



### **TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM**

- 8.2.7 Filled in data sheet in the format attached for TRICHY portion.  
Refer drawing No. 4-42-823-03192 attached.

### **9.0 PACKING & DELIVERY CONDITIONS**

- 9.1 All packing will be to international standards, capable of withstanding transit risks. Number of despatchable unit (DU) clearly indicating the weight of each such unit shall be brought out in the offer itself. A unique material code for each item shall be furnished and marked on top of the packing/equipment for easy identification at site.
- 9.2 Minimum roll size of tracers shall be such that uncut length of tape shall be at least 100 metres, to minimise site joints.

### **10.0 Erection, Commissioning & Extended Warrantee Requirements**

- 10.1 Alternatively supervisory assistance during erection and commissioning (E&C) of the system shall be quoted separately. Under such circumstances, special kits, if any, for E&C shall be quoted.
- 10.2 Extended guarantee for a period of 3 years over and above normal 2 years from the date of commissioning for the total EHT system to be provided. This shall cover, but not limited to, free replacement of defective component plus services.

### **NOTE (IMPORTANT)**

- (1) Actual requirement of tracer quantity, control system components, erection materials, etc. may vary at the time of execution at Site and the variation to the tune of +10% shall be accommodated without any commercial implication.
- (2) It is not the intent to completely specify herein all aspects of design and construction of equipment. Nevertheless the equipment shall conform in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the owner who will interpret the meaning of the specification for the purpose of which the owner reserves the right to alter the specification even during the contract execution stage for which commercial implications will not be entertained.



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**PART-1 DATA SHEET (FOR BHEL/PC'S PORTION)**



**1 Ambient Conditions**

- |     |  |        |   |
|-----|--|--------|---|
| 1.1 | Max. Dry Bulb Temp                             | (°C) : | As per the Project information indicated in Section-B |
| 1.2 | Min. Dry Bulb Temp                             | (°C) : |   |
| 1.3 | Relative Humidity                              | :      |   |
| 1.4 | Design Ambient Min. Temp.                      | (°C) : |   |
| 1.5 | Design Temp. for Electrical Equipment / Device | (°C) : |   |

**2 EHT SERVICE : LSHS – FUEL OIL LINES**

For description of service, F.O pipe size, pipe length & insulation thickness, refer the Basic scope of EHT for fuel oil lines, Drg No: 4-81-441-05248.

Maintenance temperature (°C) : 70

**3** Maximum Process Temperature (°C) : 140

**4 Exposure Temp.Rating**

4.1 Continous power on temperature (°C) : 140

4.2 Intermittent power ON temperature (°C) : 150

4.3 Intermittent power OFF temperature (°C) : 150

**5** Maximum withstandable outside temperature ( Insulation rating ) (°C) : 210

**6** Power supply available at Site : 415V 3 phase, 3 wire with 50 kA fault level. Bidder to specify kVA rating of total load.



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**7 Supply variations**

- 7.1 Voltage : ± 10%
- 7.2 Frequency : ± 5%
- 7.3 Combined : Absolute 10%

**8 Insulation Data**

- 8.1 Type : LBM
- 8.2 Density : 100 kg/m<sup>3</sup>
- 8.3 Thermal Conductivity (W/m°C) : 0.040 at 50°C mean  
0.052 at 150°C mean

- 9 Design EHT Load : Each tracer circuit shall be Single phase load

- 10 Spare EHT : 10% of each type

**NOTES**

- 1 **Only SLSR tracers are acceptable.**
- 2 FOS and FOR lines are a combination of yard piping in racks plus piping inside boiler area.
- 3 The total portion shall be apportioned into segments depending on tracer limitations. Each segment shall be provided with power supply module and controls. Loading and segregation shall ensure proper balancing of all 3 phases.
- 4 Pipe layout will be finalised during contract execution stage.
- 5 EHT shall be provided with dedicated thermostat for cutting off power to effect energy savings conditions.

FUEL FIRING/PECB) BHEL,TIRUCIRAPALLI		HEAT TRACER DATA SHEET		1306 285
PROJECT:		Thermostats/Temp Switch/RTD Provided		
1 APPLICABLE STANDARDS		5 ELECTRICAL DATA :		
BS 6351 : 1983		Operating Voltage : V		
2 OPERATING DATA		Inrush Current :		
Fluid - HFO/LSHS		Circuit Breaker Data Attached Y/N		
Ambient Temperature - 5 to 50 °C		Wiring Diagram Power Attached Y/N		
Pipe Maintenance Temperature - 70 °C		Wiring Diagram Control Attached Y/N		
Max Fluid Temperature - 140 °C		6 TESTS :		
Size of Pipes/Fittings - 1/2" to 8"		Type Tests :		
Power Supply - 240 V 1Ph AC		Impact Test - Y/N		
- 415 V 3Ph AC		Cold Bend - Y/N		
Insulation : Material-Mineral Wool		High Temperature Exposure - Y/N		
: Thickness-50 mm		Repeated Electrical Cycling - Y/N		
: K-0.039 KCal/m-hr°C		Repeated Mechanical Flexing - Y/N		
(Note: K - Thermal Conductivity		Repeated Abrasion - Y/N		
at a Mean Temp. of 50°C)				
3 TYPE OF HEATER :		Routine Tests :		
<del>SLSR/Constant Voltage</del>		Dielectric Withstand Test - Y/N		
Parallel Circuitry		Output Vs Temperature - Y/N		
Cut to Length/Factory Terminated		Visual Examination - Y/N		
Burnout Proof : Yes/No				
Weather Proof : Yes/No		7 APPROVALS		
4 HEATER DATA :		Approvals for model chosen		
Watt Density - W/m at T <sub>MAINTENANCE</sub>				
Heater Insulation :		(Note: Enclose Copies of Approval Doc)		
Material -				
Max Withstand Temp - °C		8 DOCUMENTS		
Heater Core :		Documents with Offer Attached Y/N		
Material -		Documents after PO Y/N		
Max Withstand Temp - °C		List of Similar Installations : Y/N		
Max Sheath Temp (Clause 3.13)- °C				
Calculation Attached- Yes/No				
Heater T Rating -				
Unconditional - Yes/No				
If Conditional attach conditions				
Tolerance on Output - + % - %				
Max Circuit Length - m				
Min Radius of Bend - mm				
Overlapping Permitted/Not Permitted				
Predicted Heater Life : Yes				
Basis Graph/Calculation Attached Y/N				
Aluminium Tape : Provided/Not Provided				
		BHARAT HEAVY ELECTRICALS LIMITED		
		4-42-823-03192 REV 01		



## **TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL**

### **1.0 GENERAL**

This specification covers the design, fabrication, inspection, testing and delivery to Site of AC control supply panels and the associated equipments mounted thereon. This panel serves the purpose of receiving 415 volts, AC, 3 phase, 50 Hz power supply and to distribute to different segments of EHT (Electrical Heat Tracers) as 240V AC

### **2.0 SCOPE**

This standard specifies the requirement of distribution panel for use in Utility/Captive Power Plants.

### **3.0 DATA SHEET**

3.1 In addition to the general specification, specific data sheet (if enclosed indicating special requirements) shall be followed / adhered.

3.2 Wherever the specification / data sheet requires information to be furnished by the tenderer / supplier, the same shall be furnished in the offer.

### **4.0 CODES AND STANDARDS**

4.1 The design, material, construction, manufacture, inspection and testing of the control panel shall comply with the currently applicable Indian Standards and the safety codes in the locality where the equipment will be installed.

4.2 Nothing in the specification shall be construed to relieve the vendor of his responsibility. Annexure-A may be referred for applicable standards.

4.3 Design Calculations

Calculations supporting layout of components, busbar sizing, temperature rise, short circuit withstandability, component rating adequacy to be furnished.

### **5.0 SCOPE OF WORK**

5.1 The scope of work covers-

5.1.1 Design, fabrication and testing of the complete panel;

5.1.2 Procurement, mounting and wiring of all equipment, specified;

5.1.3 All internal wiring from equipment to terminal blocks and all interpanel wiring between panels;



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- 5.2 Supply of all cable terminations and mounting accessories like trays, troughs, clamps, lugs, etc.;
- 5.3 Supply of all necessary drawings;
- 5.4 Testing of panels as specified and furnishing of test certificates;
- 5.5 Preparation and furnishing of instruction manual and catalogues giving the make, model and type of all the equipments used;
- 5.6 Packing and delivery of the equipment in acceptable condition at the place specified to the satisfaction of the purchaser;
- 5.7 Typical wiring diagram for a single segment is enclosed to this specification. Bidder to actually determine the rating of each component for each segment and in total and shall furnish a consolidated wiring diagram covering all sections.

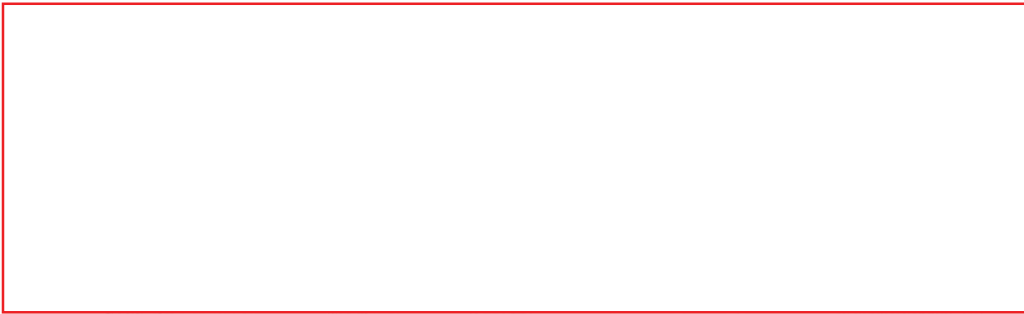
**6.0 CONSTRUCTIONAL FEATURES**

- 6.1 The panel shall be completely metal enclosed, free standing floor mounting modular type. Shall be of dust moisture and vermin proof. Shall be made of vertical sections easily extendable on both sides by addition of vertical sections. The panel enclosures shall meet the degree of protection IP 55.
- 6.2 The metal used shall be of cold rolled sheet steel of thickness not less than 3 mm for the front and rear and 2.5 mm for the other sections & sides. The panel shall be free from flaws, dents and undulations. Shall be, if needed, reinforced to provide level surfaces as mentioned below.

<u>Width</u>	<u>Desired Flatness Tolerance</u>
Upto 61 mm	0.15875 mm
61 to 82 mm	0.238125 mm
> 82 mm	0.3175 mm

The flatness tolerance is defined as the maximum allowable deflection of the surface from a flat parallel reference plane.

- 6.3 The panel shall be provided with base channels of minimum 50mm in the form of metal channels properly drilled and shall be furnished with anchor bolts and necessary hardware for mounting the panel. All the bolts and hard wares shall be cadmium plated / chrome plated / zinc passivated / nickel-plated. The panel shall be provided with kick plates, which shall be of min. 2 mm thick and of stainless steel.



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- 6.4 All removable plates, doors and glass plates shall be properly gasketed all around with neoprene gaskets (single piece-6mm). Ventilating louvers, if provided, shall be provided with fine Brass or GI meshes. All door hinges shall be of concealed type.
- 6.5 The panel shall be provided with proper anti-vibration pads between the base channel and panel so as not to transmit the vibration, if any, to the panel and panel mounted equipments.
- 6.6 The dimensions and the general arrangement of the panel shall be furnished. The cable entry to the panel shall be bottom on a 3 mm removable cable gland plate. Required number of proper cable glands shall be provided. The cable glands shall be of brass and double compression of screwed type suitable to receive PVC armoured cables.
- 6.7 The panel shall be provided with illumination lamp operated through a door switch. The panel shall be provided with necessary space heaters and accessories. The panel shall be provided with capped power sockets with switch and fuse.
- 6.8 The panel edges shall be properly smoothed or deburred so as not have any sharp or pointed surface, which may cause injury to the operating personnel. The doors provided in the panel shall have in-built locking facility.
- 6.9 Earth leakage protection shall be provided for all outgoing Heat tracing circuits with necessary relays.
- 6.10 All equipments / components shall be properly labelled for easy identification.
- 6.11 The switch gear section shall be divided into distinct vertical sections each comprising-
- 6.11.1 a completely metal enclosed bus bar compartment running horizontally;
  - 6.11.2 individual feeder modules arranged in multi-tier formation. It is essential that modules are integral multiples of the basic unit size to provide for flexibility in changes, if any, at Site;
  - 6.11.3 enclosed vertical bus bars serving all modules in the vertical section with proper safety isolation;
  - 6.11.4 a vertical cable alley covering the entire height - the cable alley shall be minimum 500 mm wide for circuit breaker controlled modules;
  - 6.11.5 a horizontal separate enclosure for all auxiliary power and control buses, as required, shall be located and tap off connection from these buses shall be arranged separately;
  - 6.11.6 each vertical section shall have space heater located on vertical cable alley.
  - 6.11.7 there is no back access available; vertical bus bar alleys have to be provided.
  - 6.11.8 Four (4) Nos. lifting lugs shall be for each section, two (2) nos. on either end of the section.



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### **7.0 PAINTING**

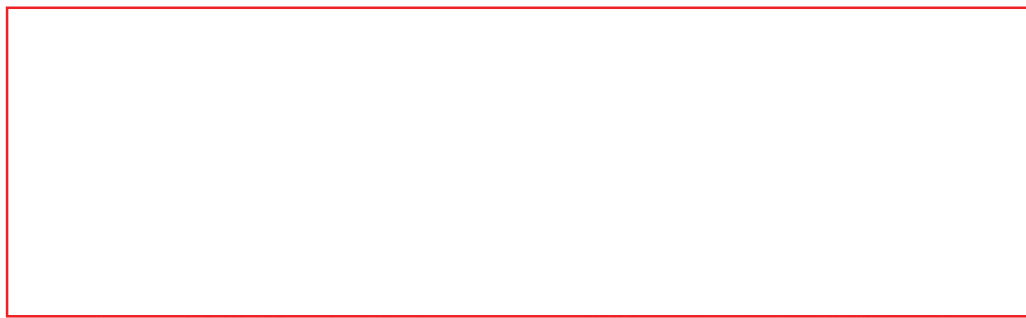
- 7.1 All metal surfaces shall be thoroughly cleaned and degreased to remove scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The surface shall be made free from all imperfections before undertaking the finishing coat.
- 7.2 After preparation of the surface, the switchboard shall be powder coated with two coats of epoxy based electrostatic power painting of min 100 microns of final painting. The finished panels shall be dried in stoving ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, run-off paint etc.
- 7.3 The pre-treatment of all steel work, including, de-greasing, rust / scale removal, phosphating and even drying shall be carried out as per IS 6005.
- 7.4 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased. The mounting plate shall be zinc passivated. A small quantity of finishing paint shall be supplied for minor touching up at Site after installation.

### **8.0 MOUNTING**

- 8.1 All equipments on front of panel shall be flush mounted or semi-flush. In case of semi-flush mounting only flange or bezel shall be visible from the front.
- 8.2 Equipments shall be mounted such that removal, replacement and maintenance can be accomplished easily without interruption of service to adjacent equipment. The terminal markings shall be clearly visible. All live parts shall be provided with at least phase to phase and phase to earth clearance in air of 25 mm.  
For all other components, the clearance between two live parts, a live part and an earthed part, and isolating distance shall be at least 10mm throughout.
- 8.3 The centre lines of switches, push buttons and indicating instruments shall not be less than 450 mm from the bottom of the panel. Control switches, push buttons and indicating instruments shall be so located for ease of operation and reading.
- 8.4 No equipments shall be mounted on the doors unless otherwise there is specific mention.
- 8.5 Current transformers shall not be directly mounted on the buses. CT on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

### **9.0 LABELS AND FERRULES**

- 9.1 All the panel front mounted components are to be provided with labels or name plates of lamicaid or anodised aluminium label with 3mm thick white letters on black background.



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The name plates are held by self-tapping screws. Name plate size shall be minimum 20x75mm for instrument/devices & 40x50mm for panels.

9.2 Labels giving following details shall be affixed on each feeder compartment.

- Feeder No.
- Equipment Reference Number and Description
- Rating (kW / kVA / AMP)

All components whether mounted inside the DB or on the door shall be permanently and clearly labelled with reference number and/or letter of their function. (Rating of fuse shall form a part of the fuse designation.).

Labels for feeder designation shall be fixed on the front side of respective feeder with chrome plated, self tapping, and countersunk head screws. These labels shall be of identical size to permit interchange.

9.3 The labels for the components coming inside the panel such as contactor switches, fuses, lamps terminal blocks, etc. shall be mounted directly below and shall be designated as per the circuit. The lettering size shall be min. 3 mm.

9.4 All wires shall be properly ferruled. Ferruling shall be over the insulation and not over the conductor. Ferrules shall not fall down from the wire when removed from the terminals. Both ends of wires shall be ferruled.

### **10.0 WIRING**

10.1 All the wiring inside the panel shall be done as per relevant IS 375 of 1963.

10.2 All wiring shall be carried out with stranded 1100 V grade for 220 V / 415 V application. The wires shall be of single core, standard copper conductor with PVC insulation and shall be of FRLS type with vermin and rodent proof. Black colour shall be used for neutral line and white colour shall be used for DC. The minimum size of the wiring shall be as follows.

10.2.1 All circuits excepting CT circuits : 2.5 sq.mm for control, current and voltage circuits.

10.2.2 CT circuits : 2.5 mm<sup>2</sup> per core

10.3 Panel wiring shall be securely supported, neatly dressed and readily accessible. Flame retardant plastic wire trays with straps on plastic covers shall be used wherever necessary.



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- 10.4 No loose wires are allowed. All the wires shall be either terminated to the terminal block or to the equipment as required. If accidental short circuiting of wires is likely to result in closing or tripping of breaker or the system, then wires shall not be terminated on adjacent terminal blocks.
- 10.5 Only one wire per terminal shall be used on the outgoing side of these blocks. Any common connections required, shall be provided on the panel side of the block. Wires shall not be looped around the terminal screws or studs. No more than two wire shall be connected to one terminal
- 10.6 All wire terminations shall be made with solderless crimping type tinned copper lugs. The lugs must be of the compression, insulated sleeve ring tongue type so as to firmly grip the conductor and insulation. Open-ended lugs are not acceptable. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block no., terminal nos., destination no. as per approved drawing.
- 10.7 Wiring of circuits for power supply to transducers and amplifiers for signal transmission shall be suitably fused to limit short circuit currents. Means for detection of blown or open circuited fuses shall be provided.
- 10.8 The vertical wiring on the panels between the terminal blocks and the devices shall be enclosed in non-metallic race ways with removable covers. All exposed wiring shall be formed neatly with wires neatly grouped using plastic bands and binders and substantially supported, along with the panels. Wire stripping shall be done in such a manner that conductor will not be nicked or cut. Wire shall not be tapped or spliced between terminal blocks.
- 10.9 Power connection between main incomer power transformer to PDP shall be supplied through adequately rated bus bar connections with accessories (if required).
- 11 EARTHING**
- 11.1 A continuous copper earth bus of minimum 50x6 sq.mm required size identified with green colour shall, run continuously throughout the length of the control panel. And it shall have the provision for termination to 50x6 mm G.S. flat station earth bus. Necessary terminal clamps and connectors for this, shall be supplied along with the panel.
- 11.2 All metallic covers of components, instruments and other panel mounted equipments shall be independently connected to the green earth bus by using 1100V grade 16 SWG copper conductor. Soldering of earthing wires is not permitted.
- 11.3 All hinged doors shall be earthed by flexible copper braid.



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- 11.4 Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earthing connections between equipment to provide alternative paths to earth bus can be provided.
- 11.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system.
- 12.0 TERMINAL BLOCKS**
- 12.1 Terminal blocks shall be 1100V grade box-type 10mm<sup>2</sup> minimum with marking strips. Separate TBs for power and control cables as per drawing, shall be provided and have to be segregated. The power TBs shall be shrouded properly.
- 12.2 Power TBs shall be of one piece moulded complete with insulated barriers, stud type terminals, washers, nuts, lock nuts and identification strips for the power circuit.
- 12.3 TBs shall be of self-extinguishing or resistant to flame propagations substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal and framework or between adjacent terminals, shall stand a test of 2KV for one minute.
- 12.4 All wiring for external connections shall be brought out to the individual terminals on a readily accessible terminal block. All terminal blocks shall be shrouded or provided with transparent covers. Minimum 1 NO + 1 NC unused contacts shall be wired up to terminal block. All the terminals shall be numbered.
- 12.5 Unless otherwise specified, the TBs for the control circuit shall be suitable for connecting minimum two 2.5 mm.sq. copper conductors.
- 12.6 Cage Clamp type control terminal blocks shall be provided for outgoing control cables. Control terminal block of different voltages shall be separated by means of an insulating barrier.
- 12.7 TBs for CT & PT secondary leads shall have test links and isolating facilities. Also CT secondary leads shall be provided with short-circuiting and earthing facilities.
- 12.8 There shall be a minimum clearance of 250 mm between the gland plate and the terminal blocks. The minimum clearance between two rows of TBs shall be 150 mm.
- 12.9 At least 20% spare terminals shall be provided on each panel and there shall be uniformly distributed on all rows of terminal blocks.



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- 12.10 Unless terminals for external connections shall be arranged for consecutive connections of different cores of a multicore cable.
- 12.11 All TBs shall be suitable for terminating recommended cables.
- 12.12 All terminal block and wires shall be tagged for identification in accordance with IS 5578 and IS 11353.

### **13.0 CABLE TERMINATION**

- 13.1 The vendor shall provide all necessary cable terminating accessories such as gland plates, double compression brass cable gland with tapered washer (Power cable only), crimp type tinned copper lugs, supporting clamps, brackets, etc., along with the Power Distribution Panel as loose items.

## **COMPONENTS**

### **14.0 TRANSFORMER**

#### **14.1 Control Transformer**

The step down transformer shall be of 415/240V of double wound, dry type with Class-B insulation or better. Sufficient margin in rating shall be available to take care of overload. Redundant transformer and auto selection of healthy transformer to be provided.

The VA rating of the Control transformer to be adequate to supply 150% of the control loads of the MCC as a minimum. Voltage regulation of the Control transformer shall be limited to 4%.

#### **14.2 Power Transformer**

- 14.2.1 Main incomer power transformer (415/415V Delta / Star) of dry type to relevant IS shall be provided with all protective switch gear.

#### **14.3 Bus bars:**

- 14.3.1 The bus bars shall be insulated copper or insulated heat shrunk PVC Sleeved aluminium alloy of E 91E grade and shall have adequate cross section to carry the required continuous current such that the operating temperature of the bus bar does not exceed 85°C and 200 °C during short circuit conditions. The temperature rise of the horizontal and vertical bus bars and main bus link including all power draw out contacts when



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carrying 90% of the rated current along the full run shall in no case exceed 55°C with silver plated joints and 40°C with all other types of joints over an ambient of 50°C. Atmospheric humidity to be considered as 100%. Bus bars shall meet the standard IS:5082.

- 14.3.2 Vertical busbars shall be designed for a minimum current rating of 200A.
- 14.3.3 Bus bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuits. Bus bar insulators shall be of track-resistant, high strength, non-hygroscopic, non-combustible type and suitable to withstand stresses due to over voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be provided. Bus bar support design should ensure free thermal expansion.
- 14.3.4 Bus-bars for horizontal and vertical risers shall be of uniform cross section throughout the panel. Bus bar risers vertical bus-bars shall be rated to carry minimum 125% of the rated current of all feeders connected to the risers. The minimum cross section of neutral bus bars shall be equal to that of the bus bars for phase.
- 14.3.5 The bus bars shall have the short circuit rating of minimum 50 kA for 1 second. The bus bars shall have proper identification.
- 14.3.6 The joints made in the bus bars shall be treated suitably to avoid oxidation of contact surfaces and bimetallic corrosion.
- 14.3.7 The bus bar shall be properly supported by epoxy / SMC / DMC supports.
- 14.3.8 Bus bars shall run at the top as required all along the length of the switch gear in a separate enclosure.
- 14.3.9 Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom, or front to rear when viewed from the front of the assembly.
- 14.4 MCCBs / MCBs:
  - 14.4.1 MCCBs (Incomer) / MCBs (Out going Feeders) shall be hand operated air break heavy duty, quick make and quick break type.
  - 14.4.2 MCCBs shall be 4pole, single throw, conforming to as IS-60947 (Part-2). MCCB shall have current limiting design. MCCB shall be provided with 1NO & 1NC electrically separate auxiliary contacts.
  - 14.4.3 The contacts of the switches shall be spring assisted and contact faces shall be of Silver/Silver alloy. Springs shall not be used as current carrying paths. The minimum current rating of the contacts shall be 10A.
  - 14.4.4 Instrument selector switches shall be of stay-put type.
  - 14.4.5 The MCCBs shall have a short circuit capacity of 50 KA for 1 second and MCBs for 9 KA for 1 second. The MCCBs / MCBs shall have a dolly for 3 position indication viz. ON / OFF and TRIP. The MCB shall be switched off on a trip and then only switched on manually.



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- 14.4.6 The contacts shall be of Silver alloy to have high arc resistance and long electrical life. The MCCBs / MCBs shall have min. 3 changeover contacts for the control purposes.
- 14.4.7 The MCCBs / MCBs shall have both adjustable thermal and magnetic tripping system.
- 14.4.8 MCCBs shall have door interlocks and padlocking facility.
- 14.5 Contactors:
- 14.5.1 Contactors shall be three pole, magnetic, air break type generally as per IS 60947 Part-4 suitable for Type 2 co-ordination.
- 14.5.2 Main contacts of the power contactors shall be of silver /silver alloy or silver plated copper. The contacts shall be of bounce free, double break non-gravity type.
- 14.5.3 All power contactors shall be provided with 2 Normally Open (NO) and 2 Normally Closed (NC) auxiliary contacts convertible from NO to NC and vice versa.
- 14.5.4 All power contactors shall be rated for minimum 125% of full load current. Minimum rating shall be not less than 16 Amps.  
Coil voltage shall be as per scheme. Contactor coils shall operate satisfactorily and drop OFF at voltages as given in IS 60947 Part-4. All contactor coils shall be suitable for tropical climatic conditions specified elsewhere in this specification. Insulation Class for Coils - Class 'H'.
- 14.6 Relays:
- 14.6.1 Necessary auxiliary relays, time delay relays and voltage relays as required for control and protection shall be mounted inside the cabinet. Relays shall be equipped with positive action operation indicator. Voltage relays shall have sufficient thermal capacity for continuous energisation.
- 14.6.2 The relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage.
- 14.6.3 Unless otherwise specified, all these auxiliary relays shall be of electro-magnetic type and time delay relays shall be of either static or electro-magnetic type.
- 14.6.4 The contacts of these relays shall be rated for min.10A and adequate for breaking inductive loads at 220V DC, 5A and 240 V AC 10A.
- 14.6.5 In case of static relays, the electronic hardware shall conform to the requirements of applicable standards and suitable for environmental conditions at Site. The non-availability of air condition system shall not affect the performance of the relay.
- 14.6.6 Static relays shall be immune to self induced and externally induced noise. The printed circuit cards shall be of fibreglass with gold plated contact connectors and shall be designed for trouble free service throughout the life of the plant when subjected to normal operation, handling and maintenance.



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### 14.7 Push Buttons:

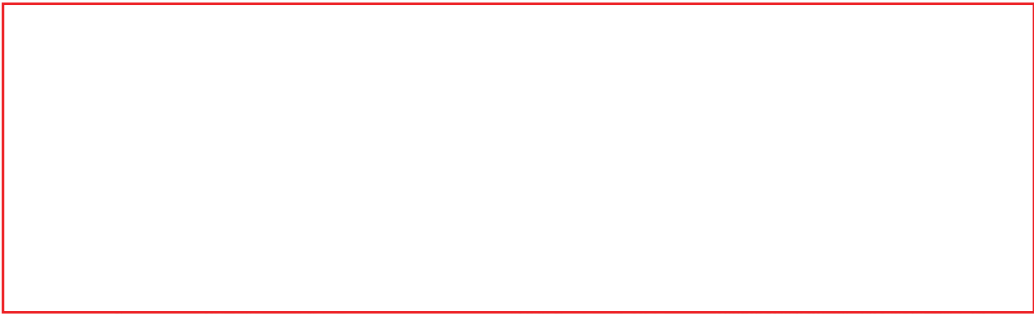
- 14.7.1 The push buttons of momentary contact push to actuate type. The push button shall be rated, continuously to carry and break 10A at 240V AC and 1A inductive load at 220V DC.
- 14.7.2 The push buttons shall be provided with 2 NO + 2 NC self reset contacts, with rear terminals. The actuator shall be of oil tight and waterproof condition. The contact faces shall be of silver / silver alloy.
- 14.7.3 The push buttons shall be provided with integral inscription plates engraved with designation.

### 14.8 Indicating Lamps:

- 14.8.1 The indicating lamps shall be panel-mounted type with rear terminal connections. The lamps shall be LED type with InP Technology (Aluminium Indium Gallium Phosphide Technology). LED circuit shall be PCB mounted. Intensity shall be greater than 200mcd. The body shall be made of Poly carbonate unbreakable lens. LED shall be protected by inbuilt fuse & surge suppresser or leakage voltage glow protection. LED circuit shall be PCB mounted. The lamps shall have translucent lamp-covers to diffuse lights, coloured red, green and amber as specified.
- 14.8.2 LED Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if any, required in replacing the bulbs and lenses shall also be supplied along with the panel.
- 14.8.3 The colour of indicating lamps shall normally be the following  
Red - Feeder 'ON'  
Green - Feeder 'OFF'  
Amber - Feeder 'TRIP'

### 14.9 Indicating Instruments:

- 14.9.1 Unless otherwise specified, all the indicating instruments shall be 96 mm<sup>2</sup> with 240° scale. They shall be suitable for semi-flush mounting with only flanges projecting on vertical panels.
- 14.9.2 The instrument dials shall be of white with black numerals and lettering. Dials shall be parallax free and shall be provided with knife-edge pointers. The instrument shall be provided with anti-dazzle glass.
- 14.9.3 Shall have zero adjustment provision in the front side. The instrument shall have an accuracy class of +/-2% full scale.
- 14.9.4 The enclosure protection shall be of IP 55. The meter shall satisfy the environmental test requirements when exposed to ambient temperatures within -10 to +55°C at all times and vibration test as said in IS 1248. The case of the meters shall be made of self extinguishing, flame retardant polycarbonate material.
- 14.9.5 The meter shall comply with IS 9249 (Part-I) safety requirement for indicating electrical instruments and their accessories.



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- 14.9.6 Ammeter shall continuously withstand 120% of rated current.
- 14.10 Current Transformers:
- 14.10.1 The current transformers shall be of Cast resin type.
- 14.10.2 The max. VA Burden shall be 10 with accuracy Class of 1 and instrument safety factor of 5 and shall conform to IS:2705, Part-V of 1981.
- 14.10.3 CTs shall have short time withstand rating equal to the short time withstand rating of the associated switch gear for one second.
- 14.10.4 All CTs shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformers insulation resistance. Test links shall be provided in the CT secondary leads to carry out current measurement tests with CTs in service.
- 14.10.5 Accuracy class for metering 0.5, Class 5P20 for relaying.  
All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.  
CT secondary shall be rated for 1A for metering and either 5A or 1A for protection.
- 14.11 Annunciators:
- 14.11.1 Annunciators of the visual and audible type suitable for operation with the power supplies as mentioned in the scheme shall be provided. The annunciator panel shall be of flush or semi-flush mounting type.
- 14.11.2 The system shall be of solid state, which dispenses with the moving contacts. The system shall use industrial grade CMOS circuitry so as to have reliable operation and immune to electro-magnetic noise.
- 14.11.3 All printed plug boards, if used, shall be provided with Gold plated edge connectors so as to have positive contacts.
- 14.11.4 The unit shall be supplied with swing door display with front accessibility for the printed circuit modules.
- 14.11.5 The windows shall be provided with two lamps for reliability. The lamps shall be provided with series resistors or shall be biased with small current. The lamps shall be replaceable from the front. However, LED type lamps are preferable. The window shall be provided with easily changeable photo type film with black letters on white translucent background.
- 14.11.6 The first in alarm condition shall be displayed distinctly from subsequent alarms by different flash rates or by continued flash after accept. First in alarm conditions shall be interlocked with subsequent alarm ensuring accept and first in reset operator sequence. The system shall have dual tone system.
- 14.11.7 The system shall be suitable for operation with normally open fault contacts which close on a fault. The system shall have the facility to change the operation from "close on a fault" to "open on a fault". Each channel shall also have a potential free output contact of rating 50 VA min. for customers use. These contacts shall be brought out in terminal blocks on the rear of the panel.
- 14.11.8 Facilities for lamp testing, audio testing and flasher testing be provided.



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14.11.9 The annunciator shall be designed for the following conditions.

<u>Operation</u>	<u>Fault Contact</u>	<u>Audible</u>	<u>Visual</u>
NORMAL	OPEN	OFF	OFF
ALARM	CLOSE	ON (BEEPS)	FLASH (BRIGHT)
ACCEPT (P.B.)	CLOSE	OFF	ON (CONTINUOUS)
BACK TO NORMAL	OPEN	OFF	FLASH (DIM)
RESET PB	OPEN	OFF	OFF
TEST PB	---	ON	ON CONTINUOUS

NOTE: Once the first fault is accepted if there is a subsequent fault even before the clearance of the first fault then the audio shall be continuous and the corresponding visual shall be a bright flash.

During a lamp test if a fault occurs, the corresponding lamp circuit shall be fed automatically disconnected from the "lamp test" circuit and go into the normal mode

**15.0 MAKES**

The materials used shall be as per the approved list of vendors enclosed vide Annexure-B.

**16.0 INSPECTION & TESTING:** Standard Quality Plan, **QA:CI:STD:QP:30/Rev.05 to be followed**, with the following tests as minimum.

- 1) Dimension check, 2) Component rating check, 3) Functional check, 4) IR test, 5) HV test, 6) Temperature raise, 7) Enclosure, 8) Paint thickness & finish, 9) Component layout (aesthetics, ease of access and maintenance)

**17.0 QUALITY ASSURANCE PROGRAMME**

17.1 In order to ensure desired level of quality of the equipment offered, the manufacturer shall adopt a well established "Quality Assurance Programme (QAP)" covering detail check on incoming bought out components, all stages of manufacturing stage inspection and final testing. The QAP in general shall comprise the following

- 17.1.1 Structure of the organisation for management and implementation of proposed QAP.
- 17.1.2 Documentation control system.

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- 17.1.3 Detailed procedures for purchase of material and source inspection, etc.
- 17.1.4 System of shop manufacturing.
- 17.1.5 Control of non-confirming item and system of corrective action.
- 17.1.6 Detailed inspection and testing procedure.
- 17.1.7 Control of calibration and testing of testing equipments
- 17.1.8 System for indication and appraisal of inspection status
- 17.1.9 System of quality audit.
- 17.1.10 System for handling and delivery.
- 17.1.11 System for maintenance and records.
- 17.1.12 Detailed quality plan for each item raw materials, sub-assembly and final testing in tabulated format covering 100% batch inspection, along with expected values and tolerance levels. International standards / IS shall be referred under Acceptance Norms.

**18.0 PACKING as per procedure QA:CI:STD:PR:02/02**

- 18.1 All equipment shall be protected for ocean shipment, inland transport and outdoor storages during transit and at the Site, strictly accordingly to the instructions given in this specification.
- 18.2 The vendor shall be responsible for any damage to the equipment during transit due to improper and inadequate packing.
- 18.3 Only packages constructed out of sound material and of dimensions proportional to the size and weight of the contents shall be used.
- 18.4 Fragile materials shall be securely braced within the containers or otherwise amply fastened and packed to prevent shifting or rattling. Soft non-hygroscopic packing materials shall be placed between the hard packing materials and the fragile equipment. The over- hanging or simply supported articles must be cushioned, braced, fastened or blocked to prevent damage to the article itself or destruction of the container.
- 18.5 Loose materials, e.g. anchor bolts, nuts, etc. be packed separately, sealed in polythene bags with proper tagging and shall be properly secured with the main panel.
- 18.6 Components containing glass shall be carefully covered with shock absorbing protection material such as expanded polystyrene (thermocole).
- 18.7 All openings in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering.
- 18.8 Wherever necessary, proper arrangements for attaching slings for lifting shall be provided.



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- 18.9 All the inside walls of the packages shall be lined with waterproof paper to protect the equipment from damage due to dust and moisture. The protective wrapping shall last for a minimum period of three months.
- 18.10 Silicagel or approved equivalent moisture absorbing material in small bags shall be placed and tied on the equipment wherever necessary.
- 18.11 Dolegnate provision of stebes and pallets shall be made to tap the packages above the collecting drainage. Crates should have drain holes in the bottom to prevent collection of water within the packing.
- 18.12 Each crate or package shall contain a packing list in a waterproof envelope. All items of materials shall be clearly marked for easy identification against the packing list. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides with-
  - 18.12.1 Destination address as communicated;
  - 18.12.2 Dimensions / weight of the equipment;
  - 18.12.3 Name of the equipment.

**ANNEXURE-A**  
**CODES AND STANDARDS**

The design, manufacture and performance of the equipment shall comply with the following currently applicable standards, regulations and safety codes. Nothing in this specification shall be construed to relieve vendor of this responsibility.

1. IS:1248 Electrical indicating instruments.
2. IS:2705 : Current Transformers.
3. IS 3043 : Code of practice for earthing
4. IS:3156: Voltage Transformers.
5. IS 3231 : Electrical Relays for power System protection.
6. IS:5082: Aluminium alloys for electrical bus bars.
7. IS 5578 : Guide for marking of insulated conductors.
8. IS:6005 : Code of Practice for phosphating iron and steel.



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9. IS:8623: Specification for factory built switch gear assemblies.
10. IS 10118: Code of practice for selection, Installation and Maintenance of switchgear and Control Gear.
11. IS 11353: Guide for uniform system marking and identification of conductors and apparatus terminals.
12. IS:12021: Control transformer for switch gear and control gear for voltage not exceeding 1000 V AC.
13. IS 13703: Low voltage fuses for voltages not exceeding 1000V AC and 1500V DC.
14. IS 60947 (part-1): Low voltage switchgear and control gear- General rules.
15. IS 60947 (part-2): Low voltage switchgear and control gear- Circuit breakers.
16. IS 60947 (part-3): Low voltage switchgear and control gear- Switches, Disconnectors, Switch disconnectors and fuse combinations unit.
17. IS 60947 (part-4): Low voltage switchgear and control gear Contactors and motor starters.
18. BS 60947 (part1-4): Specification for low voltage switchgear.
19. In the absence of specific Indian Standard Specifications, International Electro-technical Committee (IEC) Specification shall be followed.

**ANNEXURE-B**

The component makes shall be as per **QA:CI:STD:QP:34/04**



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**ANNEXURE-C**  
**DOCUMENTS**

The Tenderers shall furnish all information, drawings and catalogues as listed below.

Sl. No.	Documents	No. of Copies with Offer	Submission schedule after the award of contract	
			No. of Copies	Week after PO Date
01	Wiring diagram and G.A. drawing	2	3	2
02	Wiring Schedule	-	3	2
03	Internal Arrangement Diagram	-	3	2
04	Bill of Material & Total Weight	2	3	2
05	Name Plate Details Inscription Details	-	3	4
06	Write-up	2	3	4
07	Descriptive Catalogues for various components	2	3	4
08	Test Certificates	-	3	At the time of inspection
09	O & M Manual including Erection Instructions	-	3 + 1 CD	Immediately after inspection



**TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL**

**PART-1 DATA SHEET ( FOR BHEL/ PC's PORTION)**



- |     |  |   |   |
|-----|--|---|---|
| 1   | Type of panel  | : | Free standing, floor mounted, compartment modular, Non –Drawn out, Front Access   |
| 2   | Bus bar and cable  | : | Vertical and Horizontal runs with clearly Identifiable sections.  |
| 3   | Cable Entry  | : | Bottom  |
| 4   | Protection   | : | IP 55   |
| 5   | Colour   | : | EXT: RAL 7032 with semi glossy finish<br>INT: Brilliant white (two coat with fire resistant coat) with glossy finish.   |
| 6   | No. of panels required   | : | 2 NO. (Each 100 kW)   |
| 7   | <b>PDP Details</b><br>PDP-1 located in F.O Pump House<br>PDP-2 located in ESP Control Room Service | : | PDP-1 will drive EHT in<br><br>F.O Pump House and a portion of EHTs in zone-1 as shown in the BASIC SCOPE OF EHT FOR FUEL OIL LINES, Drg No: 4-81-441-05248<br><br>PDP-2 will drive EHT in<br>The rest of portion of zone-1 as shown in the BASIC SCOPE OF EHT FOR FUEL OIL LINES, Drg No: 4-81-441-05248 |
| 7.2 | Space required for panel   | : | Bidder to specify   |
| 7.3 | No of Feeders required for Driving Pump House EHT  | : | 5 (4.0 kW, 7.0 kW, 4.0 kW, 1.5 kW & 3.5 kW)   |



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- 8 No. of Circuit : Shall be minimum by using Power splice
- 9 No. of Spare Feeders required in each panel : **3** (each of 2.5 kW rating)
- 10 Main incomer Power Transformer : **Dry type transformer**  
(Bidder to specify incomer feeder rating to each panel)
- 11 Main incomer cable size : Bidder to specify for each panel.

