without strobe light as mentioned in BOQ distributed over various areas to alert the people in that area during fire for evacuation. Addressable electronic hooters shall have a sound output not less than 80dB. Hooter shall be provided at entry / exit.
- j) Relay modules, necessary input/output module.
- k) Mandatory spares and tools for satisfactory operation & maintenance.
- l) Tools and tackles required for mounting / working such as ladders, scaffold, safety harness & other safety equipments.
- m) Preparation of detailed cable tray routing layout drawings for fire alarm and detection system.
- n) Preparation of interconnection cable schedule & cable schedule for all the electrical equipment covered in this enquiry. Bidder shall indicate the maximum permissible distance from the fire alarm panel at which the detector will operate satisfactorily. Bidder



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shall also indicate maximum number of detectors/devices to be connected to the panel.

- o) Spares for three (3) years of satisfactory operation & maintenance tools
- p) Test reports of the detectors from satisfactory authorities shall be enclosed with the BID.
- q) 230V, 1Ph, 50Hz supply will be provided by the Purchaser at One (1) point. Any other supply required shall be derived by Contractor.
- r) PDB if required, necessary distribution & protection devices (MCB's etc) dedicated for Fire system to be considered by Bidder in his scope.
- s) Suitable interface for integrating with plant communication and plant DCS system to be provided in fire detection system panel (any hardware required to send voice evacuation / voice signal / message to be included with the panel).
- t) The FDA system shall be capable of integration with the Main Fire Alarm panel in the existing plant.
- u) Any other items which are required to make the system complete (as deemed by Purchaser) in all respects and for satisfactory operation of the system.

Exclusions

- Main fire alarm panel
- Fire proof sealing system


2.0 TECHNICAL SPECIFICATION

2.1 AUTOMATIC FIRE DETECTORS AND ACCESSORIES

2.1.1 General Specifications

All the detectors shall be intelligent soft addressable. Each detector shall have inbuilt short circuit isolator. Detectors shall be plug in type and shall have twist lock action fitting. Single LED which will remain off in normal condition and will be illuminated on fire alarm condition shall be present on the detector. Essential features of detectors are indicated as below.

Detectors shall be supplied with mounting bases. Mounting base shall be identical for all type of detectors except special application detectors such as linear beam detectors etc. for installation as well as cable connection. Detector housing (body and cover) shall be made up of damage resistant, fire resistant polycarbonate and shall be suitable for either surface or recess mounting. Detector base shall be mounted on Junction boxes having terminals for cable termination. Where installation is included in Contractor's scope, equipment such as GI conduits, GI junction box/conduit box etc. shall also be included in Contractor's scope.

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Detectors shall be suitable for storage at ambient condition specified in data sheet.

All detectors shall be on the approved list of LPC, UL / FM/ Vds equivalent international approving agency as applicable.

All detectors shall be suitable for operation at DC power supply extended from fire alarm panel.

The intelligent detectors shall have drift compensation ability. It should be able to adjust its sensitivity to the surrounding environment. It should pass on the information for service required to the panel when due for cleaning. It should be able to decide the case of alarm or fault by itself and hence no need for the panel to poll for information. Information like the life of the detector should be available depending on the environment it is placed. The sensitivity level shall be set from the service software provided with the fire alarm panel.

All addressable detectors shall have selectable settings for pre-alarm and alarm and preferably have the facility to set the sensitivity and address from the fire alarm panel.

Manual call points / break glass boxes for microprocessor based fire alarm system shall be addressable type. Each device shall have its own address module. No additional module to be used for addressing.

All addressable detectors shall be suitable for installation using fault tolerant wiring (class-A, style - 6 wiring as per NFPA72). T- Tapping shall not be permitted in the case of such wiring.

All detectors must have insect screen to prevent entry and cause false alarm.


All field devices shall be from the latest generation in the manufacturer's range of products. Commonly used field devices are listed below. The specification given shall be considered as the minimum requirement.

2.1.2 Heat Detectors

Heat detectors shall use negative temperature coefficient thermistors for sensing and for reference. The detector shall be designed to give a response that depends on both absolute temperature and rate of rise in temperature.

The rate of rise element shall be carefully calibrated to ignore any normal fluctuation temperature, but to respond quickly when the temperature rise is 9°C or more per minute

The fixed temperature feature should be entirely independent of the rate of rise element. The

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operating temperature of fixed temperature element should be adjustable in levels.

The detector shall be self-restoring type ensuring repeated use and easy maintenance. Should have inbuilt short circuit isolator.

2.1.3 Photo Electric / Optical Smoke Detector

Photo electric/ optical smoke detectors shall work on the principle of light catering utilizing a light emitting diode. The photodiode shall have an integral daylight blocking filter. Supply wiring shall be two wire supplies, polarity insensitive.

2.1.4 Manual Call Point (MCP)/ Break Glass Unit (BGU)

Manual break glass unit shall be fabricated out of 14-gauge cold rolled sheet steel or shall be of plastic, glass reinforced. It shall be suitable for indoor/ outdoor duty as specified in the data sheet. Outdoor type shall have IP-55 enclosure and weatherproof construction suitable for outdoor installation. The break glass unit shall have a minimum dimension of 100x100x80mm

The box shall be fabricated in such a way it can be mounted flush to the wall or on the surface without any modification. Two nos. 19 mm knockouts shall be provided at the bottom of the box to facilitate cable / conduit entry. The glass shall cover at least 30sqmm area and shall have a thickness not exceeding 2mm


The box shall have a push button element kept in pressed condition by a glass sheet fitted in the front of the box.

The enclosure shall be painted with fire red color (shade 536 of IS-5) epoxy painting and an inscription "Break Glass in case of Fire", shall be painted in white letters or riveted on the enclosure by a steel nameplate.

Each manual call point/break glass unit shall be soft addressable type. No external module to be used for addressing. It shall have an LED which will illuminate when the glass is pressed and broken. It should be suitable for recess as well as surface mounting. Each manual call point shall have inbuilt short circuit isolator for monitoring open or short circuits. The glass should be able to be by pressing with finger with no danger of getting hurt and no hammer should be required.

2.1.5 Response Indicator

Response indicators shall be provided suitable for wall/ ceiling mounting. Response indicator

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shall be provided where the detector is located either above false ceiling or below false floor or where detectors are not directly visible. The response indicators shall be connected to the detectors directly and shall be complete with terminal blocks suitable to accept cables with up to 1.5sqmm copper conductor. The response indicators shall mimic the LED on the detector or detectors to which it is connected physically or through software. Use of Response indicators in addressable system is not envisaged unless otherwise specified in data sheet

2.1.6 Hooter /Sounder (Loop powered type)

The unit shall consist of solid-state circuitry on a printed circuit board, a loudspeaker and a flashing lamp housed in a weatherproof dust tight wall/ ceiling mounting type enclosure. The hooter shall at least, have 102 db (A) output measured at 1-meter distance. The unit shall be loop powered and operate on DC power from the fire alarm panel. In the event of fire, the hooter / sounder shall raise pulsating audio alarm and the lamp shall start flashing.

2.1.7 Fault Isolator

Fault isolator shall be designed to provide short circuit protection to an addressable detector without outage of other detectors in loop. It shall be inbuilt or provided after every detector.


On occurrence of a fault (short circuit), the isolator shall cut power to the devices installed between the two minimizing the outage of the detectors in a loop.

The fault isolator shall have the capability to continuously check the faulted side of the loop to determine if the fault still exists. On rectification of the fault, the isolator shall automatically reset itself.

Fault isolator modules shall be housed in an enclosure having IP-55 degree of protection as a minimum.

2.1.8 Combined Heat and Smoke Detectors (Multi-sensor detector)

Combined Heat and Smoke Detectors shall have optical smoke sensor and a thermistor temperature sensor whose outputs are combined to give a final output value. The signals from the optical smoke sensing element and the temperature sensors shall be independent and the microcontroller of detector shall process the two signals. The temperature signal shall process only rate of rise information for combination with the optical signal. A sudden large change in temperature should be detected and cause an alarm. The sensitivity of the detector shall be considered such that it is optimum for most general applications and offer good response to both smoldering and flaming fires.

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The types of fire detectors which shall be generally used in different areas of the plant have been listed below:

Sr. No.	Parameter	Type of Fire Detection System
1	Control room building	Manual call points strategically located
2	Switchgear rooms, control room, UPS room	Addressable multi sensor detectors and manual call points,
3	Battery rooms	Addressable Rate of rise of temperature detector with fixed temperature element and manual call points, hydrogen detectors

3.0 INSPECTION AND TESTING


All the equipment shall be tested to the defined specifications as per mutually agreed test plan/ Factory Acceptance Test (FAT) procedure, which shall be submitted and got approved from Purchaser at least one month before inspection. Purchaser's inspectors shall witness all the tests.

During manufacture, the equipment shall be subject to inspection as per attached inspection plan to assess the progress of work and to ascertain that the quality controls are being maintained. Contractor shall provide all necessary assistance and information concerning the supply to Purchaser's inspectors.

Tests shall be carried out at the vendor's works under his care and expense and Purchaser shall be informed at least 4 weeks in advance regarding this

Factory Acceptance Test (FAT) shall include simulation of operational field conditions and test for functional adequacy. Besides all routine, and acceptance tests specified by applicable codes and standards, shall be performed on the complete system.

For bought out items, the routine and acceptance tests shall be conducted at the respective equipment manufacturer's works. For imported items, the tests will be carried out after the commissioning of the system at site. The Imported items should have 24 months guarantee from the date of commissioning. It should have all the necessary approval (UL/FM, BASEEFA, VdS or equivalent) as required (from statutory authority for review of inspectors) in India.

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At the time of inspection, Contractor shall produce original of all the type test certificates, test and approval certificates for hazardous area equipment from testing and approving authority and any other certificates as required from statutory authority for the review of inspectors.

Contractor shall submit a Site Acceptance Test (SAT) procedure for Purchaser's approval. All equipment and systems shall be tested at site as per the approved SAT procedure

SAT shall be conducted by Contractor after the entire fire alarm system is installed and- inter connected by cables. These tests shall establish the operational correctness of the system. Contractor shall rectify deficiencies noticed during SAT with no commercial implication to Purchaser including replacement of system components and supply of new component for making system successfully operational.

Sl. No.	Description	Requirements
1.1	Reset ability of detectors	Remote resettable
1.2	Interchangeability of detectors	To be provided
1.3	Response Indicator	- Lights up steadily to indicate alarm condition
		- Flashes intermittently under healthy condition
1.4	Test facility	To be provided
1.5	Label	To be provided with tag no's.
1.6	Mounting facilities	To be provided
1.7	Radioactivity for ionization smoke detector	NA
1.8	Power Supply	All devices shall be loop powered
1.10	Degree of protection of components / panels	- IP42 for indoor plant areas
		- IP65 for outdoor areas



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CHAPTER NO – 3.9

LV CABLES



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1.0. DESIGN/SIZING PHILOSOPHY OF CABLES

1.1. The bidder shall design the sizes of cables considering the sizing philosophies mentioned below. The sizing calculations for all cables shall be submitted for purchaser's/EPC consultant for approval.

1.2. In general, power cables shall be sized to satisfy the following three criteria.

- a) Full load current carrying capacity under installation conditions (i.e. with suitable derating factors to cover site conditions such as ambient temperatures and cable laying configuration).
- b) Short circuit current withstand capacity for applicable fault current & duration.
- c) Maximum voltage drop limits under steady state & voltage dip during motor starting.

1.3. 415V supply feeders.

For cables from PCC/PMCC to downstream MCC, the cable sizes are decided on the basis of 1.1 times the actual current loading on each switchboard/MCC/ACDB. For other outgoing feeders 100% of the feeder rating shall be considered. Power factor for 415V supply feeders shall be (Cos Ø = 0.8)

1.4. 415V Motor feeders.


Normal current rating for motor feeder shall be taken as 1.1 times the full load current corresponding to the motor rating. For voltage dip consideration, the starting current shall be taken as 6 times the full load current for all motors. Power factor & efficiency for 415V motors under steady state conditions shall be considered as

Cos Ø = 0.8, Efficiency = 0.85

110V DC feeders

Normal current rating for motor feeder shall be taken as 1.1 times the full load current corresponding to the motor rating. Starting current for DC motors with step resistor starting shall be taken as 2.5 times full load current.

1.5. Voltage drop limits considered for various cables are as under:

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SL. NO.	SYSTEM ELEMENT	MAXIMUM PERMISSIBLE VOLTAGE DROP
1	Bus duct or cable between transformer secondary and HV Switchboard or PMCC	0.50%
2	Cable between PMCC and MCC or other Auxiliary switchboard	
	a. If PMCC and MCC/Auxiliary Board placed in same substation	0.50%
	b. If MCC/Auxiliary Board placed at remote place from PMCC	2.50% (See Note-1)
3	Cable between PMCC and motor	5%
4	Cable between MCC (Located near PMCC) and motors	5%
5	Cable between MCC (Located remote from PMCC) and motor	3%
6	DC supply circuit	5%.
7	UPS outgoing circuit	5% (See Note-3)
8	Cable between Auxiliary Switchboard/LDB and lighting panel	1.50% (See Note-2)
9	Between lighting panel and field lighting point	4%

And the voltage drop during Transient state (during motor starting condition) - 15%

Note-1: Higher voltage drop may be permitted between PCC/PMCC and remote mounted MCC/Auxiliary switch board, if overall voltage drop up to motor (from PCC/PMCC) is limited within 5.5%.

Note-2: If it becomes difficult to achieve the specified voltage drop in cables up to lighting panel, 5% drop from Auxiliary switchboard up to lighting points may be permitted.

Note-3: Minimum voltage available across any instrument in the field shall be as per design basis. Distribution system for instrumentation supplies shall be designed accordingly. In case of any conflict between electrical design basis and instrument design basis, the latter shall govern regarding instrument power supplies.

1.6. Short Circuit current withstand capability.

a) For feeders protected by circuit breakers:

The cable cross section shall be designed to withstand the rated short circuit current for a minimum time of 1.0, 0.5, 0.16 seconds for incomers, tie feeders & transformers/motor



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feeders respectively. In general, however appropriate times as required shall be considered if the time given above is exceeded for any of the services.

b) The following data is used as the basis input data for sizing & selection of cables.

Fault current for 415V systems: 50kA. (r.m.s)

Fault current for 110V dc system: 20kA. (r.m.s)

1.7. The length of Cable shall be derived as follows:

1.7.1 Scale the length on the layout, along the center of the cable tray or trench.

1.7.2 Add approximately 5% to the measured length to compensate for deviations from the center of the tray or trench along which is measured.

1.7.3 Add the lengths for the individual run section. (e.g. inside buildings, along structures, in the switchgear, etc.)

1.7.4 Add riser heights at both ends of the cable if not covered above. (Generally a maximum length of 2 meters per riser end is sufficient if no significant risers occur.)

1.7.5 Adjust the total length found to the next higher multiple of 5 m

1.7.6 For cables running over the same track to approximately the same location (e.g. a pump and its spare) the longer length within a multiple of 5m is to be listed.

1.8. All incoming cables to switchgear, UPS, DC system, Motors, DBs or any other equipment shall be sized for maximum anticipated load including 10% future load growth. Cable for capacitor banks shall be sized for 135% of the rated capacitor current.

All control cables shall have 10% spare core, except that control cables having up to seven cores may have one core as spare.


2.0. Technical Specification

2.1. The cables shall in all respects be suitable for operation under the service conditions stated in the attachments to the Material Requisition. They shall have a design life of at least twenty years.


2.2. All armored and unarmored cables shall be suitable for operation when installed:

2.2.1 Direct buried in the ground (Note: Cables shall be suitable for direct burial in water-logged ground.)

2.2.2 In underground ducts

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- 2.2.3 Above ground, fastened to cable ladder rack or tray in the open air exposed to direct sunlight
- 2.2.4 Below ground in enclosed, air filled trenches, fastened to cable ladder rack or tray.
- 2.3. Cables for AC service shall be suitable for operation at 50 Hz. Where applicable, requirements for DC service will be indicated in the cable specification.
- 2.4. Cable Construction
 - 2.4.1. Power Cables up to 300sqmm size shall be of Multicore cables. For above 300sqmm size single core cables shall be considered. LV power cables shall be XLPE insulated type.
 - 2.4.2. All PVC insulated cables shall be suitable for continuous conductor temperature of 70°C and short circuit conductor temperature of 160°C. XLPE insulation shall be suitable for continuous conductor temperature of 90 °C and short circuit conductor temperature of 250°C.
 - 2.4.3. LV Power cables shall be of 1.1 kV grade, stranded aluminum/copper conductor XLPE insulated, extruded black PVC inner sheathed, armored, and overall FRLS extruded black PVC outer sheathed cables conforming to IEC 60502-2.
 - 2.4.4. Control cables shall be of 1.1 kV grade, multicore, PVC insulated, PVC inner sheathed, armored, FRLS extruded black PVC outer sheathed stranded high conductivity annealed tinned copper conductor conforming to IEC 60502-1. Conductor cross section will generally be 1.5sq.mm. CT, PT and switchyard control circuits will use 2.5 or 4 sq.mm copper conductor cables.
 - 2.4.5. The signal cables shall be of 650 / 1100V grade, 0.5 sq. mm, stranded high conductivity annealed tinned copper conductor, multicore, PVC insulated, flexible, twisted pair/triplets, individually and overall shielded(for low level analog signals) and only overall shielded for digital signals, extruded PVC inner sheathed, steel wire armored and overall FRLS PVC outer sheathed.
 - 2.4.6. For single core armored cables, armoring shall be of aluminum wire. For multicore armored cables, armoring shall be of galvanized steel strip/wire as per applicable IS.
 - 2.4.7. The cable cores shall be laid up with fillers between the cores wherever necessary. All the cables shall have distinct extruded PVC inner sheath.
 - 2.4.8. Conductor of Copper cables shall have plain annealed copper. All the conductors shall be multi-

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stranded.

2.4.9. Cables shall be suitable for laying on racks, in ducts, trenches with chances of flooding by water and shall also be suitable for directly buried installation. All the cables shall be flame retardant low smoke (FRLS) type designed to withstand mechanical, electrical and thermal stresses developed under steady state and transient operating conditions.

2.4.10. Cables would be laid in fabricated steel ladder type or perforated type cable trays in the station and other auxiliary buildings and upper elevations of the steam generator area. Between buildings, the cables would be laid in built-up trenches. Cables to other plant areas located far off from the station building would be laid on overhead racks.


2.4.11. Outer sheath shall be of PVC black in color having following FRLS properties.

- Oxygen index of the cable will not be less than 29 when tested in accordance with ASTM-D-2863.
- Acid gas emission will be less than 20% as per the requirements of IEC-754
- Smoke density of not more than 60% when tested as per ASTM-D-2843

2.4.12. The outer sheath of cables shall be embossed or engraved with

- a) Reference of standards
- b) Manufacturers name or trademark.
- c) Cable Type.
- d) Voltage grade in V.
- e) Number of cores and Cross section area.
- f) Cable code
- g) Year of manufacture.
- h) The drum progressive length of cable at every metre. (The starting point being the cable end at its inner coil on the cable drum.)

2.4.13. The cables shall meet flammability test as per IEEE – 383.

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2.5. Cable drum:

2.5.1. Cables shall be supplied in wooden or steel drums of heavy construction. Wooden drums shall comply with applicable IS.


2.5.2. All cable drums shall have the Purchase Order Number, Purchase Order Item Number, Drum Number and Stock Code Number clearly stenciled on the outside of both flanges.

2.5.3. Drum identification labels shall be attached to the outside and inside of the drum flanges. Labels shall be protected by transparent plastic envelopes and give the following information:

- a) Drum identification number
- b) Cable voltage grade
- c) Cable construction
- d) Number of cores and cross sectional area
- e) Length of Cable on the drum (Metres)
- f) Number of lengths on the drum (if more than one)
- g) Direction of rotation of drum (by means of arrow)
- h) Purchase order number and item number
- i) Total weight of cable and drum (kg)
- j) Manufacturer's name
- k) Year of manufacture
- l) Stock code number

2.6. **Inspection and Testing**


2.6.1 The Seller shall provide certificates for tests carried out on cables. Tests shall be those listed in the relevant standard IS 10810 and any additionally specified within the material requisition.

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- 2.6.2** Company reserves the right to witness all tests specified on completed cables.
- 2.6.3** The EPC contractor shall give two weeks' notice of tests prior to commencement.
- 2.6.4** Company reserves the right to inspect cables at the Sellers works at any time prior to dispatch to prove compliance with the specifications.
- 2.6.5** Cables shall not be dispatched unless the test certificates have been approved by the Company.

3.0. LAYING PATTERN

- 3.1.** Cable shall be laid in one (1) layer (preferred) or in more layers. The spacing of load- carrying cables shall be in accordance with the applied de-rating factor data. Non-load carrying cables shall be joined together.
- 3.2.** Cable trays for MV, LV & Control cables shall be separate. MV cable trays shall be kept in bottom tier, LV cable trays shall be kept above the MV tray tier and control cable trays shall be kept in the top tier. Minimum vertical distance of 300mm shall be maintained between two cable trays in plant area while 400 mm in case of substation area. Min. gap of 300mm shall be maintained between LV Electrical & Instrumentation trays. Min. gap of 600mm shall be maintained between MV Electrical & Instrumentation trays.
- 3.3.** In plant areas, the associated control cable shall be installed in a separate tray (Preferably top tier) or min 300mm away from Electrical cables. In case of underground it shall be layed on the upper layer.
- 3.4.** Specific attention shall be given to ensure adequate separation of cables in the vicinity of substation and at other areas of congestion.
- 3.5.** The spacing of load-carrying cables shall be in accordance with the applied derating factor data. Generally MV cables shall be laid with 1D spacing in single layer, LV cables & control cables shall be laid touching each other in (max. two) layers.
- 3.6.** Individual cables emerging from floors of soil shall be protected against mechanical damage by means of galvanized steel pipes or rigid PVC pipes. Single conductor cables emerging from floor or soil shall be protected by rigid PVC pipes. These pipes shall extend at least 100 mm aboveground or floor level, and shall be suitably sealed to avoid water ingress.

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- 3.7. Grouped cables emerging from floors or soil shall be protected collectively by a properly designed metal shield or duct in such a way that heat dissipation of the sustained load- carrying spaces to the other shall be prevented by proper sealing of openings around cables.
- 3.8. To avoid oil or chemicals leaking into the cable trench, the above-mentioned cable protection shall be sealed at the top around the cable(s) with a suitable sealing compound.
- 3.9. Cables or cable supports shall not be fixed directly or indirectly to plant equipment or process piping which may require removal or replacement.
- 3.10. Aboveground cables shall be mechanically protected either by open conduits or by cable trays with covers.
- 3.11. Cables running on cable ladders shall be securely fastened with UV-resistant tie wraps.

4.0. CABLE TRENCHES

- 4.1. The cable run between the main cable routing and the point where the cables emerge to aboveground, will either be in conduits or in small trenches, depending on the economics and practical possibilities.
- 4.2. The cables shall be laid in trays covered by clean sand fill, duly compacted and protected by protection tiles. The top finish over the protection tiles may be in accordance with the surrounding area.
- 4.3. Cable trenches in process unit if any, to be sand filled with concrete side walls and bottom & removable sealed concrete covers. No protection tiles need to be installed. Suitable drainage facilities to be provided.
- 4.4. Except for short length near the termination points of the cables in the plants area, underground cable pipes (ducts) shall be avoided, since relatively long pipes and ducts will affect the cable current rating unfavourably

Note: Cable that are de-rated for underground/direct burial installation do not require further, derating for partial installation in pipes (e.g. at road crossing) provided the piping length does not exceed 7metre. If longer runs are necessary, then the cable shall be de-rated for installation in pipes.

- 4.5. All cables shall be terminated directly in the equipment terminal box, with exception for LV

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cables, for which Exe/ Exd junction boxes may be installed between the underground and aboveground cables parts in one(1) of the following cases:

To provide a smooth construction interface, i.e. avoiding long-coiled ends of underground cabling awaiting aboveground installation.

- To reduce an exceptional large cross-sectional area of that part of the cable route installed aboveground, when the underground cable is significantly derated, i.e. more severely derated than the overall rating factors given as guidance in paragraph.
- To reduce from parallel feeder cables to single cable connections on the equipment.
- To facilitate the replacement of the final cable connection to the equipment terminal box, if frequent disconnection is required or expected.
- To provide for expected settlement of the ground.



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CHAPTER NO – 3.10

MISCELLANEOUS ELECTRICAL ITEMS



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1.0. GENERAL


- 1.1. This section covers the design, manufacture, supply, erection, testing and commissioning of Miscellaneous Electrical Items.
- 1.2. The scope of work shall include, but not limited to the following;
- a) Cable Trays and Accessories
 - b) Cable termination and jointing kits
 - c) Cable ties, clamps and markers
 - d) Conduits and accessories
 - e) Junction boxes
 - f) 3-phase power Receptacles
 - g) Cable glands and cable lugs
 - h) Fire stop cable sealing system
 - i) Danger Boards
 - j) Rubber Mats
 - k) Marshaling Boxes (MBs) / junction Boxes (JBs) shall be supplied as required for marshaling cables of devices located in an area/ equipment
 - l) Name Plates indicating the identification of all equipments/systems/plants/etc.

2.0. CODES AND STANDARDS

All the items shall conform to latest edition of relevant IS / IEC standards amended up to date. contractor shall comply with local statutory requirement also.

3.0. CABLE TRAYS AND CABLE TRAY SUPPORTS

- 3.1. Cable trays shall be pre-fabricated ladder type, made of 3 mm thick sheet steel with hot dip galvanized furnished in standard lengths of not less than 2.5 m. Cable trays of tough FRP material may also be used especially in corrosive chemical laden atmospheres / areas.
- 3.2. Cable trays shall be complete with all necessary hot dip galvanized sheet steel accessories such as coupler plates, ground continuity connections, nuts, bolts, washers, clamps etc. Also necessary horizontal/ vertical bends, horizontal/vertical Tees, Reducers, Horizontal cross pieces etc. shall be supplied to make the system complete.
- 3.3. Cable tray support system shall be of sheet steel prefabricated and galvanized or of site fabricated and painted type. The distance between two supports shall not exceed 2 meters.

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- 3.4. Sheet steel covers of minimum 2 mm. thick shall be provided for wall/column mounted vertical raceways and wherever specifically required. The width of the cover shall be same as that of the tray.
- 3.5. Provision shall be made in the cable trenches so that water should not enter inside any building through cable trenches.
- 3.6. Cable Loading shall be as per the following guidelines:
- 150mm wide cable tray : 30kg/linear meter
 - 300mm wide cable tray : 60kg/linear meter
 - 600mm wide cable tray : 75kg/linear meter
 - 750mm wide cable tray : 75kg/linear meter


In addition, 70kg concentrated load at centre span shall be considered.

4.0. CABLE TERMINATION & JOINTING KITS

- 4.1. The cable termination and jointing kits shall be either "Heat Shrink" / "Cold Shrunk" / Push ON type. The kits shall include all insulation and sealing materials apart from conductor fittings and consumable items. Joints and terminations shall meet test requirements as per IS/IEC. The straight through jointing kits shall be suitable for underground buried installation with uncontrolled backfill and possibility of flooding by water or overhead tray installation.
- 4.2. Cable ties & trefoil clamps shall be of special nylon high tensile material. Cable markers shall be of aluminum.

5.0. PUSH BUTTON STATION(PBS)

- 5.1. Local push button station shall be provided for all the drive motors as per scheme requirement. Start/Forward/Open PBs shall have green colored actuator and stop/reverse/close PBs shall have red colored actuator.
- 5.2. The degree of operation of LPBs shall be IP65 with both canopy and lid for outdoor and IP54 with lid and hinged door for indoor applications. For Hazardous area LPB shall be Flame proof, IP 65, CMRI/CCE Certified. Temp Class and Gas group shall be as per Hazardous area classified area.
- 5.3. All PBs shall be push to actuate type and the stop PB shall be lockable in off position as per the scheme requirement.


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- 5.4. Emergency local stop push button should be latchable. For critical loads, two stop push buttons connected in series shall be provided as per the scheme requirement.
- 5.5. All push buttons shall be provided with 2 NO & 2 NC contacts for various interlocking purposes.
- 5.6. Terminal block of stud type are to be provided in the LPB station. Terminals to be suitable for 2 cores of 2.5 Sq.mm. conductors with 20% spare terminals.
- 5.7. All LPBs shall be of FRP in corrosive area and Di-cast aluminum for other area. Flame proof LPB shall be provided wherever required as per hazardous area classification layout.
- 5.8. Name plate with tag number & description of the service controlled by the LPB shall be provided on the front. LPBs shall be suitable for wall/column mounting. Covers shall be provided with captive screws.
- 5.9. The cable size to be used for LPB connection shall take into account the voltage drop in the cable between the LPB & the switchgear/MCC/DCS.

6.0. JUNCTION BOXES (JB)

- 6.1. Junction boxes as required shall be supplied:
- 6.2. The JBs used in outdoor areas shall be weatherproof type and coated with epoxy paint enable running a large core cables from (JB/MB) to control panels, terminal cabinets etc.
- 6.3. All JBs shall be of FRP for corrosive area and Di-cast aluminum for other area. Flame proof JB shall be provided wherever required as per hazardous area classification layout.
- 6.4. The JB shall have provision for wall, column, pole or structure mounting and shall be provided with cable/conduit entry knock outs & terminal blocks.
- 6.5. The terminals for junction boxes shall be suitable for terminating two (2) nos. 2.5 sq.mm stranded copper conductors on each side.
- 6.6. Spacing of 250mm between two rows of terminal blocks and between the gland plates and the bottom most terminal block to be provided. Gland plate to be of removable type & made out of 3mm thick sheet steel.

7.0. Receptacles

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7.1. Industrial Receptacles

The industrial receptacles shall be heavy duty type rated for 20 A and 32A , 240V AC complete with plug and switch housed in galvanized sheet steel enclosure having degree of protection of IP 55. These shall be of three pin type with the third terminal connected to earth.

Receptacles shall be provided in all the indoor and semi indoor areas such that the any point is accessible within 25m of cabling distance from the receptacle. For outdoor area also necessary receptacles shall be provided as per Company requirement to be indicated during detailed engineering.

Receptacles shall be provided in all the buildings of buildings of auxiliary equipment, Rail gantry and road gantry area as a minimum requirement. The receptacle shall have safety shutters and other safety interlocks for safe operation.

7.2. Welding Receptacles

The welding receptacle to be supplied shall be of 100A, industrial heavy duty type with 5pin (with earth connection) suitable for 415 V, 3 phase, 50 Hz supply.

For outdoor area, necessary receptacles shall be provided as per requirement.

Receptacles shall be provided in all the buildings of auxiliary equipment, Rail gantry and road gantry area as a minimum requirement. In Loading Gantry, Welding receptacles of 100A rating shall be provided at approximate interval of 150mtr.

The receptacle and switch shall be housed in a sheet steel enclosure complete with gasket, cable glands etc. All receptacle enclosures shall have 2 Nos. earthing terminals.


The enclosure shall be min. 2 mm. thick galvanized sheet steel and shall conform to the degree of protection IP-55 class.

All receptacles shall be provided with matching plug tops.

In hazardous areas, receptacles shall be of flame proof type, tested by CMRI and certified by PESO.

The receptacle and switch shall be interlocked with the plug such that it shall not be possible to remove the plug with the switch in 'ON' position.

Lighting Receptacles shall be provided at every 45 meter distance in gantry area, there shall be maximum three nos. of lighting receptacles in single power feeder.


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8.0. Cable Glands & lugs

- 8.1. Cable glands shall be tinned brass, shrouded, double compression type, complete with necessary armor clamp and tapered washers etc. Cable glands shall match with the different cable sizes.
- 8.2. Cable lugs shall be tinned copper lugs suitable for termination of different sizes of LT/ control cables. Lugs for power cables shall be of compression type, whereas lugs for control cables shall be of insulated terminal crimping type.

9.0. Fire Stop Cable Sealing System

- 9.1. In order to restrict the propagation of cable fire and spread of toxic smoke, the cable entry below switchgear panels/ control panel, cable penetration through walls and cable shafts on the floors need to be sealed by fire seal system.
- 9.2. Fire stop cable sealing shall have two (2) hours fire rating. The sealing compound shall have special property to allow for thermal expansion of cables both under normal and short circuit conditions. The sealing system shall be proven type and tested as per relevant standard.
- 9.3. Necessary fire proof doors in cable spreader rooms/switchgear rooms shall also be provided.
- 9.4. If required by the fire stop sealing system to achieve the fire rating of 2 hours, cable coating shall be adopted on cables. The coating shall have minimum two hours fire protection rating. Cables at least 1 m before & after the penetration seals shall be suitably coated. Cables shall be sized to take care of any derating due to fire stop sealing.
- 10.0. Danger boards shall be provided in line with the statutory requirements.
- 11.0. Rubber mats shall be provided to meet the safety and other statutory requirements.

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CHAPTER NO – 3.11

SCHEMATIC DIAGRAM



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Sr.	DOCUMENT NAME	DOCUMENT NUMBER
1.	KEY SINGLE LINE DIAGRAM	9242-M-GAN-ELE052-00001
2.	SCHEMATIC DIAGRAM FOR UPS	9242-M-GAN-ELE056-00001
3.	LEGENDS FOR LV SWITCHGEAR SCHEMATIC DIAGRAM	9242-M-GAN-ELE056-00002
4.	SCHEME DIAGRAM FOR ACB O/G FEEDER > 630 A UP TO 1600 A	9242-M-GAN-ELE056-00003 – SHEET – 1 TO 3
5.	SCHEME DIAGRAM FOR BUS COUPLER FEEDER	9242-M-GAN-ELE056-00004 – SHEET 1 TO 5
6.	SCHEME DIAGRAM FOR ACB INCOMER FEEDER	9242-M-GAN-ELE056-00005 – SHEET 1 TO 3
7.	SCHEME DIAGRAM FOR MCCB O/G FEEDER > 100 A UP TO 400 A	9242-M-GAN-ELE056-00006
8.	SCHEME DIAGRAM FOR MCCB O/G UP TO 100 A	9242-M-GAN-ELE056-00007
9.	SCHEMATIC DIAGRAM FOR 415/240 V AC MOTOR CONTROL SUPPLY TRAFO (TYPE J3)	9242-M-GAN-ELE056-00008
10.	SCHEME DIAGRAM FOR DOL STARTER UPTO 30 KW	9242-M-GAN-ELE056-00009
11.	SCHEME DIAGRAM FOR DC SYSTEM	9242-M-GAN-ELE056-00010



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CHAPTER NO – 3.12

TECHNICAL SUBMITTAL SCHEDULE



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1.0. LT SWITCHGEAR (TO BE FILLED FOR EACH TYPE AND RATING SWITCHGEAR)

Sl. No.	Description	Unit	Data
1.0	PCC/MCC/DB		
	a) Make	-	
	b) Type	-	
	c) Reference Standard	-	
	d) Voltage (Nom./Max)	V	
	e) Phase/Frequency	No/Hz	
	f) Short Circuit Rating		
	• Interrupting Symmetrical	kA (peak)	
	• Short-time for 1 sec	kA rms	
	g) Insulation level	kV	
	h) Degree of Protection	-	
	i) Dimensions of vertical section in mm (L x D x H)	Mm x mm x mm	
	j) Equipment working height limits from floor level	mm	
2.0	Bus conductor		
	a) Material & Grade	-	
	b) Busbar size	mm ²	
	c) Current density	A/mm ²	
	d) Support spacing	m	
	e) Type of insulating sleeve for busbars	-	
	f) One second withstand capability	kA (rms)	
	g) Temperature rise over 50°C ambient		
	• for rated current	°C	
	• for short circuit current	°C	
	h) Minimum clearance of busbars and connections		
	• Phase to phase	mm	
	• Phase to ground	mm	
	i) Bus support insulator		
	• Material	-	
	• Min. total creepage distance	mm	
3.0	Air Circuit Breaker		
	a) Make	-	
	b) Type	-	
	c) Standards applicable	-	



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	d) Rated voltage	V	
	e) Continuous current rating		
	• As per manufacturer's standard	A	
	• Under site conditions after derating for ambient and within cubicle	A	
	f) Symmetrical and asymmetrical interrupting current	kA rms	
	g) Making current (peak)	kA	
	h) Total opening time (measured from trip coil energisation)	m s.	
	i) Closing time	m s.	
4.0	Contactors		
	a) Type	-	
	b) Rated making capacity	kA	
	c) Rated breaking capacity	kA	
	d) Duty category	-	
	e) Class of Protection for Motor feeders	-	
5.0	Isolating Switches		
	a) Make	-	
	b) Type	-	
	c) Rated voltage	V	
	d) Rated Current	A	
	e) Utilization Category	kA	
6.0	Current Transformers		
	a) Type	-	
	b) Type of insulation	-	
	c) CT secondary current	A	
	d) Accuracy Class	-	
7.0	Voltage Transformer		
	a) Type	-	
	b) Type of insulation	-	
	c) Accuracy Class	-	
8.0	Relays		
	a) Make & type	-	
	b) Relays details	-	
9.0	Instruments and Meters		
	a) Type	-	
	b) Size	mm x mm	



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	c) Accuracy Class	-	
10.0	Local Pushbuttons/control stations		
	a) Type	-	
	b) Enclosure material	-	
	c) Degree of Protection	-	
11.0	Control Transformers		
	a) Type of Insulation	-	
	b) Voltage ratio	V/V	
12.0	Control switch/Selector Switch		
	a) Type	-	
	b) Contact rating	A	

1.1. DC SYSTEM (TO BE FILLED FOR EACH TYPE AND RATING)

Sl. No.	Description	Unit	Data
1.0	Battery	-	
	a) Make & Country	-	
	b) Type		
	c) Rated capacity for one hour	Ah	
	d) Rated system voltage	V	
	e) System voltage limits permitted for one hour capacity	V	
	f) Number of cells per battery	-	
	g) Material of electrodes	-	
	h) Electrolyte		
	i) Nominal voltage per cell	V	
	j) End cell voltage		
	k) Type of operation	-	
	l) Short circuit current	kA	
	m) Mounting type	-	
	n) AH efficiency at rated load	%	
	o) Watt Hour Efficiency	%	
	p) Load cycle curve furnished	Yes/No	
2.0	Charger		
	a) Make & Country	-	
	b) Type	-	



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Sl. No.	Description	Unit	Data
	c) Rectifiers with thyristors	Yes/No	
	d) Number of chargers	-	
	e) Rated input AC voltage	V	
	f) Frequency	Hz	
	g) Rated output DC voltage	V	
	h) Output DC current	A	
	i) Rectifier Efficiency		
	j) Charging voltage	V	
	• Float charging	V/Cell	
	• Boost charging	V/Cell	
	k) Protection class of cubicles	-	
	l) Residual ripple	%	
	m) Height x width x depth of cubicles	mm	
3.0	Rectifier Transformer		
	a) Make & Country	-	
	b) Type	-	
	c) Rating	kVA	
	d) Voltage ratio	V/V	
	e) Insulation class	-	

1.2. UPS (TO BE FILLED FOR EACH TYPE AND RATING)

Sl. No.	Description	Unit	Data
1.0	GENERAL		
	a) Make & Country		
	b) Type		
	c) UPS Capacity (at 0.8p.f & upf)		
	d) Output Voltage and regulation	V, %	
	e) Frequency and regulation	Hz, %	
	f) Radio interference suppression	Yes/ No	
2.0	CHARGER		
	a) Float Charging voltage & current		
	b) Boost Charging voltage & current		
	c) Nominal Voltage	V	

	d) Voltage Regulation for AC Input Variations & Load Variations	%	
	e) Ripple	%	
	f) Time to recharge the completely discharged battery	s	
	g) Protection class of cubicles	-	
	h) Over load current limit	%	
	i) Type of Rectifier Bridge Circuit	-	
	j) Rectifier Efficiency	%	
3.0	BATTERIES		
	a) Nominal System Voltage	V	
	b) Nominal Cell Voltage	V	
	c) End Cell Voltage	V	
	d) Duty cycle of the battery	hour	
	e) Battery Capacity	Ah	
	f) Ah efficiency at rated load	%	
	g) Watthour efficiency	%	
4.0	INVERTER SYSTEM		
	a) Type	-	
	b) Type of power switching	-	
	c) Input	-	
	d) Nominal input DC voltage	V	
	e) Input DC voltage range	-	
	f) Output AC Voltage	V	
	g) Voltage adjustment range	%	
	h) Accuracy (Steady State)	-	
5.0	Transient voltage regulation for		
	• 50 % step load change		
	• Sudden input voltage change of + 10 %		
	• Loss and return of input AC power		
6.0	Transient recovery time		
	• Recovery to 95%		
	• Recovery to nominal value		
	a) Output Frequency	Hz	
	b) Frequency regulation		



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	c) Harmonic Distortion		
7.0	Guaranteed Efficiency		
	• At 100 % load	%	
	• At 50 % load	%	
	a) Power factor range	-	
	b) Protection class of cubicles	-	
8.0	STATIC TRANSFER SWITCHES		
	a) Type	-	
	b) Voltage	V	
	c) Frequency	Hz	
	d) Transfer time	ms	
9.0	BYPASS/INVERTER/RECTIFIER TRANSFORMER		
	a) Type	-	
	b) Voltage Ratio	V/V	
	c) Frequency	Hz	
	d) Type of cooling	-	
	e) Winding insulation class	-	

1.3. ILLUMINATION SYSTEM (TO BE FILLED FOR EACH TYPE)

Sl. No.	Description	Unit	Data
1.0	Lighting fixtures (Data to be furnished for each type of lighting fixtures)		
	a) Make & Country	-	
	b) Operating voltage	V	
	c) Type	-	
	d) Wattage	W	
	e) No. of lamps	-	
	f) Lumen output	l	
	g) Power factor	-	
	h) Igniter type		
	i) Dimension	mm x mm x mm	
	j) Weight	kg	
2.0	Lighting panel		

	a) Type	-	
	b) Voltage	V	
	c) Short circuit rating	kA	
	d) Degree of protection	-	
3.0	Bus conductor material		
4.0	Lighting Poles height		
5.0	Lighting Towers height		

1.4. LT POWER / CONTROL CABLES

Sl. No	DESCRIPTION	UNITS	DATA
1.	Make		
2.	Type		
3.	Applicable standard		
4.	Cable size	Sq.mm	
5.	Rated voltage	V	
6.	Earthed/Uneearthed grade		
7.	Maximum temperature: -Continuous, -Short time,	°C	
8.	Continuous current rating at 50°C air ambient temperature (For single core cables rating shall be based on bonding screen at both the ends)	A	
9.	Continuous current rating at 50°C ground ambient temperature	A	
10.	Short circuit withstand current for 1 sec duration for		
a)	Conductor	KA rms	
b)	Armour	KA rms	
11.	Conductor		
a)	Material		

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b)	Grade i) Aluminium ii)Copper		
c)	Nominal cross sectional area	Sq.mm	
d)	Number and diameter of wire		
e)	Conductor strands	Nos./mm	
f)	Shape of conductor		
g)	Approx. diameter over conductor	mm	
h)	Direction of lay of stranded layers		
i)	Conductor resistance (DC) at 20 °C	Ohm/km	
j)	Conductor resistance (AC) at 85 °C (for HR PVC cables)	Ohm/km	
k)	Reactance for multi core cables at maximum operating temp at 50 Hz	Ohm/km	
l)	Reactance for single core cables laid in trefoil formation at maximum operating temp at 50 Hz	Ohm/km	
m)	Capacitance at 50 Hz	Micro Farads/km	
12.	Insulation		
a)	Composition of insulation		
b)	Nominal thickness of insulation	mm	
c)	Tolerance on thickness of insulation		
d)	Type of curing		
e)	Min. insulation resistance at 20 °C	Mega Ohms	
f)	Identification of cores		
13.	Type of extrusion		
14.	Inner sheath		
a)	Material		
b)	Diameter over the laid up cores	mm	



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c)	Thickness of sheath (min)	mm	
d)	Color of sheath		
e)	Extruded or not		
f)	Type of filler material		
15.	Armour (in case of armoured cables)		
a)	Type of material of armour Strip/wire		
b)	Nominal diameter of cable over inner sheath (under armour)	mm	
c)	Dimension of strip/wire	mm x mm	
d)	No. of armour wires/strips		
e)	Approx. Cross sectional area of armour	Sq.mm	
f)	DC resistance of armour wires/strip at 20 °C	Ohms	
g)	AC resistance of armour wires at 80 deg.C (ohm/km)	Ohms	
h)	Direction of lay of armour		
16.	Outer sheath		
a)	Material and type		
b)	Calculated diameter under the sheath	mm	
c)	Thickness of sheath	mm	
d)	Tolerance of thickness of sheath		
e)	Colour of sheath		
f)	Minimum Oxygen index		
g)	Minimum Temperature index		
h)	Maximum Smoke Density		
i)	Light Transmission		
j)	Maximum Acid gas emission		

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17.	Shield		
a)	Material		
b)	Thickness of individual shield (min)		
c)	Thickness of overall shield (min)		
d)	Noise interference better than (dB)		
e)	Coverage / overlap (min)		
18.	Drain wire		
a)	Material		
b)	Size and no. of strands		
c)	Resistance per Km when contact with screen at 20°C		
19.	Overall diameters of cable	mm	
20.	Weight per 500 metres.	Kg	
21.	Recommended min. bending radius	m	
22.	Safe pulling force when pulled by pulling eye on the conductor	kg	
23.	Cable Drums		
a)	Type		
b)	Material		
c)	Flange diameter (mm)		
d)	Barrel diameter (mm)		
e)	Traverse (mm)		
f)	Weight of cable drum with cables		
g)	Whether Cable drums confirm to relevant IEC standards		
h)	Length of Cables in drum & tolerance		
i)	Weight of Cable Drum without cable		



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j)	Type of end sealing		
24.	Maximum dielectric stress at core screen	kV/cm	


1.5. EARTHING & LIGHTNING PROTECTION

Sl. No	DESCRIPTION	UNITS	DATA
A	Earthing System		
1	Earth mat		
a)	Material		
b)	Size of conductor	mm ²	
c)	Fault withstand current & duration	kA	
d)	Soil resistivity and duration	Ohm meter	
e)	Mesh width	m x m	
f)	Total length of conductor	m	
g)	Earth resistance	Ohm	
h)	Permissible touch voltage	V	
i)	Permissible step voltage	V	
j)	Actual touch voltage	V	
k)	Actual step voltage	V	
2	Equipment earthing		
a)	Material		
b)	Size of conductor	mm ²	
c)	Thickness of galvanizing		
3	Earth electrode		
a)	Material	-	
b)	Size	mm ²	
c)	Length	m	
B	Lightning Protection System		
1	Material and size of horizontal air termination	mm	

2	Material & size of vertical air termination		
3	Material and size of down conductor	mm	
4	Size of test link	-	
5	Material of enclosure for test link	-	
6	Material & size of earth electrode		
	Earth resistance	Ohms	

1.6. FIRE DETECTION AND ALARM SYSTEM

Sr. No.	Description	Vendor data
1.	DETECTORS	
1.1.	Make/Model	
1.2.	Nature	
1.3.	Type	
1.4.	Wiring	
1.5.	Sensitivity	
1.6.	Configurability	
1.7.	Smoke Setting	
1.8.	Smoke Sensing Principle	
1.9.	Thermal sensor type	
1.10.	Temperature Setting	
1.11.	Alarm Feature	
1.12.	Power Source	
1.13.	Detector base	
1.14.	Approvals & Listings	
1.15.	Detectors above ceiling and Below Flooring (Wherever applicable)	
1.16.	Appropriate remote response indication Considered? Make and Model No	
1.17.	Any Accessories Provided	
2.	SOUNDER / HOOTER WITH STROBE LIGHT / SIREN	
7.1.	Make/Model	
7.2.	Power Source	
7.3.	Audible Range	
7.4.	Type	
7.5.	Mounting (Surface / Semi flush)	

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Sr. No.	Description	Vendor data
7.6.	For Hooters (semi flush mounting), cabling should be internal to wall through GI conduit. Necessary civil work in Contractor scope	
7.7.	Degree of protection	
7.8.	Temperature range	
7.9.	Colour of Dome	
7.10.	Approvals & Listings	
3.	MANUAL CALL POINT (OUTDOOR TYPE)	
3.1.	Make/Model	
3.2.	Type	
3.3.	Weatherproof protection	
3.4.	No of Stage (Single or Dual)	
3.5.	Mounting (Surface / Semiflush)	
3.6.	For call points (semiflush mounting), cabling should be internal to wall through GI conduit. Necessary civil work in Contractor scope	
3.7.	Approvals & Listings	
4.	MODULES FOR HOOTER	
4.1.	Make/Model	
4.2.	Type	
4.3.	Capacity	
4.4.	Power Supply	
4.5.	No of Devices per Module	
4.6.	Fiber Optic Cable, LIU & Switches	
4.7.	Approvals & Listings	
5.	ISOLATOR	
5.1	Make/Model	
5.2	Type	
5.3	Approvals & Listings	
6.	RESPONSE INDICATOR	
6.1	Make/Model	
6.2	Grouping of Response Indicator	
6.3	Approvals & Listings	
7.	CABLE, NETWORK HARDWARE & Erection Hardware	
7.1.	Type of Communication Cable (Contractor to specify as per distance limitation)	
7.2.	Cable Size (core / Size / AWG)	
7.3.	Quantity	
7.4.	Type of Loop Cable (Signal Cable)	
7.5.	Max. loop length per loop	
7.6.	Quantity	
7.7.	FOC Cable	



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Sr. No.	Description	Vendor data
7.8.	Quantity	
7.9.	Necessary network hardware including LAN points, Switches and other media conversion as per configuration	
7.10.	Make / Model of Hardware	
7.11.	Termination Hardware	
7.12.	Necessary accessories like cable glands at the inlet to panels, call points, and other sharp edge areas.	
7.13.	Approvals & Listings	
8.	EXIT SIGNS WITH EMERGENCY LIGHT & BATTERY BACKUP	
8.1	Type	
8.2	Approvals & Listings	



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