
	<p>Bokaro Power Supply Company (P) Limited</p> <p>Replacement of 6.6kV Switchboard installed at 82T Substation in Coal Handling Plant.</p>	
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PREAMBLE

Bokaro power Supply Company (Private) Limited [BPSCL] is a joint venture company of Steel Authority of India Limited (SAIL) and Damodar Valley Corporation (DVC).

BPSCL (P) Ltd, Bokaro, now owns two Power Plants inside the premises of Bokaro Steel Plant (BSP), namely Thermal Power Plant (TPP) and a Captive power plant (CPP). While TPP is primarily used for meeting emergency power demand, steam demand of turbo blowers and other process needs of steel plant, CPP is entirely a base load power plant.

Additionally, one no. 36 MW BPTG has been commissioned recently in 2014.

The installed capacity of power generation of TPP is 122 MW, CPP is 180 MW and that of BPTG is 36 MW totaling to 338 MW.

BPSCL, Bokaro now intends through this specification to replace its existing 6.6 kV Switchboard, Slip ring motor rotor control panel and starting resistors along with associated power and control cables etc. installed at 82T Substation in Coal Handling Plant due to its old and obsolete design with BOCBs and to avoid regular breakdowns.

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01.00 DETAILS OF EXISTING PLANT, EQUIPMENT AND SYSTEM

The entire power plant has come up in two phases i.e. Thermal Power Plant (TPP) & Captive Power Plant (CPP).

Thermal Power Plant consists of five nos. multi fuel fired boilers (Boiler No. 1 to 5), each of capacity 220 TPH, one no. 12 MW back pressure steam turbine generator (TG-1) and two nos. condensing steam turbine generators each of 55 MW (TG-2 and TG-3).

Captive Power Plant consists of three nos., multi fuel boilers (Boiler No. 6, 7 & 8), each of capacity 260 TPH and three nos. condensing steam turbine generators (TG – 6,7 & 8) each of 60 MW.

Additionally, one no. 36 MW BPTG consisting of one no., multi fuel boilers (Boiler No. 9), of capacity 300 TPH is commissioned recently in 2014.

The total power plant of BPSCL is now operated as a single station comprising of five boilers each of 220 TPH capacity, three boilers each of 260 TPH capacity, five condensing turbo generators and one back pressure turbine. The plant has designed electrical power generation capacity of 302 MW + 36 MW (BPTG) along with capacity of meeting steam requirement of turbo-blowers, turbo-compressors and process needs of steel plant (partly).

EXISTING POWER DISTRIBUTION AND EVACUATION SYSTEM

The 3 nos. TG sets (TG # 1, 2 & 3) of TPP generate power at 11 kV bus and evacuate the generated power at 11kV itself to various load centers. For internal unit auxiliary consumption, they use 6.6 kV power as primary distribution level available from 11 kV bus through 4 nos. 11/6.6kV step down transformers each of capacity of 10 / 15 MVA. 11 kV bus is also tied up with 132kV outdoor

switchyard through 2 nos. 11/132 kV transformers, each of capacity of 40 MVA, for evacuation of surplus power as well as import of startup and station power.

TG # 6 of CPP generates power at 11 kV bus and evacuate the generated power at 11kV itself to various load centers. For internal unit auxiliary consumption, it uses 6.6 kV power as primary distribution level available from 11 kV bus through 1 No. 11/6.6kV step down transformer of capacity of 10

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MVA. 11 kV bus is also tied up with 132kV outdoor switchyard through 1 No. 11/132 kV transformer of capacity of 80 MVA for evacuation of surplus power as well as import of startup and station power.

TG # 7 & 8 of CPP generate power at 11 kV and evacuate the generated power directly at 132kV switchyard through 2 Nos. 11/132 kV transformers, each of capacity of 80 MVA. For internal unit auxiliary consumption, they also use 6.6 kV power as primary distribution level available from outgoing 11 kV terminals of generators through 2 Nos. 11/6.6 kV transformers, each of capacity of 10 MVA. Station power is available at 6.6 kV through 2 nos. 132/6.6kV transformers, each of capacity of 10 MVA.

BPTG # 9 of CPP generates power at 11 kV and evacuate the generated power directly at 132kV switchyard through 1 No. 11/132 kV transformers of capacity of 50 MVA. For internal unit auxiliary consumption, it will also use 6.6 kV power as primary distribution level available from outgoing 11 kV terminals of generator through 1 No. 11/6.6 kV transformers of capacity of 12.5 MVA. Station power is also available at 6.6 kV through 1 no. 132/6.6kV transformers of capacity of 12.5 MVA.

02.00 PLANT LOCATION & METEOROLOGICAL DATA

Location of the Site



The existing Power Plant Complex of Bokaro Power Supply Company (P) Limited (BPSCL) is located inside the premises of Bokaro Steel Plant. Bokaro Steel Plant is located in Bokaro District, Jharkhand state at latitude 23^o47' and longitude 85^o53'.

Approach to the site

Bokaro Steel Plant is 53 KM by rail from Muri Junction and 34 Km by rail from Gomoh Junction. It is a distance of 45 KM by road from Dhanbad. NH-32 is passing through Sector IV of Bokaro Steel Township. Ranchi airport is about 100 KM away from Bokaro Steel City.

Meteorological Data

The climate prevailing at Bokaro Steel Plant is tropical and humid. The equipment offered will be suitable for following climate condition.

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Altitude above mean sea level : Less than 1000 m.
Average ambient temperature over 24 hrs : 45⁰C
Maximum Ambient temperature : 50⁰C
Maximum Humidity : 100%

Seismicity : Earthquake zone III (As per IS Code:1893::2002, Part-1)

All other relevant details about site condition shall be obtained by the Tenderer from the client/ consultant.

03.00 SPECIAL INSTRUCTIONS TO TENDERERS

03.01 Inspection of site by Tenderer

Tenderer shall inspect the site and examine and obtain all information required and satisfy himself regarding all matters such as access to site, communication, transport, right of way, details of existing systems, availability of local labour, availability and rates of materials, local working conditions, extreme weather conditions, uncertainty of weather, obstructions and hindrances that may arise, etc, which may affect the work or cost thereof, before the submission of his tender.

Ignorance of site conditions shall not be accepted as basis for any claim for compensation. The submission of tender by Tenderer will be considered as evidence that such an examination was made and any later claims / disputes in regard to price quoted shall not be entertained or considered.

Tenderer shall note that the plant and equipment covered under this specification, in no way will obstruct / hinder the operation and maintenance of the existing plant and equipment.

03.02 Compliance with Specification

All equipment and accessories covered under this specification shall conform to 'Technical Specifications' given in this document.

The standard voltage levels and earthing system of the Plant are as follows:

- 132 kV - Solidly earthed
- 11 / 6.6 kV - Unearthed

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415 V - Solidly earthed

All equipment shall be suitable for voltage (+/- 10%) , frequency (+/-5%) variations and combined variation of +/- 10%. All equipment shall be designed for 50 Deg. C.

The Tenderer shall be responsible for satisfactory working of system with guaranteed parameters. All the major equipment shall be installed, tested and commissioned under supervision of representative of manufacturer of respective equipment.

03.03 Standards and Regulations



The design, manufacture, performance, testing and installation (including safety, earthing and other essential provisions) of equipment and accessories covered under this specification shall, in general, comply with the latest issue of the following:

- Applicable Standards and Codes of Practices published by Bureau of Indian Standards.
- Central Board of Irrigation and Power
- Indian Electricity Act, 2003
- Central Electricity Authority
- Indian Electricity Rules
- Equipment specific statutory regulations
- Indian Factory Act

Equipment complying with other recognized Standards such as IEC, BS, VDE, DIN etc. will also be considered if it ensures performance equivalent to or superior to Indian Standards.

Equipment and accessories for which Indian Standards are not available, shall be designed, manufactured and tested in accordance with the latest issues of recognized Standards such as IEC, BS, VDE, DIN etc.

In case of conflict between applicable Standards referred to in this part and technical specifications, the Technical Specifications shall govern to the extent of such difference.

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03.04 Make & Interchangeability

The make of all equipment shall be restricted to preferred makes indicated under chapter 'List of preferred makes'. Makes of all other equipment and accessories 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.

03.05 Safety

All equipment shall be complete with approved safety devices wherever a potential hazard exists and with provision for safe access of personnel to and around equipment for operational and maintenance functions.

All danger and caution notice boards shall be in English as well as in Hindi.

The Tenderer must take sufficient care in moving his construction plants and equipment from one place to another so that those may not cause any damage to the property of the Purchaser particularly to the overhead and underground cables and other service lines.

All electrical drives and equipment must be equipped with safety devices. The safety provisions shall conform to the recognized standards, safety codes and statutory regulations.

All safety measures as required to be adopted as per the statutory regulations and the safety rules of the plant shall be strictly followed by the Tenderer during the execution of the Contract.

03.06 Tenderer's License

The Tenderer shall possess a valid and competent Tenderer's license issued by the electrical licensing authorities of the Govt. of Jharkhand or other States for carrying out electrical installation work of the type and magnitude covered in this document, in the state of Jharkhand. The Tenderer shall also be required to obtain labour license from Statutory Authority.

Copy of the license shall be made available to the owner/consultant for verifications during the execution of contract.

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All linemen, wiremen, electricians, supervisors and engineers engaged by the Tenderer or his sub-tenderer shall possess necessary valid license issued by the statutory authority and the same shall be submitted for verification, if called for.

03.07 Compliance with rules, regulations, and obtaining statutory approval

All equipment/materials shall be installed in accordance with the requirements of relevant standards, Indian electricity Rules, Indian Electricity Act, 2003 and also the Factory Act. It is the responsibility of the contractor to see that the electrical installation supplied and erected by him shall be to the entire satisfaction of Chief Electrical Inspector, Central Electricity Authority or any other statutory body having jurisdiction in the area and also to the owner/consultant.

The responsibility for obtaining all statutory approvals, if required, for the installation to be carried out rests entirely with the contractor. It shall be the responsibility of the contractor to prepare and submit all necessary drawings, calculations, test certificates and relevant details (other than those given by the owner/consultant) to the Electrical Inspector and obtain prior approval for commencing the work and for the complete installation work done. Obtaining approval certificate from Chief Electrical Inspectorate of the state and CEA for installation and energizing the complete electrical system and equipment covered under the package is in the scope of contractor. Any modification or additional requirements by Electrical Inspectorate shall have to be carried out without time and cost implication to the Purchaser.

The inspection fee for statutory approvals shall be reimbursed by the owner on submission of documentary evidence.

03.08 Time Frame

Time frame for execution of this Project shall be Five (5) Months from the date of LOA / Placement of Order by the Purchaser to the successful Tenderer.

03.09 PERFORMANCE REQUIREMENT AND GUARANTEE

The Tenderer shall study the specification and satisfy himself thoroughly regarding the workability of the plant, equipment and systems offered and also take full responsibility for the guaranteed operation and performance of the same as well as for their smooth, safe and reliable working.

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04.00 SCOPE AND BRIEF DESCRIPTION OF WORK

04.01 General

The scope of work includes the basic engineering, detailed engineering, construction / manufacture or procurement of electrical equipment / protective equipment, shop testing, packing, transportation, loading, delivery at site, unloading, storage at site, handling, erection, pre-commissioning tests and commissioning of all equipment / system including preliminary acceptance test, performance guarantee and post commissioning services, including insurance cover during transit, storage, erection, testing and commissioning. After successful commissioning, the commissioning spares not used, will be the property of the owner. The job shall be done on turnkey basis. Scope of tenderer shall also include the following;



- Supply of commissioning spares.

All commissioning spares, whatever required are included in scope of Tenderer. Prices of commissioning spares shall be included in the base price of the offer , i.e no unit rate shall be applicable on commissioning spares.

04.02 6.6 kV Switchboard, Slip ring motor rotor control panel and starting resistors etc. within the scope of the Tenderer shall be installed in the existing 82T Substation in the Coal Handling Plant on existing foundations / floor cut-outs etc. after dismantling the existing Switchboard / equipment of the Substation. Any modifications required in the existing foundations / floor cut-outs for installation of the new 6.6 kV Switchgear and other equipment shall also be carried out by the Tenderer.

The 6.6 kV Switchboard in the existing 82T Substation is being fed from the 6.6 kV Board of TPP installed in the Switchgear Room located at ground floor of Main Power Plant Building and is feeding to 750 kVA Transformer and 450 kW Hammer Crusher Slip ring induction motor.

The electrical scheme is indicated in enclosed single line diagram No: MEC/11/E1/Q7EA/82T/001, Rev 00.

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The scope of the Tenderer starts from outgoing end of 6.6 kV existing Switchboard at TPP feeding to proposed / new 6.6 kV Switchboard at 82T Substation in the Coal Handling Plant.

Replacement of existing 6.6 kV cables and associated control cables from 6.6 kV Board of TPP to Tenderer's New 6.6 kV Switchboard installed in the existing 82T Substation as well as outgoing 6.6 kV Power and Control cables to 750 kVA Transformer and 450 kW Hammer Crusher Slip ring induction motor including their laying, termination at both ends and jointing / termination materials etc are also included in the scope of the Tenderer.

Two runs of three core, 240 sq.mm (2Rx3Cx240sq.mm) XLPE Aluminium cables shall be provided from existing 6.6 kV Board of TPP to Tenderer's New 6.6 kV Switchboard. Any modification required in the existing 6.6 kV Board of TPP for termination of 2Rx3Cx240sq.mm XLPE Aluminium cables shall be carried out by the Tenderer.

These new cables shall be laid in the existing cable tunnel / cable trenches etc. to the extent possible or else shall be laid buried with the consent of the Purchaser with suitable protection over it. The final routing shall be finalized as per site conditions with the approval of the Purchaser.

450 kW Hammer Crusher Slip ring induction motor has a rotor control panel located in 82T Substation. The existing panel of Rotor Control for this Slip Ring motor is also to be replaced by the Tenderer with the latest available technology.

The existing system of stator control consisting of isolator, fuses, air contactors, etc. shall be removed and power supply to stator shall be provided directly from VCB terminals.

A control circuit drawing of the Hammer Crusher Slip Ring Induction Motor and Data / Details of Motor are also enclosed with the TS for reference of the Tenderer. However, any other details associated with the replacement of Rotor control panel shall be obtained during execution, if available with Client or else the same shall be collected from in-situ conditions by the Tenderer.

All civil work, existing foundation modifications etc. associated with the installation of the Tenderer's equipment are included in the scope of the Tenderer.

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Design and installation of the equipment shall ensure trouble free operation without any constraint during maintenance. Items / services / tests etc. not specially mentioned but considered necessary for smooth and trouble free operation of the equipment / system shall be treated as included in the scope of the Tenderer.



04.03 The major equipment / activities covered under scope of work shall be as follows:

1. Supply and Installation / Replacement of the following along with all associated electrical, mechanical and civil works :
 - a. 6.6 kV Switchboard .
 - b. Resistor Boxes with Rotor Control Panel for 450 kW Hammer Crusher Slip ring induction motor.
 - c. HT, LT Power and Control Cables and cable accessories etc.
2. Complete relay co-ordination including relay setting calculations for all the relays.
3. Replacement of existing 6.6 kV cables and associated control cables from 6.6 kV Board of TPP to Tenderer's New 6.6 kV Switchboard installed in the existing 82T Substation as well as outgoing 6.6 kV Power and Control cables to 750 kVA Transformer and 450 kW Hammer Crusher Slip ring induction motor including their laying, termination at both ends and jointing / termination materials etc.

In addition to above, supply of all interconnecting HT, LT and Control cables from 450 kW Hammer Crusher Slip ring induction motor rotor to Resistor Boxes and associated Rotor Control Panel including their laying, termination at both ends and jointing / termination materials etc. are also included in the scope of the Tenderer.

Any modification required in the existing 6.6 kV Board of TPP for termination of 2Rx3Cx240sq.mm XLPE Aluminium cables shall be carried out by the Tenderer.

4. Supporting structures, conduits, prefabricated GI cable trays, cable racks, other associated accessories like cable glands, lugs, termination/jointing kits, ferrules, cable markers, cable identification tags, fire sealing materials and all other hardware material as per requirement. However, Tenderer

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can use vacant cable trays in existing cable trenches / cable tunnel etc. to the extent possible.

5. Dismantling of all old and existing Panels, cables etc. which are to be replaced along with other related equipment and safely transporting to storage area & handing over to the Purchaser.
6. Construction of 4 nos. of new earth pits and the same to be connected to the new Panels and equipments. Also, this new earthing system / ring shall be connected to Purchaser's existing earthing rings at two places.



The materials shall be galvanized steel laid over the ground and mild steel buried inside the ground/concrete.

Earthing protection system shall be designed on the basis of the standards like IS : 3043 (Latest revision), IEEE 80 and Indian Electricity Rules.

All joints in the run of the main earthing conductors will be welded or brazed type. Connection to equipment structure shall be bolted type. All welded joints shall be protected from corrosion by applying bitumen paint.

The minimum earthing conductor sizes to be used are as follows :

- i. 75 x 6 GI Flat for Main earthing ring and HT Switchboard.
 - ii. 50 x 6 GI Flat for LT switchboards / control panels /resistance box etc.
7. All interconnections / wiring and integration between Tenderer's own equipment and between Purchaser's and Tenderer's equipment including supply of HT, LT power and control cables, wherever required to complete the system in all respect are included in the scope of the Bidder.
 8. Base frame / base channel / base plate / cross channels etc. , if required for switchboards and other equipment to flush them with FFL along with associated civil works shall be under scope of Tenderer.

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9. Any modifications required in the existing foundations / floor cut-outs for installation of the new 6.6 kV Switchgear and other equipment shall also be carried out by the Tenderer.
10. All erection materials required during erection of all types of electrical equipment under Tenderer's scope.
11. Safety items, rubber mats for switchboards etc.
12. Any other equipment / system etc that will be necessary to complete the work in all respect.



04.04 Estimated cable route lengths

Estimated cable route lengths from existing 6.6 kV Switchboard of TPP to Tenderer's New 6.6 kV Switchboard installed in the existing 82T Substation is approximately 750 metres and 750 kVA Transformer and 450 kW Hammer Crusher Slip ring induction motor each will be located at an approximate cable route lengths of 50 metres from the new 6.6 kV Switchboard.

Tenderer shall consider following lengths of cables for his offer.

1. HT (6.6 kV) Power and Control cables from existing 6.6 kV Switchboard of TPP to Tenderer's New 6.6 kV Switchboard installed in the existing 82T Substation as well as outgoing 6.6 kV Power and control cables to 750 kVA Transformer and 450 kW Hammer Crusher Slip ring induction motor.
 - a) 6.6 kV (UE) ; 3C x 240 sq.mm XLPE Al. cable – 1600 Mts.
 - b) 1.1 kV ; 5C x 2.5 sq.mm Copper control cable – 800 Mts.
 - c) 1.1 kV , Al. Power cable – as required.

Tenderer shall quote units rates of various cables as indicated here in TS in their price bid that will be applicable for any addition / deletion of cables over the specified quantity. Cable route lengths given in the TS are estimated only. Any addition / deletion shall be based on unit rates during detailed engineering.

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Unit rate of cables of various voltage grades and sizes shall include cable laying, cable trays, supporting structures, cable accessories like clamps, ferrules, lugs, tags, markers, etc. **Addition / deletion based on unit rate shall be applicable to cables only.**

Tenderer shall order the procurement of incoming cables to his sub vendor after finalization of actual requirement of cables. Tenderer shall finalize the requirement along with Purchaser/ Consultant just after order placement by making a realistic survey.

The drum length shall be decided accordingly to avoid wastage of cables. Any jointing at mid point shall be avoided to the extent possible.

04.05 Installation, Testing and Commissioning

The scope of the Tenderer shall also include the following;

- Erection, testing, commissioning including transportation of all equipment and material, which are in the scope of supply of Tenderer.
- Supervision of erection, testing and commissioning of electric and equipments by representatives of respective equipment manufacturer.
- Necessary coordination work required for erection, testing & commissioning and resolving problems of all equipment.
- Installation & testing of cabling system, including cable, trays/supports etc.
- Laying and termination of all interconnecting cabling required for completeness and commissioning of the plant.

04.06 Construction Power

For construction power supply a 415 V feeder (only one feeder) shall be provided by the purchaser at one point at an approximate distance of 50 Mtr. Tenderer shall have to make their own arrangement for feeding to various load centers. This shall include required power and control cables and switch fuse units etc.

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05.00 ELECTRICAL SYSTEM DESIGN CRITERIA

05.01 General

The design, manufacture, assembly and testing as well as performance of the equipment shall conform to the relevant IS specifications (latest revision) and other relevant standards.

All equipment supplied and all work done including system design and detailed engineering shall also comply with the statutory requirements of the Government of India and the Government of Jharkhand.

05.02 Climatic Conditions

Electrical Equipment selection and derating shall generally be based on ambient temperature of 50°C. For specific hot areas the ambient temperature conditions 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.

The equipment offered shall be suitable for smooth, efficient and trouble free service in the climate prevailing at Bokaro Steel City.

05.03 Permissible variations

The system/ equipment shall be designed suitably for following variation in voltage and frequency;

	Voltage	Freq.
Permissible variation with rated performance and control effectiveness maintained	+10% to -10% (for LT) +10% to -10% (for 6.6 kV)	+5% to -5%
Permissible variation for control and regulation equipment with rated performance and control quality maintained	± 10 %	+5% to -5%

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Permissible voltage dip at HT switchgear bus during starting of HT motor	- 15 %	-----
Permissible voltage dip at LT switchgear bus during starting of LT motor	- 15 %	-----

05.04 Basic insulation levels

The basic insulation levels considered for different equipment are:

	Basic Insulation Level
6.6 kV	60 kV
415 V	-----

05.05 Symmetrical short circuit ratings

The short circuit levels are required to be calculated to determine the ratings of the new equipment and to ascertain the adequacy of the ratings of the equipment for safe and reliable operation.

The three phase symmetrical short circuit ratings of the switchgear at different voltage levels envisaged are as follows:

	Breaking Capacity	Making Capacity
6.6 kV	40 kA	100 kA
415 V	50 kA	105 kA
110 V DC	10 kA	-----

The rated short circuit withstand duration for 6.6 kV switchgears will be 3.0 Secs, whereas for 415 V switchgears it will be 1.0 sec.

05.06 System earthing

6.6 kV systems will be unearthed and 415 V systems will be solidly earthed.



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06.00 TECHNICAL SPECIFICATION

06.01 6.6 kV SWITCHBOARD

06.01.01 GENERAL ARRANGEMNET OF SWITCHBOARD

01. The switchboard shall be of metal clad single bus bar self standing, dust proof construction, indoor cubicle type fitted with VCB circuit breakers for 6.6 kV in fully draw out execution.
02. The circuit breakers shall be suitable for following duties.
 - To withstand in rush magnetizing currents of transformers & capacitor bank during "ON" and "OFF" operation.
 - To withstand switching off over voltages caused due to break of lightly loaded low capacity cage type induction motors. It shall also withstand DOL starting of motor with large starting time and repeated starting like one hot start and two successive cold starts.
 - Transient surge produced by Circuit breaker due to severe chopping during sudden interruptions of inductive current (i.e. motor loads), shall be within limits allowable for motors according to IEC34 part 1 otherwise suitable surge absorber shall be provided.
03. The controls, indicating lamps, relays and meters shall be mounted on breaker cubicle.
04. Operation counter, close / open mechanical indications, spring charged / discharged indication shall be provided.
05. All circuit breakers shall have motor operated spring charged independent closing and shunt tripping from 110 V DC. Closing coil shall be suitable to operate between 85% to 110 % of voltage and tripping coil between 70-110% of rated voltage. Spring charging motor shall operate between 85 – 110% and motor shall be of 110 V DC.

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06. Jumpers (vertical busbars) in the cubicle also shall be of same current rating as that of the breaker. Only the jumpers connected to CT shall be rated according to CT rating.
07. A manually operated type devices to enable charging of closing springs.
08. Manual / mechanical tripping arrangement for emergency tripping or Circuit breakers.
09. All circuit breaker truck shall have service, test and draw out positions. Test position shall engage only the auxiliary (control) contacts to close trip the CB during testing.
10. Anti pumping feature shall be provided.
11. All live parts shall be insulated by tapping supported by suitable designed insulators. Proper insulation of bus bars upper and lower contacts or breaker vacuum bottles (for VCB) and sealing of opening of bushing shall be provided to eliminate accidental contacts. Switch board busbars shall be tapped by proper grade of insulating tape
12. The cubicle shall be provided with a position changing gear arrangement in such a way that by engaging detachable device from outside the front door. It shall be possible to move the breaker truck and change position without opening the cubicle door. Facilities for pad locking in each position shall be provided.
13. Each cubicle shall be of compartmentalized construction and shall have separate compartments for bus bars, CTs and outgoing cable, metering & protection devices.
14. All circuit breaker trucks of same rating shall be identical in all respects (except metering and protective devices) and shall be interchangeable with similar breaker rating panel.
15. Continuous earth bus shall be provided throughout the board.
16. The position of various control switches, push buttons, leavers etc requiring manual operation shall be at a height not less that 450 mm and shall not need 1850 mm from the finished floor level.





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17. The operating mechanism parts shall be designed to give longer life, trouble free operation and require minimum maintenance.
18. The material and components used shall have chopping current limited to minimum.
19. The following auxiliary buses shall be provided for controls and protection
 - control supply buses for AC and DC
 - Signalling supply
 - PT secondary voltage
 - Spare buses – 2 nos.
20. In case of breakers like VCB that give rise to over voltage surges due to current chopping phenomenon. Surge suppressors to be provided at the load side terminals of the breakers to limit the switching surges to a value limited as per IEC regulations.
21. Breakers outgoing to HT motors shall be with transient surge protection

Sr. No.	PARTICULARS	6.6 KV SWBD
1.	Type	VCB
2.	Service	Indoor
3.	Enclosure	IP4X or better
4.	Nominal system voltage	6.6 kV
5.	Highest system voltage	7.2 kV
6.	No. of phase and frequency	3 Phase, 50 Hz
7.	Busbar material (for 6.6 kV)	High conductivity electrolytic aluminium alloy
8.	Bus color code	Red, Yellow, Blue, Black & Green
9.	System Earthing	Unearthed
10.	Circuit breaker rating	
a.	Continuous current rating at 45°C.	1250 Amps.
b.	Short circuit rating	40 kA for 3 secs.
c.	Rated making current	100 kA

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11.	Busbar rating	The bus section shall be designed that the maximum temperature rise does not exceed 45 deg. C while carrying rated continuous current & satisfies IEC stipulations.
12.	Power frequency withstand voltage	28 kV for 1 min.
13.	Impulse withstand voltage (1.2 / 50 micro sec).	66 kV
14.	Control voltage	110 V DC
15.	Spring charging motor voltage	110 V DC
16.	CT Ratio	Secondary current 5 Amps.
17.	PT Ratio – Star / Star / Open Delta	6.6 / $\sqrt{3}$ / 0.11/ $\sqrt{3}$ / 0.11/ 3
18.	Aux. Contacts	6 No. + 6 NC
19.	Termination	6.6 kV XLPE Al. Armoured cables
20.	Incomers	2 Run of 3 C x 240 Sqmm XLPE Al. cable
21.	Outgoings	1 Run of 3 C x 240 Sqmm XLPE Al. cable
22.	Clearance in air	
	Phase to phase (mm)	As per IS, IEC & IE Rules
	Phase to earth (mm)	As per IS, IEC & IE Rules
23.	Current Transformer (CT)	Class B or better
24.	Potential Transformer (PT) ; Over voltage factor	Drawout type ; 1.9 for 8 hrs & 1.2 continuous

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06.01.02 Mechanical Positive interlocking

In the design of the switchgear the following positive interlocking shall be provided.

01. It shall not be possible to move the truck cassette from the isolated to the Service Position unless low voltage plug and socket connections have been made.
02. It shall not be possible to disconnect the low voltage plug and socket as long as the circuit breaker truck cassette is in service position.
03. It shall not be possible to withdraw the truck / cassette without disconnecting the low voltage plug and socket.
04. It shall not be possible to move the truck / cassette from the service to the isolated position or vice – versa with the circuit breaker in the “ON” position.
05. It shall not be possible to switch on the circuit breaker when the truck is in between the isolated and the service position except in test position.
06. It shall be possible to switch on the earthing switch only when the truck is in the isolated position, wherever an integral earth switch is provided.
07. It shall not be possible to open the circuit breaker enclosure when the breaker is “ON” or to have access to any part of the draw out assembly which is live when the circuit breaker is in the service position.
08. Shutters shall be lockable in closed position.
09. Where local / remote selector switches are called for, it shall be ensured that :
 - The breaker can be closed locally only if the breaker truck is in the test position and the local / remote selector switch is in local position.
 - The breaker can be operated from remote panel (in shop : control room) only when the breaker truck is in service position and the local / remote selector switch is in remote position.



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- The breaker can be tripped locally regardless of the position of the breaker truck and regardless of position of local / remote selector switch.

06.01.03 Construction Features

01. Mechanical Design

- Sheet steel clad, compartmentalized floor mounted, free standing design.
- Minimum sheet steel thickness, doors & covers, 2 mm cold rolled, other load bearing members – 2.5 mm CRCA steel.
- Doors shall be provided with lock and key arrangement.
- Lockable front doors with concealed hinges with the door not forming part of the draw out truck.
- Panels shall be extensible on both sides.
- Removable sheet steel covers shall be provided at rear.
- Degree of protection shall be IP4X.
- Assembled on base channel of structural steel of minimum height 150 mm painted black. This should be able to withstand load of panel.
- Operating height shall be between 450 to 1800 mm. Total height of the Switchboard should not exceed 2500 mm (including height for protecting and metering panel).
- Earthed metallic barriers between compartments and between vertical sections.
- Seal off bushings wherever bus bars pass through metallic partition.
- Zinc bichromated and passivated hardware.

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- Transport unit not larger than 3.2 meters.
- Removable lifting arrangement for each transport unit.
- Explosion vent for each chamber.
- Control cables entry shall be from front side.
- CTs shall be located in such a way that they are easily accessible.
- Incomer feeder VCB shall be of PT mounted type.
- Panel door switch shall be provided for illumination inside the panel.
- All live parts shall be insulated by tapping, supported by suitably designed insulators. Proper insulation of bus bars, upper and lower contacts of breakers and sealing of opening of bushings shall be provided to eliminate accidental contracts.
- Screw wire mesh in the power cable chamber of incoming feeder is to be provided.
- In case of 6.6 kV switchgear, instrument and meters can be provided on LT compartment provided on top of circuit breaker chamber.
- Indications with Cluster LED lamps. Following indications shall be provided.

Phase supply ON, Breaker ON, OFF, Auto Trip, Spring charged, Service & Test Position, Control supply healthy, Trip circuit healthy and Lock out relay healthy etc.

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02. Labels

- Switchboard designation nameplate at the center of the board with letters not less than 50 mm high.
- Panel designation and number on each panel, both in front and rear.
- Instruction plate for each feeder on the door with letter size not less than 25 mm height.
- Door front mounted devices to have labels directly below them.
- Labels made on non-rusting metal or 3 ply lamicold with engraved inscription of white letters minimum 8 mm high on black background.
- Label designation and size of lettering subject to approval.
- Bus side and cable side shutters labeled for identification.

03. Surface Treatment

All metal parts of the panel to undergo Seven tank process surface treatment that includes de-rusting, cleaning, chemically degreasing, pickling in acid, cold rinsing, phosphating and passivating followed by spraying with two coats of zinc oxide primer and baking in oven.

Shade of paints.

Panel interior and Exterior : Epoxy based powder coated, shade 631 as per IS : 5.

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04. **Busbar and Connections**

- Power buses of EC grade aluminum alloy equivalent to E91EWP as per IS : 5082 – 1981 or high conductivity electrolytic grade copper as per IS : 613 - 1984.
- Control and Auxiliary buses of electrolytic grade copper.
- In case of 6.6 kV switchboard the busbar shall be insulated. Even that part of isolating contacts which projects into the bus compartment shall be covered with an insulating sleeve.
- The continuous rating of the main horizontal bus not less than the rating of the incomer specified. Where not specified, the rating to be selected for at least 125% of the maximum demand of the switchboard taking into account spare feeders.
- The vertical bus rating
 - for incomer : Not less than that of horizontal bus
 - for outgoing : Not less than that of the outgoing breaker, irrespective to relay setting.
- Final operating temperature under continuous operation in enclosure limited to 90°C by thermometer method.
- Both horizontal and vertical bus bars to be designed and supported to withstand the thermal and dynamic supported to short time and peak withstand current specified.
- Bus bar arrangement as per IS 375.
- Phase identification by color in each panel.
- Bus bars horizontal as well as vertical shall be provided with heat shrinkable, non tracking, low absorption type sleeving conforming to international standards for full voltage for 6.6 kV switchboard.
- Tender shall supply along with Panels, busbar joints and tap off connections of bolted type with zinc dichromate high tensile steel



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bolts, nuts and spring washers, fishplates with accessories for site connections.

- Bus bar support insulators of non-hygroscopic material high impact and dielectric strength with an anti tracking contour.

05. Internal Wiring & termination

- Control wiring shall be carried out by 1100 V grade PVC insulated. Single core multi stranded copper wire of minimum cross section 1.5 sq. mm.
- Flexible wire of 2.5 sq. mm shall be used from CT chamber to relay chamber and shall have protection against heat & mechanical damage due to flash over. Use of heatproof sleeves and rigid conduit shall be made to run the control wires from back to front.
- Wiring and terminal arrangement for all panels shall be carried out as per approved scheme. The scheme shall be submitted by successful tenderer for approval.
- Flexible wires, protected against mechanical damage, for wiring to door mounted devices.
- Wires identified at each end in accordance with schematic diagrams by interlocked type ferrules. These shall be firmly located so that these do not move.
- Colour code for control wiring.

AC – Black

Earth wire – Green

DC – Light gray

Trip CKT – Red

- All connections external to a feeder, all the auxiliary contacts of the HV breaker and at least 1 NO. & 1 NC spare contacts of the relays shall be brought to terminal blocks.
- Interconnection between panels of adjacent shipping sections to be brought out to a separate terminal blocks.

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- Control wires shall be run in earthed metallic flexible conduits when laid in HV bus chamber.
- Not more than two connections shall be provided on any one terminal.
- Heat proof arrangement for the passage of wiring in HT panel.
- All telemetering signals wired to terminal strips.
- **Control Terminations**
- 650 V grade multi-way open type terminal blocks of non-tracking moduled plastic complete with insulated barriers stud type terminals, washers, nuts and lock nuts and identification strips.
- All terminals going out of the switch board shall be brought to a separate terminal board marked "External Termination". These will be easily accessible.
- External terminal blocks shall be provided in the relay chamber with proper clamping facilities for cable dressing.
- Control terminals shall be suitable to receive two numbers 2.5 sq. mm copper conductor.
- 20% spare terminals in each control terminal block. Terminal blocks in separate groups shall be provided for DCS, remote control panels, transformer marshalling boxes, local push button stations, etc.
- Gland plate for control cables shall be of adequate size to accommodate and to facilitate glanding of all the control cables coming from external equipment.
- Terminal blocks shall be placed separately for internal looping and external looping.

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- **Power Terminations**

- Suitable for accepting cable / bus trunking as required.
- Sufficient space and support arrangement inside each panel to accommodate HT cable termination kits and sealing kits suitable for the size and number of XLPE cable.
- Dummy panels to be provided adjacent to the switch panel, where the required number cable terminations can not be accommodated in the cabling chamber of the main panel. Rear extension not acceptable.
- Where more than one cable have to be terminated per unit, the arrangement shall permit connection and disconnection of cables separately without disturbing other cables.
- Power cables termination shall be designed to facilitate easy approach to CTs.
- The following cable termination accessories, suitable for the type, size and number of cables to be terminated, to be supplied with switchboard.
 - i. Cable sockets with all HT terminals (sockets set at such an angle that cable tails can be brought up for termination with minimum bending and setting).
 - ii. HT cable termination and sealing kits.
 - iii. Double compression type Nickel brass cable glands and crimping type tinned heavy duty copper lugs for HT, LT power and control cables.
 - iv. Gland plate for power cables shall be of 3.0 mm.



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06.01.04 Control Supply

01. Control supply buses shall run throughout the switchgear.
02. One DC feeder shall be taken in each board controlled by MCBs.
03. Failure of DC supply shall be monitored in the switchboard as well as at remote.
04. 240 V AC supply shall be taken from a station aux. Board.
05. Each panel shall have one MCB for controlling its AC supply.
06. Sub circuits shall be protected with HRC fuses in each panel for indication lamps, closing and tripping circuits.
07. Control circuit should be protected, preferably with MCBs alternatively HRC link type fuses conforming to IS 9224 – 1979.

06.01.05 PROTECTIVE EARTHING

01. Continuous earth bus of minimum size 50 x 6 mm of copper or equivalent aluminium / galvanized steel section, designed to carry the peak short circuit and short time fault current as specified.
02. Provided at the bottom extending throughout the length of the board, bolted / brazed to the frame work of each panel with an earthing terminal at each end for terminating external earth conductor.
03. Vertical earth bus for earthing individual functional units.
04. All non-current carrying metal work (including metallic cases of instruments and other panel mounted components effectively) bonded to the earth bus.
05. Hinged doors earthed through flexible earthing braid.
06. Looping for earth connection resulting in loss of earth connection to other devices when the loop is broken not permitted.
07. Withdrawable units provided with self aligning, spring loaded, silver plated copper scrapping earth contacts of make before / break after type, ensuring earth continuity from service to the test position.

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06.01.06 Details of major protections and metering for 6.6 kV panels.

Sl. No.	Type of Feeders	Protection	Metering
1.	Incomer	<ul style="list-style-type: none"> ➤ Over-Current INST (50) & IDMT O/C (51-3 Pole) ➤ Earth Fault (50N & 51N-Single Pole) ➤ Under voltage protection (27) with time (2) ➤ Fuse failure protection of line PT (98) (for alarm) ➤ Over voltage protection (59) ➤ Neutral displacement relay (59N) ➤ IDMT Earth leakage relay (51G) ➤ Provision to trip upstream breaker on Inter trip faults 	<ul style="list-style-type: none"> ➤ Voltmeter with VSS (for line PT) with R, Y , B phase indication LED lamps ➤ Ammeter with ASS ➤ Multi Function Meter (MFM) meter
2.	Outgoing transformer feeder	<ul style="list-style-type: none"> ➤ Over-Current INST (50) & IDMT O/C (51-3 Pole) ➤ Earth Fault IDMT (51 N) ➤ Provision to trip on transformer fault (Signal to be received from downstream breaker panel). ➤ Sensitive E/F Protection (50G) ➤ Aux. Relays for Transformer internal faults 	<ul style="list-style-type: none"> ➤ Ammeter with ASS ➤ Multi Function Meter (MFM) meter



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3.	HT Motor Feeder	<ul style="list-style-type: none"> ➤ Comprehensive Slip Ring Motor Management Relay (99). ➤ Sensitive E/F Protection (50G) ➤ Tripping Through U/V Relay. ➤ VAA11 Relays for Technological Faults 	<ul style="list-style-type: none"> ➤ Ammeter with ASS ➤ Multi Function Meter (MFM) meter
4.	Bus PT Feeder	<ul style="list-style-type: none"> ➤ Fuse ➤ Link (Drawout) ➤ Relays for use in interlock of other feeders, incomers & bus couplers) <ul style="list-style-type: none"> - Under voltage with timer (27-2) - Over voltage protection (59) - Fuse failure protection (98) (for alarm) 	<ul style="list-style-type: none"> ➤ Voltmeter with VSS with R, Y , B phase indication LED lamps

NOTES :

*** Licensed Software for relay programming should be supplied.**

1. All protective relays shall also have self supervision and diagnostic features with open communication protocol IEC 61850. All Relays shall be microprocessor based numerical type.
2. Line & Bus PT's shall be provided with suitable 0.11 kV secondary two winding transformer.
3. Each feeder shall have master trip VAJHM relay (86) and close / trip coil supervision relay (95).
4. Aux. Relays to be considered as per scheme requirement.
5. Aux. Relay VAA 33 / equivalent type shall be used for transformer faults.
6. Comprehensive motor protection (99) shall include the following;

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| <ul style="list-style-type: none"> ▪ Thermal overload ▪ Start inhibit ▪ Ambient temperature biasing ▪ Over temperature ▪ Under current ▪ Low set over current ▪ Any other protections (as applicable) | <ul style="list-style-type: none"> ▪ Unbalance ▪ Locked rotor ▪ External command ▪ Directional earth fault ▪ Curve switch ▪ Block provision |
|--|---|

7. The protections / meters etc. mentioned in the TS and Drawings are indicative only and shall be finalized during detail engineering to suit system requirement . Also, any other protections / meters etc deemed necessary for the equipment / system shall be provided by the Tenderer.

06.01.07 Annunciation Scheme

01. Annunciation Scheme

- Flag indication for all faults for which individual protective relays have been specified.
- Warning signals (as applicable) on individual panels.
 - (a) All transformer wiring / signaling conditions (group signal from corresponding transformer control panel / substation).
 - (b) Loss of trip circuit supply
 - (c) Earth fault
 - (d) Control supply failure
 - (e) PT fuse failure / MCB tripping
- Emergency signaling for tripping of HT breakers on fault.
- One common signal for warning and one signal for emergency from each panel to be wired to a common annunciation panel of the switchboard, wire specified.

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- Annunciators for warning and emergency signaling condition on individual panels of solid state facia windows type.
- Common audio signaling with Accept, Reset, and Test push buttons for the switchboard where common annunciation panel is not specified.
- Audio signaling to have distinct tones for warning and emergency.

06.01.08 Panel Earthing

Each cubical should have Panel earthing provision with mechanical interlocking (Except Incoming and PT panel). Bidder shall offer built-in earthing facilities for the outgoing connections. The inbuilt earthing switches shall have provision for short circuiting and earthing a circuit intended to be earthed. These switches shall be quick make type, independent of the action of the operator and shall be operable from the front of the switchgear panel. These switches shall have facility for padlocking in the earthed condition.

06.01.09 Set of accessories to be provided are as detailed below :

1. VCB (PT mounted type) identical to Incomer Feeder : One (1) No.

06.02 RESISTANCE BOX :

Resistances shall meet arduous heavy duty industrial and steel works application, air cooled, unbreakable, rigid, resilient & rust less, Fechrul type. Resistances shall be in step wise execution with suitable tapping points and vibration proof. It should have properly dimensioned resistance elements to take care of current and time rating for starting and speed control of 450 kW Hammer Crusher slip ring induction motor.

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It should be rated for 10 minutes duty of BS: 587. The thermal loading of the resistance box should be uniform. Maximum temperature of resistor elements shall be limited to 300 deg. C at desired duty. Testing shall be carried in accordance to BS: 587.

The resistances shall be mounted in racks that permit independent removal of any selected resistance. The resistance box shall be made up of sheet steel metal enclosed cubicle of thickness not less than 2.0 mm. Enclosure class shall be IP-11.

All metal works for the housing shall be degreased, derusted and passivated before applying two coats of stove enamel. Paint shade shall be 631 of IS: 5.

06.03 CABLE AND CABLE ACCESSORIES

TYPES OF CABLES

Cables of following grades and general specifications shall be used taking into consideration the application requirements. All cables shall have FRLS PVC outer sheath.

Type 1 : HT XLPE Cables – 6.6 kV (Unearthed) voltage grade.

Heavy duty power cable with aluminium conductor with extruded conductor shielding of semi-conducting material, XLPE insulated, with insulation shielding over individual cores consisting of extruded semi-conducting compound followed by lapped semi conducting material and copper tape, cores stranded together with a holding tape provided with a common extruded covering of inner sheath of ST2 compound, aluminium armoured and FRLS PVC outer sheath of type ST2 compound as per IS : 7098 (Pt-II)-1973 as amended up to date. Copper screen shall be suitable to carry 1 kA E/F current for one second.

The cable shall be dry curing type.

Type 2 : 1.1 kV, PVC aluminium power cables suitable for 415 V, 3 phase, 50 Hz, solidly grounded system.



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1.1 kV, heavy duty power cable multicore with standard sector shaped (sm) or with compact circular stranded (rm/V) or circular stranded (rm) aluminium conductors as applicable, PVC insulated of type C PVC compound suitable for 85 deg.C. operation as per IS:5831-1984, core stranded together provided with a common covering of FRLS PVC inner sheath of type ST2 PVC compound, galvanised round steel wire armoured and FRLS PVC outer sheathed of type ST2 PVC compound conforming to IS:1554 (Part-I) - 1976, as ammended upto date. Type AYWY.

Type 3 : 1.1 kV PVC copper control cables

1.1 kV circular stranded (rm) annealed copper conductor, PVC insulated of type A PVC compound suitable for 70 deg.C operation, as per IS:5831 - 1984, cores stranded together provided with a common covering of FRLS PVC inner sheath of type ST1 PVC compound, galvanised round steel wire armoured and overall FRLS PVC sheathed of type ST1 PVC compound and multi-core to IS : 1554 (Part-I) - 1976, Type YWY :

FRLS cables shall meet the following requirements;

1. Critical oxygen index, temperature index and smoke density tests shall conform to the requirement of ASTM-D 2863.
2. Oxygen index minimum 30%, the minimum temperature index 250 deg C and the minimum average light transmission of 40%.
3. Acid gas generation limit shall be as per IEC 754-1. (Hydrochloric acid gas released 20% maximum)
4. Ignition resistance and flame propagation shall conform to IEC 332-1 and Fire resistance test shall conform to IS 5831.
5. Flammability test and flammability test on group of cables (in installed condition) shall conform to requirement of IEEE 383 and IEC 332-1.

Standard drum length for all types of power and control cables shall be offered. Cable shall be supplied in non-returnable drums and cable ends shall be sealed by non hygroscopic sealing compound.

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ISI marking at every meter of cable length shall be provided. Cores of multi-core control cables shall be serially numbered. For all cables, extra length of 2 meters will be left before jointing.

Additional Tests on cable

To prove the fire retardant low smoke characteristics, the following additional tests shall be conducted at works on any size of each type of cable namely, L.T. power, control and instrumentation cables.

Oxygen index test as per ASTM-D 2863. Minimum value of Oxygen index shall be 30.

Flammability tests on finished cable as per the requirements of IEEE-383 and IEC-332-1.

Smoke generation by inner/outer sheath fire as per ASTM D 2843. The cables shall meet the requirements of light transmission of minimum 40% after the test.

HT Cable termination & joints

All high voltage cable terminations shall meet the test procedures and requirements stipulated in IEEE 48-1990 as class-I termination.

Following type of cable termination and joints shall be used for HT cables in indoor and outdoor applications:

1. Tapex type
2. Heat shrinkable type
3. Pre moulded push on type

Tapex type system

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The stress grading material shall be wrapped around the cable core, over lapping the edge of the outer conducting layer. The tape layer shall fuse together to form a compact rubber body around the stress grading material and cable core and thereby exert an active pressure on cable. This system shall be used for straight through joint only.

Heat Shrinkable type system

The stress control and grading wherever necessary shall be by means of semi conducting heat shrinkable tubing. Environmental sealing between heat shrinkable material and cable surfaces shall be achieved by using hot melted sealants or adhesives.

Where such sealants or adhesives shall be exposed to high electrical stress, same shall be track resistant type.

Pre-moulded Push On type system

Premoulded refers to moulded Ethylene Propylene Diene monomer rubber components. Sealing between the pre-moulded push on material and cable surface shall be achieved by semi conducting pad which has cold flow properties.

Specifications for miscellaneous materials



Connectors

Cable termination shall be made with aluminium/ tinned copper crimped type solder less lugs for all aluminium conductor and stud type terminals.

Cable identification

Cable tags shall be of 2 mm thick, 20 mm wide aluminium strap of suitable length to contain cable number as per cable schedule.

Ferrules

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Ferrules shall be approved interlocked type & size to suit core size mentioned and shall be employed to designate the various cores of control cable by the terminal numbers to which the cores are connected, for ease in identification and maintenance.

Cable Glands



Cable glands to be supplied shall be nickel plated brass double compression type. Glands for classified hazardous areas shall be certified by CMRS and approved by CCE, Nagpur.

Cable clamps

All cables shall be clamped with metal clamps and single core cables shall be clamped with trefoil clamps made of aluminium.

Cable trays

This shall be prefabricated hot dip galvanized, ladder type / perforated hot rolled mild sheet steel cable trays of minimum 2.0 mm thick. Galvanising content shall be 86 microns. Length shall not be more than 2.5 meters.

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07.00 INSPECTION AND TESTING

Inspection

Within 8 weeks of the award of contract the Contractor shall furnish the quality assurance plan (QAP) for electrical equipment.

Inspection & testing of equipment shall be undertaken by the Purchaser / Consultant after finalization & approval of QAP by the Purchaser / Consultant.

The Purchaser / Consultant shall have the right to be present and witness all tests being carried out by the Contractor / sub-contractor.

Method of giving inspection calls

Inspection calls shall be given by the Contractor. All calls shall accompany four sets of relevant test certificates and inspection report of the Contractor/sub-contractor after satisfactory completion of internal inspection and tests by them as per approved QAP.

Obligations of the Contractor

The Contractor shall provide all facilities and ensure full and free access of the Inspecting Engineer of the Purchaser/ Consultant to the Contractor's or their sub-contractor's premises at any time during contract period, to facilitate him to carryout inspection & testing of equipment during manufacture of equipment.

Testing

Test of all equipment shall be conducted as per latest IS. Tests shall also confirm to International Standards IEC/VDE/DIN/BS.

All routine tests shall be carried out at manufacturer's works in presence of purchaser or his representative.

The tenderer shall submit type test certificates for similar equipment supplied by him elsewhere. Type test certificate shall not be more than 10 years old.

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Site Tests

The tests to be carried out on the equipment at pre-commissioning stage shall include following but not limited to the following;

6.6 kV SWITCHGEAR

1. IR test before and after HV test.
2. HV test with HV testing kit.
3. Functional test for all feeders
4. Testing and calibration of all meters
5. Checking and calibration of relays as per supplier's commissioning manuals.
6. Checking of interlocking between incomers/bus coupler and other feeders.
7. Test to prove interchangeability of similar parts
8. Tests to prove correct operation of breakers at minimum/maximum specified control voltages
9. Check test, service and draw out position of all the breakers and operations of mechanical flag indicator and electrical indication lamps.
10. Check functioning of electrical schemes, signaling, annunciation etc.
11. Contact pressure test
12. IR value checking with breaker ON. Phase to phase and phase to earth and between phases in OFF position.
13. Measurement of contact resistance of breaker
14. Measurement of closing & tripping time of breaker.
15. Testing of CT as per CT testing details
16. Breaker : IR value checking with breaker ON. Phase to phase & phase to earth and between phases in off position

CURRENT TRANSFORMER

1. Testing of CT polarity and CT ratio by primary injection test and CT characteristics.
2. Measurement of knee point voltage and secondary winding resistance for the CTs used.
3. IR test on each winding, winding to earth and between windings.
4. Continuity check for all windings.
5. Check for connections to correct taps.

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6. Checking of continuity and IR values for cables from CT to Marshalling Box.
7. Checking tightness of earthing connections.
8. Checking of insulator for cracks (for EHV).
9. Check output after loading of the main circuit.

POTENTIAL TRANSFORMER

1. IR test of primary winding by HV megger between windings and earth
2. IR test of secondary winding by LV megger between windings and winding to earth
3. Checking of voltage ratio
4. Verification of terminal markings and polarity
5. Checking of continuity and IR values for cables from PT
6. Checking tightness of earthing connections
7. Check output on charging of the system with connected meters/relays

RESISTANCE BOX

1. HV Withstand test.
2. Resistance value measurement at ambient.
3. IR value.
4. Dimensional and visual checks etc.

CABLES & CABLE SUPPORTING STRUCTURES

1. Checking of continuity/phasing and IR values for all the cables before and after HV test.
2. High pot test and measurement of leakage current after termination of cable kits (for HT cables) and after jointing work of straight through joints.
3. Checking of earth continuity for armour.
4. Check for mechanical protection of cables.
5. Check for identification (tag number system) distance placement of cable marker, cable joint etc. as per the cable layout drawing.
6. Check earthing of cable structures.

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7. Check clearances from ventilation duct and light fittings for cable structures.
8. Check proper fixing of cable structures.
9. Check for proper drainage and removal of water for cable tunnels, basements, channels.

EARTHING

1. Check tightness of all earth connections
2. Check earthing of all metallic equipments, cable trays, busbar supporting structures, all elect. equipments, etc. as per the requirement of IE rules and IS 3043
3. Measurement of earth resistance for each electrode.
4. Measurement of total earth resistance.
5. Measurement of earth loop resistance for E/F path of biggest LT drive.

MISCELLANEOUS

1. Checking of continuity of the system
2. Checking of phase sequence between two sources of switchboards.
3. Checking safe accessibility of all operating points
4. Check availability of control/aux. supply
5. Ensure availability of first aid box, rubber mats, rubber glove, etc.
6. Check working of exhaust fans
7. Check proper dressing of cables, mechanical protection of cables, placement of cable markers
8. Check sealing of all cable openings including conduit opening with fire resistance material
9. Check sealing of all openings at bottom of elect. panels.

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08.00 DRAWINGS / DOCUMENTS TO BE SUBMITTED BY THE TENDERER

- A) Drawings/Data along with tender:-
- 1) Detailed scope of Work.
 - 2) List of deviations from technical specifications.
- B) Some of the Major Data/Drawings to be submitted by supplier after placement of order:-

FOR APPROVAL



The Contractor shall furnish the following documents / data in soft copy and five (5) number of hard copies for approval. On approval, the same shall be supplied as soft copies in CDs, in addition to ten(10) number of hard copies.

a) Calculations

1. Relay settings with calculations.
2. Calculation of short circuit withstand capacity, temp rise and nominal rating of panel bus bar.

b) Others



1. Single line diagram indicating CT/PT, all relays, meters, LA, cable/busbar sizes, details of CT/PT ratio, VA burden, knee voltage value, type and make of all relays, their range.
2. Front view and GA diagrams for all panels.
3. Control and schematics drgs. for control / protection for each equipment.
4. Interlocking schemes

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5. Sequence of annunciator and list of annunciation points for all the panels/desk of each areas.
6. Equipment data sheets

FOR INFORMATION



1. Work Schedule with bar chart indicating all activities for electricians.
2. Catalogues for each type of equipment, relays, meters etc.
3. Installation and commissioning manuals for each equipment, relay etc.
4. Operation and maintenance manuals indicating trouble shooting procedure for all equipment.
5. Type test certificates for all the equipment.
6. Details of test results conducted at works for all equipment
- 7.. Panel wise bill of material indicating type make and brief technical particulars of all items/ accessories mounted on the panels.
8. Overall GA of all the panels/equipment
9. Foundation Plan and fixing details for each equipment.
10. Static and dynamic loading of each equipment.
11. As built drawings incorporating site changes along with reproducible. Soft copy and ten (10) Hard copies.

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09.00 DRAWINGS



The Following Drawings are enclosed with this Specification.

SI.No	Description	Drawing No.
1	SLD of 6.6 kV Switchboard	MEC/11/E1/Q7EA/82T/001, Rev 00
2	Control Circuit of 450 kW Slip Ring Motor	MEC/11/E1/Q7EA/82T/002, Rev 00
3	450 kW Slip Ring Motor – Data Sheet	MEC/11/E1/Q7EA/82T/003, Rev 00

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10.00 LIST OF PREFERRED MAKES

S.No.	Equipment	Preferred Makes
1.	6.6 kV Switchboard (Switchboard with own VCB)	ABB / SIEMENS / SCHNEIDER / CGL / L & T
2.	Protective Relays (Numerical Type)	ABB / SIEMENS / SCHNEIDER
3.	Aux. Relays	ABB / AREVA / BCH / L&T / SIEMENS / SCHNEIDER / GE POWER
4.	MCCB	L&T / CGL/ GE-POWER / ALSTOM / SCHNEIDER / ABB
5.	AC / DC Power Contactors	SIEMENS / L&T / TM / SCHNEIDER / BCH / ABB / BCH
6.	Control switches	SIEMENS / L&T / KAYCEE / ABB / SWITRON / GE POWER / BCH / ALSTOM
7.	Push buttons	SIEMENS / L&T / ALSTOM / TM / TEKNIC / BCH / SCHNEIDER / GE POWER
8.	Timers/Time delay relay	L&T/ SIEMENS /TM / ALSTOM / ABB / BCH / GE POWER
9.	Control contactors	SIEMENS / L&T / TM / CGL / ABB / BCH / SCHNEIDER / GE POWER
10.	CT / PT	BHEL / CGL / SIEMENS / ABB / KAPPA / PRAGATI / PRAYOG
11.	HRC Fuses	L&T / SIEMENS / BUSMAN / GE POWER
12.	Indicating lamps (LEDs)	BINAY / TECHNIC / SIEMENS/ L&T / BCH
13.	Terminal block	ESSEN / CONNECTWELL / ELMEX / PHOENIX
14.	Solid state annunciator	APLAB / MINILEC / ILECI / AREVA / L&T
15.	MCB (Miniature circuit	MDS / S&S / INDO-ASIAN /

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	breaker)	VERSATRIP / MDS / SIEMENS / L&T
16.	Energy meter / Wattmeter / Ammeter / voltmeter / Multifunction meter	BHEL / SIMCO / ABB / IMP/ MECO / TOSHNIWAL / SECURE / CONZERV / L&T / RISHAV / AREVA
17.	Resistors	BCH / ELECTROMAC / EPCC / SIEMENS / RSI
18.	Transducer	ABB / MECO / RISHAV
19.	HT , LT Power & Control Cables	FORT GLOSTER / ASIAN CABLES / CCI / GOVIND / UNIVERSAL / DELTON / FINOLEX / CRYSTAL / KEI / INDUSTRIAL / RPG CABLES / NICCO / CHORDS / TORRENT / PLAZA / POLYCAB
20.	Cable Termination Kit (XLPE)	MECP / RAYCHEM / M-SEAL / DENSSION

NOTE : For items not indicated above, Tenderer shall have to obtain prior approval from the Purchaser / Consultant.

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06.05 EARTHING AND LIGHTNING PROTECTION

Earthing

Tenderer shall include complete substation building earthing including Main earthing ring and equipment earthing.

Tenderer shall include complete earthing material including earth electrodes, risers, MS rod, earthing strips, other accessories, etc. and carry out main earth grid, earth pits, risers, interconnections, equipment earthing, all associated civil works, etc within battery limit of the package. All the interconnections with other earthing systems of the plant and with existing systems shall be under scope of the contractor.

The actual soil resistivity of the plant area shall be obtained by the Tenderer by carrying out soil resistivity tests and design the earthing system accordingly.

All earthing connections shall be of sufficient section to carry the fault current for 3 seconds. Plant earthing system shall be designed such that overall earthing resistance is less than 1(One) Ohm without interconnections.

The materials shall be galvanized steel laid over the ground and mild steel buried inside the ground/concrete.

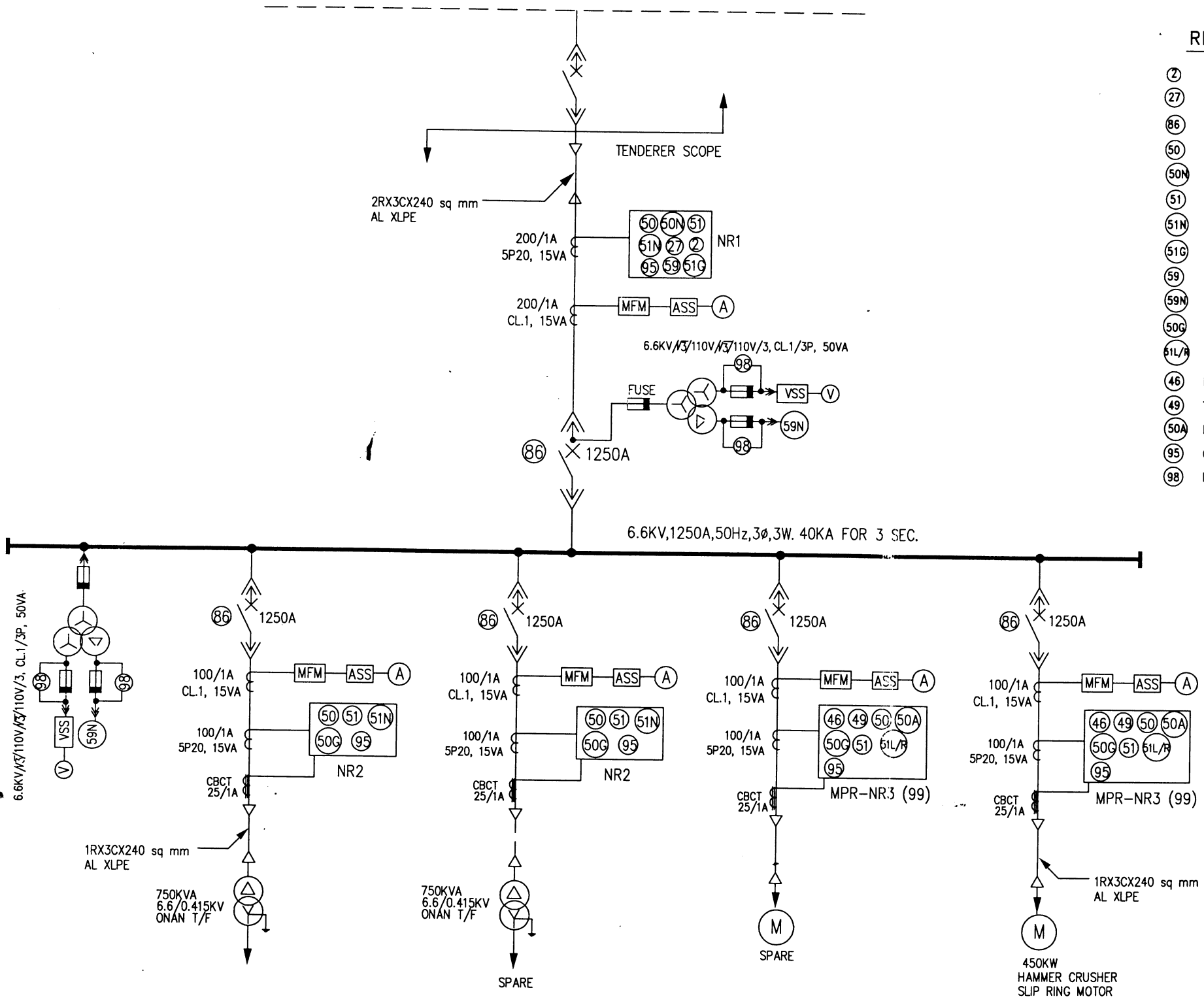
Earthing protection system shall be designed on the basis of the standards like IS : 3043 (Latest revision), IEEE 80 and Indian Electricity Rules.

All joints in the run of the main earthing conductors will be welded or brazed type. Connection to equipment structure shall be bolted type. All welded joints shall be protected from corrosion by applying bitumen paint.

The minimum earthing conductor sizes to be used are as follows :

- i) 75 x 6 GI Flat for Main earthing ring and HT Switchboard.
- ii) 50 x 6 GI Flat for LT switchboards / control panels /resistance box etc.

6.6KV BOARD TPP-SECTION IV CUBICLE NO 76



RELAYING:

- (2) TIMER
- (27) UNDER VOLTAGE RELAY
- (86) HIGH SPEED TRIPPING RELAY
- (50) INSTANTANEOUS OVER CURRENT RELAY
- (50N) INSTANTANEOUS E/F RELAY
- (51) IDMT OVER CURRENT RELAY
- (51N) IDMT E/F RELAY
- (51G) IDMT EARTH LEAKGE RELAY
- (59) OVER VOLTAGE RELAY
- (59N) NEUTRAL DISPLACEMENT RELAY
- (50G) SENSITIVE EARTH FAULT RELAY
- (51L/R) LOCK ROTOR PROTECTION RELAY
- (46) NEGATIVE PHASE SEQUENCE PROTECTION
- (49) THERMAL OVERLOAD PROTECTION
- (50A) DEFINITE TIME OVER CURRENT ALARM
- (95) C.B TRIP COIL SUPERVISION
- (98) FUSE FAILURE PROTECTION

LEGEND

- 3 WINDING POTENTIAL TRANSFORMER (PT)
- TWO WINDING TRANSFORMER
- VACUUM CIRCUIT BREAKER (DRAWOUT)
- MOTOR
- NUMERICAL RELAY
- MOTOR PROTECTION NUMERICAL RELAY (99)
- CBCT
- CURRENT TRANSFORMER (CT)
- AMMETER SELECTOR SWITCH
- AMMETER
- MULTIFUNCTION METER
- VOLTAGE SELECTOR SWITCH
- VOLTMETER

ROTOR CONTROL PANEL FOR CRUSHER MOTOR

RESISTANCE BOX FOR CRUSHER MOTOR

FOR TENDER PURPOSE ONLY

बोकारो पावर लि
BPSCL

मेकॉन लिमिटेड
MECON LIMITED

SECTION	ELEC. (POWER)	PROJECT- REPLACEMENT OF 6.6KV BOARD AT 82T SUBSTATION IN CHP
LOCATION	RANCHI	
DESIGNED	UTTAM	
DRAWN	UTTAM	
CHECKED AND VERIFIED	A. PANDEY	SLD FOR 6.6KV SWITCH BOARD
APPROVED	<i>[Signature]</i>	SCALE- NOT TO SCALE
DATE: JUNE 20	DRG.No.-MEC/11/E1/07EA/82T/001	SHEET 1 OF 1

NOTES: 1. THE PROTECTIONS, METERS, CTS ETC. MENTIONED IN THE DRAWING ARE INDICATIVE ONLY AND SHALL BE FINALIZED DURING DETAIL ENGINEERING TO SUIT SYSTEM REQUIREMENT. ALSO, ANY OTHER PROTECTIONS/METERS ETC DEEMED NECESSARY FOR THE EQUIPMENT/SYSTEM SHALL BE PROVIDED BY THE TENDERER.
2. ALL PROTECTIONS RELAYS SHALL BE MICROPROCESSOR BASED NUMERICAL TYPE.

REV.NO.	DATE	ZONE	DESCRIPTION	BY	VERIFIED