



SECTION – III

ELECTRICS

1.0 GENERAL

1.1 This section of the specification covers the design, manufacture, testing, supply, loading/unloading at site, storage at site, handling, erection, testing and commissioning of electrics of four (4) Nos. ESP of TPP-1 within the described battery limit for the proposed capital repair project of the power plant-1 of VSP, Visakhapatnam. This specification also stipulates the basis of design and the specification of equipment to be supplied by the Contractor.

1.2 Bidder shall visit the site and study the power distribution of the existing ESPs thoroughly. Single line diagram/wiring diagram/I/O list and control philosophy of each and every electrical equipment of ESP to be studied to adopt the existing facilities in new system. Control philosophy for local and remote operation of the new ESP electrics shall be done in line with existing system and any changes in existing control philosophy, if required to adopt by bidder shall be discussed with purchaser.

1.3 The equipment offered shall be complete in all respect to achieve smooth and efficient integral operation of the new equipment. Any equipment/item not indicated in this specification but essential for proper installation, operation and maintenance of the equipment shall be included by the bidder in his offer and reason for such inclusion shall be clearly stated.

1.4 All electrical equipment within battery limit including power distribution, motor and controls, power wiring, earthing as well as cabling shall be supplied and installed in conformity with Indian Electricity Rules, relevant Indian Standards and General specifications of VSP as well as conformity to CEA. Fuse less system to be adopted. Successful bidder shall provide all assistance to VSP in obtaining approval of CEA and any other statutory authorities as required. Further any modification/changes sought by CEA/any statutory authority shall be carried out without any additional price implication to VSP.

1.5 Bidder shall visit plant site to get acquainted with the proposed locations of new installations and locations of the existing power sources (as identified by purchaser) where new and modification work needs to be carried out by bidder to make them suitable for the new electrics. Bidder shall study thoroughly the locations of existing power sources/cable tray routing/location of cable shaft/location of floor opening and earth conductor in each plant's load



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centre/ECR/controller room and plant outdoor cable routing to get himself thoroughly acquainted with the existing system and equipment locations. Bidder shall study all the relevant drawings and document of the existing ESP which are available with the purchaser, which shall be useful to get a clear understanding about the work.

1.6 In the interest of standardization, bidder shall offer equipment as per preferred make of VSP enclosed with this specification. All TR sets and TR Controllers shall be of same rating, so that interchangeability of the same can be achieved.

1.7 Standards

1.7.1 All equipment and their accessories covered by this specification to be designed, manufactured and tested in compliance with the latest relevant standards published by the Bureau of Indian Standards, any other recognized National Standards Institution and latest publication of International Electro-technical Commission (IEC).

1.7.2 The equipment and accessories shall also conform to the following:

1.7.2.1 The General Specifications for various electrical equipment, selection of electrical equipment, installation, testing and commissioning given against item No. 2.4 of Section-I of this specification.

1.7.2.2 Indian Electricity Rules, 1956 with latest amendments.

1.7.3 All equipment shall also comply with the statutory requirements of the Government of Andhra Pradesh, where the equipment shall be installed. Nothing shall be construed to relieve the supplier of this responsibility.

1.7.4 In the event of any counter stipulation made in this specification in relation to the General Specifications enclosed, the stipulation made in this specification shall prevail.

1.7.5 In cases, where the offer deviates from the specified standards, the bidder shall indicate clearly the standards proposed to be adopted by him along with details thereof and the reasons for the deviation.

1.7.6 Each exception to the specification or other parts of the bid documents to be listed separately item wise by the bidder. If exceptions are not clearly listed as such, they shall not be considered by the purchaser later on.



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1.8 Site Conditions

Ambient conditions:

The electrical equipment proposed shall be suitable for operation under the following local conditions:

Temperature:

- Outdoor : 50°C (ambient temperature)

- Indoor : 45°C (ambient temperature)

Humidity : Maximum monthly mean humidity 88%

Equipment located in other hot areas shall be derated for 55°C.

Note: The electrical rooms, control rooms shall be provided with adequate ventilation/air-conditioning system. All electrical, electronic and automation equipment shall be designed for an ambient temperature of 45 deg C for indoor installation and 50 deg C for outdoor installation. In addition to this, for the switchboard, the in-panel temperature as per general specification shall also be considered for derating.

1.9 Voltage and Power Supply Conditions

System voltage : 11 kV, 3-phase, 3-wire,
415 V, 3-phase, 4-wire

Frequency : 50 Hz

Voltage : +6 to -9% for 11 kV
Fluctuation : ±6% for 415 V

Frequency : ±3% for all the voltage levels
fluctuation

Fault level (for : 40 kA for 3 sec for 11 kV
selection of : 50 kA for 1 sec. for 415 V
equipment)

System grounding: 11 kV – Resistance earth
415 V solidly earthed



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Control voltage:

- 415 V air : 240 V, 1-phase, 50Hz
circuit breaker
operation, AC
contactor coil,
auxiliary relays,
LED indication
lamps etc.
- Normal single/ : 24 V DC
double solenoid
valves
- Lighting : 230 V AC (minimum 25 kVA, 415/415-
230 V lighting transformer shall be
used)

Power will be made available at 11 kV cable feeder. Any other voltage level required for the system shall be arranged by vendor by suitably transforming the supplied voltage system.

1.10 Equipment Layout

1.10.1 It is envisaged to locate the electrical equipment covered in this specification in the respective existing electrical control room (ECR) of ESP.

1.10.2 Cabling

Cabling from the electrical and instrumentation equipment to their respective consumers shall generally follow the existing cable route i.e. through cable trays, conduits, cable trenches, cable tunnels, along structures etc. In addition to it, cables shall also be routed through embedded conduits to reach to the consumers located in the field. Bidder to study the existing cable route between ESP between ECR and controller room/load centre etc. thoroughly. Existing cable trays/conduits/underground cable duct/trenches etc. can be used, if they are suitable for further use or cabling space is available in existing cable tray/conduit etc. otherwise new galvanized steel cable trays, galvanized cable tray supports, galvanized steel conduits etc shall be supplied and installed by bidder. Existing cable trays/supports etc within ECR building can be utilized if suitable and wherever required existing cable trays and supports (all with galvanized steel shall be modified/strengthened/replaced as per requirement. Existing cable trays and supports outside ECR & ESP shall be dismantled and new cable tray and supports (all with galvanized steel) shall be provided as per

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requirement. However, all cables shall be removed and new cables shall be supplied and laid.

1.11 Painting of Electrical Equipment

1.11.1 For all electrical equipment necessary steps shall be taken in treating all enclosures, plates, frames, fixtures etc to prevent any rusting, corrosion, sulphation or any other physical damage to the equipment or the components thereof.

1.11.2 All steelworks shall undergo a process of degreasing, pickling, cold rinsing, phosphating and passivating. It shall be given two coats of high corrosion resistant primer and finished by application of epoxy based paint so as to protect the equipment from saline atmosphere prevailing in the place of installation. Thickness of paint for outdoor and indoor equipment shall be 120 and 60 microns respectively.

1.11.3 Shade of finish coat to be applied for equipment installed indoor shall be No. 631 as per IS:5 of 1994. For outdoor equipment paint shade shall be No. 632. All equipment to be installed in the control room shall generally have paint shade RAL 7032 as per DIN/VDE.

2.0 EXISTING POWER DISTRIBUTION ARRANGEMENT

2.1 Power supply to three (3) existing load centre substations (LCSS) located at ESP control room 1,2 & 3 are fed from 11 kV switchboard of power plant. Panel No. 6 of 5LBDS7, panel No. 19 of 5LBDS7 & panel No. 29 of 5LBDS7.

2.2 11 kV/433 V transformers of the LCSS are installed at ECR-1,2&3 (total six (6) Nos. 1600 kVA 11 kV/433 V oil type transformer).

2.3 Three (3) 11 kV feeders are feeding six (6) Nos. transformer over loop in loop out arrangement at 11 kV VCB/isolator located in front of transformer.

2.4 A 28882-000-000-ELE-0002 is enclosed showing power distribution of existing system.

3.0 INSTALLATION, TESTING AND COMMISSIONING

Bidder shall include, in his scope of work, installation, testing and commissioning of all electrical equipment, cables, earthing materials etc. All necessary tools, tackles, erection materials shall be



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included in the scope of work. Moreover, scope shall include dismantling of existing electrical equipment and handing over of the same to VSP.

4.0 SCOPE OF WORK

The scope of work shall include but not be limited to the design, supply and installation of following equipment:

4.1 Power supply will be made available over three (3) Nos. 3c – 240 mm² 11 kV (UE), XLPE(A) cable at two (2) Nos. ESP switchgear room and will be looped to three (3) nos. of ESP switchgear rooms. For six (6) transformers, loop in loop-out system exist. Vendor to reterminate existing incoming cable to new VCBs and make arrangement for loop in loop out arrangement. New 11 kV (UE), XLPE, 3c, 240 mm² cable including termination and jointing as required for retermination and loop in loop out arrangement shall be considered by vendor.

4.2 Replacement of protection and metering CTs at feeding 11 kV switchboard for upgradation of transformer rating (Total 6 Nos. Corresponding ammeter shall also be replaced by new one.

4.3 Six (6) Nos. new 2500 kVA, 11 kV/433 V cast resin transformer to be installed on existing foundation. Six (6) sets of 11 kV 40 kA for 3 sec. unit VCB with protection and metering CTs, line PT, power pack for VCB closing and tripping ammeter and voltmeter with selection switch, transformer protection relay, master trip relay and five (5) Nos. VAA relay. Standby earth fault relay with timer shall be considered for transformer protection. Three (3) Nos. earthing truck with full capacity VCB (40 kA for 3 sec) with PT and 1-phase voltmeter and indication and hooter shall also be provided and six (6) Nos. 630A 11 kV busduct between VCB and transformer primary. Due to space constraint 6.6kV PT shall be mounted on 6.6kV breaker truck itself. Three(3) numbers dummy panel for housing earthing truck shall be considered. Annunciation and indication shall be provided as per general specification. Numerical relay confirming to VSP-GS-6.3-E-01(R1) shall be provided. Communicable type multifunction meter shall be considered.

4.4 Three (3) sets of 2500 kVA, 4000A double ended power control centres with requisite Nos. outgoing ACB/MCCB feeders (to be installed on existing foundation). Feeders used by VSP for other MCC, PDB, LDB etc shall also included in outgoing feeder. For boiler-1 & 2 in ESP ECR-1, one (1) section need to be modified by increasing incoming and bus coupler breaker rating from 2500A to 4000A. Moreover, main busbar and vertical dropper busbar shall also to be enhanced to suitable for 4000A. Connectivity between bus coupler to second section will be over new 4000A busduct. Two (2) Nos. 800A ACB feeder, four (4) 400A



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MCCB feeder at bus section II and two (2) Nos. 100 MCCB feeder shall be kept for VSP's spare feeders. In addition to spare feeder at bus section II

For ESP3 & 4, five (5) Nos. 400A MCCB and two (2) 100A MCCB feeder shall be kept at bus section-1 for VSP's use in addition to spare feeder. Four (4) 400A MCCB feeder and two (2) 100A MCCB feeder shall be kept for VSP's use in addition to spare feeder. For ESP5 two (2) 800A ACB feeder, six (6) 400A MCCB feeder and two (2) 100A feeder shall be kept in PCC for VSP's use in addition spare feeder.

- 4.5
 - a) Six (6) sets of 4000A, 50 kA for 1 sec. aluminium busduct with aluminium enclosure.
 - b) Three (3) sets of 415V, 4000A busduct for connecting between section-I & section-II of each PCC.
- 4.6 LT motors of 415 V AC and field equipment as per process requirement.
- 4.7 415 V AC motor control centres and auxiliary control panel for heater and rapping motor.
- 4.8 415 V power distribution board (PDB), lighting transformers (25 kVA minimum), main lighting distribution boards (MLDB), SLDB, MCBDBs, 240/24 V transformers etc. (to be located at switchgear/control room).
- 4.9 Control posts, local control panels.
- 4.10 TR sets, TR controller, rapper control panels and associated control and automation system. Individual TR set shall be provided for each ESP field. HV busduct shall be provided between TR set and held along with isolator, door interlocking and association earth system.
- 4.11 Dismantling of electrics including cables shall be properly packed, tagged and to be transported to purchaser's central stores, which is five (5) KM away from site.
- 4.12 If any electrical equipment damaged during execution of work, such equipment complete set shall be provided by the vendor without any price implication to VSP.
- 4.13 415 V welding socket, 240V AC socket outlets and 24V hand lamp sockets.
- 4.14 Total illumination in the working platform, walkway, staircases, rapper floor of ESP, ESP top and other area of



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new ESP. Illumination of existing PCC rooms, transformer room, cable vault, ECRs and controller room, ventilation & all room, staircase.

4.15 All interconnecting 11 kV (UE) XLPE, 1.1 kV power, 1.1 kV control, 1.1 kV signal and special cables etc including GI cable trays/supports and GI supporting brackets/structures etc for installation of cables.

4.16 GMS conduit, flexible conduit and other erection material viz. cable lug, gland etc.

4.17 HT & LT cable termination and jointing kits.

4.18 Power & control junction boxes, and lighting junction box. Power junction boxes shall be made of stainless steel. Control junction box shall be made of cast aluminium/FRP/thermoplastic.

4.19 All earthing materials for earthing of existing and new equipment, devices etc including earthing stations within the proposed plant scope along with copper cables for electronic grounding shall be supplied and installed by bidder. Supply and installation of complete earthing and lightning protection system with earth stations, earthing materials e.g under ground and over ground earth conductor, GI wire etc. for ESPs and new equipment shall be provided by in the scope of the bidder. The same shall be connected to the nearest existing earthing grid by at minimum two (2) points. Bidders to dismantle existing earthing system and install new earthing and lightning protection system. Below ground work for earthing including excavation, laying or earth strips, earth electrode, fully with material as per IS 3043 including marker shall be included.

4.20 Fire protection measures shall be provided after installation of cables covering necessary provision of fire resistant boards, fire resistant sealing compound and fire resistant paint as specified in General Specification.

4.21 Special tools and tackles as required for testing and commissioning shall be arranged by the bidder. However special tools and tackles required, if any for regular operation and maintenance shall be included in the scope of supply of the Contractor.

4.22 One (1) set of commissioning spares as required.

4.23 Spares for two (2) years normal operation shall be referred from Annexure-4.



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- 4.24 Any item for accessories not included in this specification, but essential for proper functioning of the offered system shall be included by the bidder in his scope.
- 4.25 The scope of work shall also include the following:
- 4.25.1 Installation, testing and commissioning of all equipment within the scope as indicated above.
- 4.25.2 Supply and installation of insulating mats (of voltage class as applicable in front of new HTVCB, 415V PCC, MCCs, PDBs and MLDBs etc. conforming to IS:15652 (type tested at CPRI/ERDA) with BIS certification marking, danger boards/identification board, shock treatment chart of all electrical items.
- 4.26 All civil and structural work related to cable laying work and for installation of different electrical boards and any other equipment as required, shall be in the scope of bidder.
- 4.27 Supply and installation of control junction boxes, LCS, lighting junction boxes made of thermoplastic/cast aluminium/FRP housing with IP:65 degree of protection. Make Hensel/Rittal.
- 4.28 Supply and installation of 415 V, 63A, 5 pin socket outlets with MCCB and required power cables shall be bidder scope. Socket outlet shall be housed in aluminium/thermoplastic (Make Hensel/Rittal) enclosure suitable for outdoor installation (IP:65 degree of protection). Minimum four (4) Nos. socket shall be provided for each ESP.
- 4.29 Power, control, screen and special cables
- i) Supply and installation of 11 kV (UE), XLPE, armoured aluminium cable
 - ii) Supply and installation of 1.1 kV grade XLPE armoured aluminium cable for power wiring system.
 - iii) Supply and installation of 1.1 kV grade HRPVC, FRLS power and control cables for hot areas.
 - iv) Supply and installation of flexible copper cable for motor connection from power junction boxes to motor terminals as per GS.



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- v) Supply and installation of 1.1 kV grade PVC armoured copper stranded control cable for motor control and automation.
 - vi) Supply and installation of 1.5 sq mm/2.5 sq mm copper wire for lighting system.
 - vii) Supply and installation of special twisted pair and triad shielded cable for analog signals.
- 4.30 Bidder shall include all such items as required for the entire system on a turnkey package concept although these items may not have been specifically mentioned. Additional claim of any nature during execution of contract shall not be entertained by the purchaser.
- 4.31 Supply, fabrication and erection of galvanized mild steel cable racks/trays/supports and equipment supports cabling materials, GMS pipes and fittings, flexible GI conduit, coupler, sockets, clamps etc for cable routing and protection of cables, road crossing RCC/GMS pipes etc as required to complete the installation and conforming to VSP-6.3/GS-E-07(R1) RCC/GMS pipe/conduit system required for cable routing shall be properly encased in concrete with finishing of surface. Galvanised Steel structural/steel materials angle, channel, flats etc as required for the entire installation shall be supplied by the bidder.
- 4.32 All the dismantled equipment including cables shall be handed over to customer (at central stores which is about 5 KM away, in good condition.
- 4.33 The successful bidder shall carry out at no extra cost, the following services:
- a) Supply of drawings (both hard and soft copy) of the equipment covered in this specification along with all necessary test reports.
 - b) Supply of complete lists of equipment detailing individual items and accessories, tools etc.
 - c) Preparation and submission of erection/construction drawings for installation of equipment, cables, illumination, earthing and lightning protection system etc.



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- 4.34 Successful bidder shall extend all necessary assistance to purchaser to obtain approval from Govt./State Electricity Inspector/CEA/any statutory authority.
- 4.35 Consumables like DA, oxygen etc. shall be arranged by bidder.
- 4.36 Cable trenches are passing near to ECR building upto ID fan area carrying various cables. If same obstruct revamp/upgraded ESP, these cables shall be re-routed before revamping of ESP by providing new cable trenches/cable routing etc. All Civil and structural works required for completion of new cable trench/ cable gallery etc. shall be included in the scope of work. This may require 11 KV jointing kit and same shall be in Bidder scope.
- 4.37 All electrical buildings are very near to ESP-2 & 4. While revamping/strengthening of ESP foundation, effect of same of electrical building shall be studied and corrective action shall be taken considering at a time only one ESP shutdown will be available but each ECR in feeding two (2) ESP. Utmost care shall be taken to ensure that existing building/trench are not disturbed at all. However, in case of any disturbance to existing building /trenches either partially or totality, the same shall be rectified in all respect without price implication to VSP.

5.0 DESIGN BASIS

- 5.1 Three(3) nos. 11 kV feeders shall be made available to the successful bidder from 5LBDS7 over three(3) numbers 1-3/C, 240 sq.mm, 11kV XLPE(A), Al cable for three (3) nos. switchgear rooms as per SLD 28202-000-000-ELE-0002, REV 0 and further interconnection of HT cable for three(3) LCSS, HT & LT equipment and all other downstream equipment of three(3) ECR buildings and four(4) ESPs etc. is under the scope of work of vendor.
- 5.2 The controls for the equipment within the scope shall be designed for independent operation as well as for an integrated system. The equipment shall be designed in accordance with the latest technological development. It shall also be designed to provide easy interfacing with other systems provided by VSP.
- 5.3 The motors and controls shall be provided to suit the main mechanical equipment as well as the process control requirements. The controls shall be designed for easy interfacing with other processors.
- 5.4 The basic level automation (Level-1) system required for interlocking, sequencing, switching etc. shall be carried out



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by distributed control philosophy through micro processor based control systems and PCs and as described in Section-IV of this specification.

5.5 At least 100 lux shall be considered for designing the illumination system of the walkways and the staircases with 39W LED glass fittings. The type of these fittings shall be selected to suit the environment prevailing in the new ESP area. Wiring for these shall also be carried out to suit the above environmental condition.

5.6 All the electrical equipment and devices (within the scope of work) which are envisaged to be located in the new ESP area shall be selected to suit the environment prevailing in the above area. Cabling for these equipment and devices shall also be carried out to suit the above environmental condition.

5.7 Indicating lamps wherever considered shall be of clustered LED type.

5.8 Fuseless system to be adopted.

5.9 11 kV VCB and earthing truck shall conform to VSP-6.3/GS-E-01(R1).

5.10 415 V PCC, 2500 kVA transformer and 415 V busduct shall conform to VSP-6.3/GS-E-04(R1).

5.11 415 V motor & control shall conform to VSP-6.3/GS-E-05(R1).

5.12 415 V PDB, MLDB etc shall conform to VSP-6.3/GS-E-06(R1).

5.13 TR sets, TR controller, rapper panel etc shall be proven design and latest state of the art technology.

5.14 Vendor to furnish design calculator for sizing of ESP transformer, cable sizes, illumination system, earthing and lightning protection system.

5.15 2.5 MVA transformer rating indicated is minimum. Higher rating, if required, shall be provided considering design margin of 10% and future load of 10% in addition to ESPs existing load.

6.0 SALIENT TECHNICAL FEATURES OF EQUIPMENT SYSTEM

6.1 11 kV busduct, 11 kV/433 V cast resin transformer, 415V busduct and 415 V power control centre shall be as per VSP/GS-E-04 (R1). 11 kV VCB shall be as per VSP/GS-E-01(R1) ABT

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shall be provided for 415 V PCC as per VSP/GS-E-04(R1). 415 V PCC shall be type tested compliance to IEC61439 and IEC61641 for arc flash protection. Display unit of release of ACB shall be visible and operatable even power is off. MFMs of LCSS incomer and important feeder shall be connected to control system through communication link. 415V PCC make shall be selected from make of process PCC of VSP's preferred make list.

6.2 AC Motors

6.2.1 All 415 V motors shall be TEFC type. For all insulation class shall be class F insulation with temperature rise limited to class B.

6.2.2 All continuous duty 415 V motor shall be energy efficient type of IE3 and above as per IS:12615-2011. Motor rpm shall be restricted to 1500 rpm. Flexible cable with power junction boxes shall be considered for motor rated 75 kW and above. Motor terminal box shall preferably be on top.

6.2.3 All AC motors shall fully confirm to IS:325 for all essential design construction and test feature. The motors shall have standardized dimension and rating strictly conforming to IS:1231 for foot mounted and IS:2223 for flange mounted application.

6.2.4 All motors unless required otherwise shall have IM:1001 form of construction. Where motors are provided with brakes, IM:1002 form of construction shall be adopted. Brakes shall be provided on the non-drive end.

6.2.5 The motor body shall have two separate earthing terminals for earthing in compliance with Indian Electricity Rules.

6.2.6 Motors located outside shall be provided with space heaters. Canopy shall also be provided for motors located outside. All 415V motors above frame size 280 shall be provided with anti condensation heaters.

6.2.7 Greasing outlet facility with provision of collection of grease for motors above 250 frame size shall be considered.

6.2.8 Motor located to water prone area shall have GI/cadmium bone foundation bolts.

6.2.9 Voltage levels of the motors and all other constructional features shall be as indicated in General Specification VSP-6.3/GS-E-05 (R1).

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6.3 Motor Control Centre (MCC)

6.3.1 The MCCs shall be provided for LT motor control as well as for power and control supply feeders for downstream equipment. Motor control centre shall used for process only and shall be type tested. Compliance to IEC61439 and IEC61641 for arc flash protection. Make of MCC shall be from make of process MCCs from VSPs preferred make list.

6.3.2 The MCC shall conform to IS:8623 (Part-1), (Part-2) for factory built assemblies, IS:13947 (Part-1) for general requirement of switchgear.

6.3.3 The MCC shall be designed for 415 V, 3 phase, 4 wire, 50 Hz with 50 kA for 1 sec. fault level.

6.3.4 The MCCs shall be fabricated from rolled sheets with 2 mm thickness for load bearing members and 1.6 mm for non load bearing members.

6.3.5 The MCC shall have TPN busbars of aluminium alloy conforming to IS:5082. Rating of the busbars shall not be less than the derated rating of the incoming isolator.

6.3.6 The MCC shall be fed by double incomer and bus coupler from 415 V switchboard. Local/Remote selector switch and auto/manual selector switch shall be provided on ACP/MCC panel.

6.3.7 MCCBs to be used in motor feeders shall have built-in earth fault protection and shall have service breaking capacity (ICS) of at least 75% of ICU as per IEC 60947-2. All motor feeders shall have MCCB with direct acting short circuit protection, contactor and EOCR with display unit. For motor of 3.7 kW and below capacity, motor protection circuit breakers (MPCB) (in place of MCCB for short circuit protection, EOCR with display and contactor shall be used.

6.3.8 MCCBs used in the MCCs shall be with positive isolation feature as per IEC:60947. MCCBs with all protection shall be provided for rating below 630A. For 630A and above ACBs with release shall be provided.

6.3.9 240V AC control voltage shall be fed from two (2) Nos. adequate capacity, single phase, double wound, copper conductor, dry type control transformers of voltage rating 415/240V generally confirming to IS:11171, with selector switch for working/standby selection. The control busbar shall be made of copper.

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- 6.3.10 Preferably one make of devices shall be adopted for motor feeders considering type-2 co-ordination as per IS:13947 (Part-4).
- 6.3.11 The contractors shall conform to requirements of IS:13944 (Part-4). All reversing contactors shall be provided with both mechanical and electrical interlock. The contactor shall be of utilization category AC-3 with minimum rating of 32A.
- 6.3.12 Each cubicle shall have segregated motor circuit components arranged in tier formation upto 5 tiers maximum.
- 6.3.13 Adequately rated continuous aluminium earth busbar shall be provided for the complete length of the MCC. Two separate terminals shall be provided for external earth connection in conformity with IE rules.
- 6.3.14 Since this MCC shall be located inside ECR building minimum degree of enclosure protection shall be IP:52.
- 6.3.15 Draw out type ACB shall be considered for the incomer, bus coupler and the outgoing feeders with loading 630A and above. Below 630A, non drawout type MCCB shall be provided. Outgoing power feeders shall comprise MCCBs (50 kA fault level). Display unit of releases of ACBs shall be visible and operable when power is OFF.
- 6.3.16 Outgoing feeder shall have MCCB, contactor and EOGR with display unit/comprehensive motor protection relay. Temperature scanner and current transducer for motor rated 110 kW and above shall be considered. Overload relay shall be considered as follows:
- Electronic over current relay for motor rated upto 15 kW with digital display.
 - Electronic over current relay for O/C, E/F and unbalanced protection with digital display for motor rated more than 15 kW upto 110 kW.
 - Comprehensive motor protection relay for motor rated more than 110 kW.
- In all cases digital display shall be visible with panel door closed position.
- 6.3.17 Power feeder shall have MCCB with E/F release. However, MPCB can be used for PT and control transformer feeder.



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- 6.3.18 The motor control circuit shall be provided with test push button inside the compartment so that it is possible to test the control circuit with main power circuit disconnected.
- 6.3.19 Following fully wired spares shall be considered in each MCC:
- Two (2) Nos. spare motor feeders in each bus section, one for the highest rated motor and the other of mostly used motor rating.
 - Two (2) blank compartment shall be kept in each MCC for future addition of motor feeder of 15 kW rating (minimum).
- 6.3.20 MCC shall be provided with two full capacity incoming feeders and one bus section feeder and shall be suitable for extending on either side.
- 6.3.21 Metering in LTMCC shall be as follows:
- | | | |
|-------------|---|---|
| Incomer | : | Multi function meter (communicable type), analog ammeter and analog volt meter. |
| Bus coupler | : | Analog voltmeter |
- Outgoing feeders:
- Below 15 kW feeder : Suppressed scale ammeter
 - From 15 kW to less than 110 kW : Analog ammeter
 - From 110 kW and Above : Multi-function meter (communicable type) and analog ammeter
 - For critical motor : Multi-function meter (communicable type) and analog ammeter
- 6.3.22 Metering in local control post shall be as follows:
- Below 15 kW : No ammeter
 - 15 kW and above : Suppressed scale ammeter
 - For critical motor : Suppressed scale ammeter

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6.3.23 Each outgoing motor feeder shall be provided with facility for remote as well local operation to meet the functional requirement.

6.3.24 In MCC all the spare contact shall be wired up and brought upto the terminal block. All auxiliary/interposing relays, and all control accessories shall be provided to meet the drive control philosophy considering sequence of operation in automatic mode/manual mode through controller and operation in manual de-interlocked made through local/remote selector switch in Controller/LPBs/MCC as per existing plant philosophy. However, in all modes of operation protection circuit of motor shall be effective and motor can be stopped through its protection circuit/stop push button even in case of Controller malfunctioning. Separate marshalling panel shall be considered in MCC for interconnection with Control Panel.

6.3.25 General design and constructional features for 415V MCC shall be as per clause 5.0 of General Specification VSP-6.3/GS-E-05 (R1). Bidder to ensure that new MCCs can be installed in the space of existing MCCs. Bidder to visit site, to check adequacy of existing space for new MCCs.

6.4 Transformer Rectified Set and Rectifier Control Panel

6.4.1 Transformer

Applicable standard	:	DIN 57146/Relevant clause Of IS2026
Primary voltage	:	415 V
Efficiency	:	Better than 90%
1 minute power frequency withstand	:	3 kV (RMS) on primary
Impulse withstand	:	250 kV for transformer at 1.2/50 m sec.
Ambient	:	45°C
Type of cooling	:	ONAN
Class of insulation	:	A
LV & HV winding	:	Electrical copper
Class of insulation	:	LV – A, HV - B

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conductor

Creepage : 850 mm min.

Duty : Continuous

6.4.2 Rectifier

Type – full wave :
Two (2) No. earth terminal

6.4.3 Rectifier control panel shall be made of 2 mm thick CRCA sheet steel with degree of protection for enclosure IP42. All controls, display and annunciation shall be provided. Total control of TR sets and connectivity amongst TR sets and level-1 automation system shall be ensured. ESP cum panel shall be latest micro processor based with mimic in front of the panel ON/OFF of MCCB with door interlocking for giving clearance for shut down and emergency push button shall be provided on each TR set panel. TR panel shall have adequate indication and annunciation system in addition to display unit.

6.4.4 HV Busduct shall be provided between TR set and field. Isolator and earth switch as required for safety and earthing of the system shall be considered.

6.4.5 Each TR sets shall have oil collecting trays which shall be interconnected and necessary down comer from ESP top shall be connected to oil pit.

6.4.6 Full proven earthing of ESP fields shall be considered with proper mechanical castle key interlocks with man entry door. Additional fully insulated four (4) Nos. earthing stick shall be considered for discharge of potential.

6.4.7 TR set shall be high efficient type, totally dust and vermin proof design with facility of current and voltage feedback feature to controller. TR set shall be 3 phase/single phase of make Ador/Kraft Powercon/BHEL/HIND RECTIFIER. Current & voltage signals of TR set shall be provided in TR control panels in respective ECR.

6.4.8 TR set controller and rapper panel shall have adequate indication and annunciation system in addition to display out. Documents regarding performance and life of TR set shall be submitted by bidder.



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6.5 Control Posts and Local Control Stations

6.5.1 Each drive shall be provided with its own local control station (local push button station) located near the mechanism. These LCSs shall be functional only during local de-interlocked condition during maintenance and testing. However, the LCSs related to the equipment, which are connected with the integrated operation of the process, shall be functional through microprocessor based control system. For the equipment which are operated in isolated manner and are not directly linked with the integrated operation of the process, shall function independently.

6.5.2 All control posts and local push button stations shall be designed, manufactured and tested in accordance with the requirements given in General Specification VSP-6.3/GS-E-05 (R1) for AC motor and controls except the material of enclosure for LCS, which shall be of thermoplastic/cast aluminium/FRP housing (Make – Hensel/Rittal).

6.5.3 LCSs for non-reversible drives shall be provided with 'Start', and 'Emergency stop' push buttons along with indicating lamp showing 'Local Selected' whereas the LCSs for reversible drives shall be additionally provided with 'Forward/Open/Up' and 'Reverse/Close/Down' push buttons. Selection of Local/Remote shall be provided on ACP/MCB as per existing plant practice.

6.5.4 For drives which are not being controlled through Level-1 automation system, Local-Remote selector switch shall be provided in the respective LPBS instead of the indicating lamp showing 'Local Selected'.

6.5 All local control station/control junction box shall be thermoplastic housing with IP:65 degree of protection for the enclosure. Adequate space to work inside shall be considered.

6.6 Power Distribution Board/Aux Power Wiring**6.6.1 Power Distribution Board (PDB)**

6.6.1.1 Power distribution boards shall be provided for distribution of power to various 415V welding and vulcanizing socket outlets, cranes, hoists, Lighting Distribution Boards (LDB), air conditioning and ventilation starters.

6.6.1.2 The distribution board shall be suitable for 415V, 3-phase and neutral, 50 Hz system.



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- 6.6.1.3 Adequately rated single incomer with ACB/MCCB (acting as isolator) being fed from 415V PCC.
- 6.6.1.4 Circuit breaker shall be four (4) pole, air break, trip free, drawout type housed in individual compartments having stored energy mechanism for manual and electrical operation. For rating 630A and above drawout type ACBs shall be provided.
- 6.6.1.5 For feeders below 630A, fixed type MCCBs shall be provided. MCCBs shall have service breaking capacity (ICS) of at least 75% of ICU as per IEC:60947-2.
- 6.6.1.6 The outgoing MCCB feeders in new PDB shall be provided with integral release comprising over current and short circuit releases as well as additional earth fault protection with CBCT.
- 6.6.1.7 Type of PDB shall be floor mounted with IP:52 protection, compartmentalised, having separate segregated metallic compartments for busbars, switches and cables as per cubicle type board specified in VSP-6.3/GS-E-06 (R1).
- 6.6.1.8 Adequately rated TPN MCCB (below 630A) as required to feed cranes, hoists, power outlets, LDBs shall be considered. MCCB shall have overload and short circuit protection. For feeder to hoist and cranes, MCCB shall be provided with overload, short circuit protection and earth fault protection module with CBCT.
- 6.6.1.9 Fully equipped compartments with two (2) 125A, for VSP's use shall be provided as spare apart from regular spare feeder.
- 6.6.1.10 Breaker safety features for different types of operation shall be provided.
- 6.6.1.11 ACBs shall be provided with over current, short circuit and earth fault protective releases and the outgoing MCCB feeders shall be provided with over current, short circuit and earth fault module with CBCT arrangement.
- 6.6.1.12 All busbars of PDB shall be provided with heat shrunk PVC sleeve/tape with coloured tapes at intervals.
- 6.6.1.13 The neutral bus size shall be same as that of phase bus.
- 6.6.1.14 Panel detail inscription shall be provided in all panels front side as well as back side.



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- 6.6.1.15 Analog ammeters & voltmeters for incoming feeders shall be provided with necessary CT, PT and selector switches.
- 6.6.1.16 New PDB shall be located in place of existing power distribution boards. Bidder to check adequacy of existing space for installation of new PDB.

6.7 415 V Switch Socket Outlets with MCCB

- 6.7.1 Socket outlet with MCCB, housed in aluminium/thermoplastic (Make Hensel/Rittal) enclosure suitable for outdoor application (IP:65). Dimensions shall be as per IEC Standard 60309-2.
- 6.7.2 Maximum two (2) numbers of socket outlets shall be looped from one feeder.

6.8 240V & 24V Switch Socket Outlets

- 6.8.1 240V switch socket outlets shall be provided in adequate numbers to cater to the need of 240V AC power to the different consumers of the plant. Dimensions of switch socket outlet shall conform to IEC Standards 60309-2. 24V socket outlet shall be provided on ESP platform for hand lamps for working inside ESP enclosure 240V / 24V transformer shall be provided for generation of 24V AC.

6.9 Earthing and Lightning Protection System

- 6.9.1 Earthing stations around the new ESP area shall be provided by bidder & existing earth pit near ECR shall be retained wherever possible. New earth station shall be provided for new distribution transformer (Two(2) for each transformer) and electronic earthing. All new panels shall be provided with minimum two(2) nearest earth station.
- 6.9.2 Earthing of all equipment/system in bidder scope shall be connected to the Purchaser's earth mat. For that all necessary earthing materials and necessary installation materials shall be included in the scope of bidder.
- 6.9.3 Earthing of all electronic equipment (within the scope) shall be included in the scope of bidder along with all necessary copper cables. Special earthing network for the electronic equipment, if recommended, shall be provided by the bidder along with earth electrodes and suitable earthing mat etc to make the earthing

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installation complete in all respects from where the equipment shall be earthed by 1-core, PVC copper cables.

6.9.4 Lightning protection system along with earthing shall be provided by bidder as per IS:2309. The same shall be provided along with all necessary earthing materials, earth electrodes etc to make the installations complete in all respects.

6.9.5 All earthing materials and their accessories shall be selected based on the guidelines given in VSP-6.3/GS-07 (R1).

6.9.6 Earthing shall be carried out in line with the requirement given in General Specification VSP-6.3/GS-E-07 (R1).

6.9.7 In addition to normal earthing, separate electronic earthing station shall be considered for Electronic panels, field sensors and other electronic devices.

6.10 Illumination System

6.10.1 Light fittings and lamps (LED type)

6.10.2 The lighting system shall cover complete indoor and outdoor lighting system in ESPs and periphery lighting as well as ECR buildings within battery limit. Conforming to the General Specifications No. VSP-6.3/GS-E-06 (R1) and VSP-6.3/GS-E-07 (R1). Area around ESP existing lighting system shall be retained.

Lighting for TR floor, approach staircase, walkways, rapper floor of ESP etc shall be provided by bidder.

Indoor lighting along with push button stations shall be considered for MCC room, controller room, PCC transformer room, PCC rooms etc. Outdoor lighting with timer controlled automatic switching shall be considered.

6.10.3 Dismantling of existing lighting fittings to be included in scope and work. New lighting system shall be provided for all areas including ESPs and electrical building.

6.10.4 All lights shall be energy efficient type.

6.10.5 The scope of supply and installation shall generally include but not be limited to the following:

- i) All lighting fittings complete with accessories.

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- ii) Isolation transformers 415V/415-240 V of adequate rating, main lighting distribution boards, MCBDBs, automatic switching units for controlling ESP and area lighting, 240V, 15A metal clad switch socket outlets with RCCB, MCB isolators, 6/16A plate type switch socket outlet etc.

All the lighting system shall be designed in such a way that the area shall be covered with two different circuits so that in case of failure of one source at least 50% of lighting is available all the time.

- iii) All interconnecting cables, cabling materials, GMS pipes, conduits, cable trays, structural supports, earthing materials etc as required to interconnect the complete lighting system.

6.10.6 The maintenance factors shall be considered 0.7 for indoor area and 0.6 for outdoor area for illumination design.

6.10.7 Illumination (lux) levels for different area to be considered as indicated below:

Switchgear room/transformer cell	:	150-200 lux
A/C & ventilation/Cable vault room	:	70-100 lux
ACP, TR set & MCC room	:	300-350 lux
ESP structure & staircase	:	100-120 lux

Type of fittings to be adopted are as follows:

Switchgear room/AC ventilation room/cable vault – 20W /30W baton type LED fittings with diffuser (Equivalent to BAJAJ make BCLSB 18 WH or equivalent).

ACP, TR set & MCC room – 2' x 2' 36/40 W LED square decorate fittings(Equivalent to BAJAJ make BPRF 36W WH LED or equivalent).

ESP structure/walkway/staircase : 39/42 W LED well glass fitting(Equivalent to BAJAJ make BIWIDP 42 WH LED or equivalent)

Make of LED lighting fittings shall be PHILIPS/BAJAJ/CROMPTON/GE/WIPRO/HAVELLS

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- 6.10.8 General importance shall be given towards energy saving type light fittings for existing as well as new areas.
- 6.10.9 Supply and installation of emergency lighting from SEP/UPS along with all necessary materials to be considered. Emergency lighting fixtures without self contained battery shall be considered for controller rooms, ECRs and in strategic areas required for safe evacuation during normal power failure shall be provided by bidder.
- 6.10.10 The lighting layout shall be developed by the bidder based on his equipment layout/plant layout with number of fittings determined based on required illumination levels and to be finalized during detail engineering.
- 6.10.11 The degree of protection for equipment enclosure shall be IP:54 for indoor application and IP:55 for outdoor application.
- 6.10.12 The MLDB shall generally comprise two (2) full capacity isolation transformers of 415V/415-240V, two (2) Nos. incoming MCCB of adequate rating duly interlocked, full capacity bus coupler between two (2) bus sections duly interlocked, and requisite number of outgoing MCCB units. Power supply to the MLDB shall be from PDBs of respective areas. The MLDB shall be manufactured as per General Specification No. VSP-6.3/GS-E-06 (R1). MLDB shall have TPN incoming and outgoing MCCB. MLDB shall directly feed the street lighting fixtures and MCBDB.
- 6.10.13 MLDB shall be provided for power supply to MCBDBs (in electrical room, office, control room, ESP platform etc). 240V socket outlet circuits also to be fed from MCBDBs. The MCBDBs shall generally comprise incoming 63A/32A TPN miniature circuit breaker isolator and requisite number of outgoing 10/16A miniature circuit breakers. MCBDB for office, control room etc, RCCB of required rating (minimum 32A) shall be provided as incomer. Feeder in MLDB for road/area lighting shall be provided with contactor and timer for automatic switching. One (1) such spare feeder shall be provided in each MLDB. ON/OFF push button with contactor shall be incorporated to control of lighting system in various buildings/areas. Push button shall be provided for switching ON/OFF of the lights at all room, transformer room etc and shall be located in separate location near the entrance of the room. All MLDBs and MCBDBs shall be manufactured as per General Specification VSP-6.3/GS-E-05(R1). Four (4) spare feeders in MLDB and two (2) spare feeders in MCBDB shall be provided.

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6.10.14 For automatic switching of peripheral/area lighting, necessary power contactor, synchronous timer (L&T type TSQ-100-T or equivalent, 0-24 hrs with battery back-up), auxiliary relay (if required for multiplication of auxiliary contacts), auto/manual selector switch, start/stop push buttons, ON/OFF lamps, control fuses and other accessories shall be provided on the outgoing feeder from lighting distribution board.

6.10.15 Control of lighting system in unmanned area containing electrical equipment shall be through contactor having ON, OFF switching facilities by push buttons in all entry/exit doors.

6.10.16 Type of lighting fittings to be used shall be generally as per General Specification No. VSP-6.3/GS-E-07(R1).

6.11 24V socket outlet for hand lamps shall be considered at different existing ECR and controller room and working platforms of new ESP structure over 415V/24V AC dry type transformer. 24V metal clad type plug and sockets shall be considered. One (1) No. 24V socket outlet shall be considered in each existing ECR & controller room.

6.12 Cabling

6.12.1 11 kV (UE), XLPE, aluminium armoured cable.

6.12.2 1.1 kV grade PVC/XLPE armoured aluminium cable for secondary distribution, power wiring and lighting system.

6.12.3 1.1 kV grade HRPVC/FRLS power and control cables for hot areas.

6.12.4 Flexible copper cable for motor connection from power junction box to motor terminals (power JB for motor rated 75 kW and above).

6.12.5 1.1 kV grade PVC armoured copper control cables.

6.12.6 1.1 kV grade PVC armoured individually screened cable for analog signals.

6.12.7 1.5 sq mm / 2.5 sq mm copper wire (multi strand) for lighting system.

6.12.8 Tables given in VSP-6.3-GS-07(R1) are applicable for PVC as well as XLPE cable.

6.12.9 All cabling accessories including pre-fabricated GS cable trays, racks, hooks, tray supports, GI pipes and conduits,



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flexible GO conduits, coupler, sockets, clamps, exposed conduits, flexible conduits, glands, lugs, terminal boxes HT & LT termination and jointing kits etc as required for completeness of the installation.

6.12.10 All power, control and special cables as well as all cabling accessories, cable trays shall be selected based on the guidelines given in VSP-6.3/GS-E-07 (R1).

6.12.11 Cabling shall be carried out in line with the requirement given General Specification VSP-6.3/GS-E-07 (R1).

6.12.12 The fire protection measures shall be carried out after installation of all equipment as per the guidelines given in General Specification VSP-6.3/GS-E-07 (R1).

6.12.13 M-Seal (fire proof compound) putty for sealing cable opening.

7.0 CONSTRUCTION POWER

Construction power shall be made available near construction area. Bidder shall lay cable from this outlet to an outdoor pedestal type switchboard. They shall consider the same at the work site for further distribution as per their requirement. Approximate route length of 300 M shall be considered for power source from battery limit.

8.0 MISCELLANEOUS

8.1 All electrical panels shall be single front only. 415V PCC will be double front except incomer and bus-coupler due to space constraint. However, adequate front and back access shall be provided between two sections for ease of maintenance.

8.2 ESP controller shall be latest micro processor based with mimic in front of the panel (TR panel). ESP controller shall have connectivity to the level-1 automation system for integrated operation of the system. ON/OFF MCCB (door mounted type, with door interlocking facilities for giving or clearing shutdown without opening the door) and mushroom head type emergency stop push button (press to lock, turn to release type) shall be provided on the front of each ESP controller panel (TR panel).

8.3 Nomenclature/tags/identification boards, identification of all electrical items and danger board shall be under the scope of bidder.

8.4 Insulated rubber mat as per IS:15652:2006.

8.5 Fire retardant paint for application on cable.