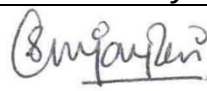
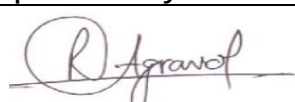


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GENERAL TECHNICAL SPECIFICATION

**PROJECT :- 2 X 500 KVA DG SETS FOR VYASI
HYDRO (2 X 60 MW)**

CUSTOMER :- UJVN LIMITED

Prepared By		Checked By		Approved By
				
Namit Prakash Dy. Manager, CXX		Sanjay Rai Sr. DGM, CEE		Rajesh Agrawal AGM-CEE, CXX & OFE

ISSUED BY

**CONTROL EQUIPMENT ENGINEERING DIVISION
BHEL BHOPAL-462022**

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GENERAL TECHNICAL SPECIFICATION

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1.0 INTRODUCTION

Lakhwar Vyasi Project comprising 300 MW Lakhwar Dam Scheme and 120 MW Vyasi Dam Scheme is a multipurpose scheme on the river Yamuna. The project has been under active construction since 1987 to 1992 and thereafter work on this project has been stopped. After formation of State of Uttarakhand, the project by virtue of its location was transferred to Uttarakhand Jal Vidyut Nigam Ltd. (UJVNL) by Govt. of India in Nov, 2001. The Project was subsequently handed over to NHPC for further execution though a MOU between Govt. of Uttarakhand, UJVNL and NHPC in Nov, 2003. The DPR of the project was submitted by NHPC in July, 2006. However, since the issue of sharing of project cost between beneficiary states towards Irrigation & drinking water & power generation relating to Lakhwar HEP is still under resolution, it was decided to take up construction of Vyasi HE Project independently and Lakhwar Scheme can be taken up at a later date after resolution of cost sharing between beneficiary states. Vyasi Project has now been taken over from NHPC by Govt. of Uttarakhand and is being implemented by UJVNL on its own.

Vyasi HEP is a run-of the river scheme on river Yamuna. The project, envisages utilization of 111 m of net head by construction of 86 m high concrete gravity dam, known as Vyasi Dam located near Judo village (5 Km d/s of Lakhwar Dam). Water is led to powerhouse through 2.7 Km long, 7.00 m diameter Headrace tunnel. The surface powerhouse on left bank of the river located near Hathiari Village is proposed to house two units of 60 MW each. The total energy generation works out to be 438.73 MU for 90% dependable year, with 95% machine availability.

The salient features of the project are as given here under:

SALIENT FEATURES

Country
State
District
River
Location of Dam

Location of Power House

Nearest Airport & Railhead
Latitude
Longitude

LOCATION

India
Uttarakhand
Dehradun
Yamuna
Village Vyasi, 5.0 Km.d/s of
Lakhwar
Village Hathiari 9.5 Km. d/s of
Lakhwar
Dehradun
30° 31' 00" N
77° 53' 00" E

POWER HOUSE

Type
Machine Location
Nos. & size of units
Dimensions of the power house
Deepest foundation level
Machine centre line.
Machine & Erection bay floor level.

Surface Power House
Near village Hathiari
2 units of 60 MW each
66.5 m(L)x21 m(W)x35 m(H)
El. 500.50 m
El. 510.30 m.
El. 520.30 m.

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2.0 CLIMATIC CONDITIONS

Physiography

River Yamuna, after flowing approximately 100 Km from its source at Yamunotri passes through a narrow gorge at village Judo. The catchment area is bounded between latitude 30° 25' N to 31° 05' N and longitude 77° 52' E to 78° 35' E. The catchment area of river Yamuna up to the proposed Vyasi dam site is 2100 sq km, out of which 2080 sq km is catchment of Lakhwar Dam, which is located 5 km upstream of Vyasi Dam and 20 sq km is intermediate catchment between Vyasi and Lakhwar Dam Site. About 60 sq km of the total catchment is snow bound. The region is mountainous, partly covered with vegetation and varying in elevation from about EL 620 m to EL 631.50 m. The river channel is without any extensive flood plains so that the attenuation of flood peak due to channel storage is not considerable. Pronounced orographic features favour a quick run off. These factors are conducive to short duration and high peak floods.

Climate

The climate is well defined in spring, summer & rainy seasons. The foothill areas of the catchment in the vicinity of the project site are characterized by a temperature of 2.5 °C to 40 °C during winter & summer respectively. The relative humidity measures between 25% to 85 % with saturated atmosphere during rainy seasons. The monthly maximum and minimum temperatures at Dehradun in degrees centigrade for different months of the year from 1967 to 2002 is available. The maximum observed temperature is 42.8 °C and minimum observed temperature is 0.3 °C. The relative humidity is generally high during monsoon and low during post monsoon and winter seasons. The maximum observed relative humidity is 100% & minimum observed relative humidity is 8%. The rainfall data at rain gauge stations such as Kempty, Dhamta, Lohari, Bausan, Naugoan, Dehradun, Dakpathar, Dhanaulti, Chibro, Koti, Purola, Uttarkashi & Chakrata are available for different periods. Out of which Naugoan, Kempty & Dhamta are inside the catchment at Vyasi. While Lohari, Dhanaulti, and Chakrata station are on the periphery of the catchment boundary and Bausan, Chibro, Koti and Dehradun is outside the Vyasi catchment. The annual average rainfall varies from 1250 to 2000 mm.

3.0 COMMUNICATION AND TRANSPORT LIMITATIONS

3.1 LOCATION AND ACCESS

Vyasi HE Project, (2X60 MW) is located in Dehradun District of Uttarakhand. The Project sites are easily accessible by road, as all the project components are located on double lane approach roads taking off from National Highway NH-123 at Barawala (3 km from Dakpathar). The nearest railhead (Broad Gauge) is at Dehradun.

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The approximate road/rail distances between relevant project related places/sites and important towns are as given here under:

Distance in Km	By Road	By Rail
Delhi Dehradun	240.0	313
Dehradun Lakhwar	72.0	-
Dehradun Kalsi	52.0	-
Kalsi Barawala	4.0	-
Badhwala Vyasi Dam	17.0	-
Badhwala Hathiari PH	11.5	-

3.2 TRANSPORT LIMITATION

Goods Transport

The nearest broad gauge railhead is Dehradun. National Highway NH-123 from this rail head up to Barawala and thereafter approach roads taking off from NH-123 to various work sites of the project can meet project construction requirements relating to transportation of goods.

Transport Limitation

As per the location of the project and its approachability through NH-123 and thereafter through double lane approach roads taking off from National Highway and reaching to various works sites, there may not be any specific transport limitations. However, the E&M contractor is advised to visit the access routes to the project & carefully examine all aspects relating to transportation of E&M equipment up to worksite.

4.0 BIDDERS TO INFORM THEMSELVES

The Bid documents contain relevant data relating to the Project site to enable Bidders to comprehend and understand the site specific conditions, constraints etc. The bidders are, however, free to acquaint themselves, in addition, by making independent enquiries regarding the conditions and circumstances, requirements and any other aspect which may affect their bids.

Intending Bidders who wish to visit the site to acquaint themselves of the conditions at site will be allowed to do so, for which they may contact the purchaser with their programme.

In evaluating the bids it will, therefore, be deemed that the bidders have thoroughly acquainted themselves with the requirements in all respects. No queries will be entertained after the bids have been received and opened

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5.0 ELECTRICAL EQUIPMENTS

5.1 Enclosures for Electrical Equipment & Cables

All Distribution Boards shall be of metal enclosed, indoor floor-mounted, free-standing type.

All Distribution Board frames shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2mm. Frames shall be enclosed in cold rolled sheet steel of thickness not less than 1.6mm. Stiffeners shall be provided wherever necessary. 3.2 mm thick sheet shall be used for load bearing & inside component mounting plate. Rolled steel sections may be used in cubicles for forming the frame and stiffening. Where equipment is to be mounted on a panel the thickness of the sheet steel shall be sufficient to prevent vibrations affecting the correct operation of the equipment. Base Frame of 5.0 mm Thick M.S. Channel Frame with Accessible Foundation Holes shall be provided. Foundation arrangement by sufficient no. of Anchor Bolts with Associated Hardwares shall be Provided. Neopren Rubber gaskets for all Doors and Covers and Neopren Rubber antivibration pad shall be provided. All Metal Hard Wares to be Zinc Plated and Passivated for Corrosion Resistance. All Sheet Metal Parts to be Painted.

All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement member.

The complete structures shall be rigid, self supporting, free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

Louvers backed with metal screen should only be provided on the bus bar chambers for adequate ventilation.

All Distribution Boards shall be of dust, vermin proof construction and shall be provided with a degree of protection not less than IP52 (for Indoor enclosures), and outdoor enclosures shall provide a degree of protection not less than IP53 to IEC 60947/IS2147. Separately mounted devices shall be enclosed with the degree of protection not less than IP53 to IEC 60947/IS2147. If different IP protection class, if defined in Specific Purchase Specification (Technical) for the particular panels/boards then the precedence shall be given to it. All cut-outs shall be provided with neoprene/synthetic rubber gaskets.

Distribution Boards shall be of a uniform height not exceeding 2250mm including the base channels.

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Distribution Boards shall be easily extendable on both sides, by the addition of the vertical sections after removing the end covers.

Distribution Boards shall be supplied with base frame made of structural steel sections. All necessary mounting hardware required for welding the base frames to the insert plates including the insert plate shall be covered in the scope of supply.

All Distribution Boards shall be divided into distinct vertical sections each comprising of:

- a) The bus bar compartment for running horizontal and vertical bus bars shall be completely enclosed with metallic enclosure. Bolted covers shall be provided for the access to horizontal and vertical bus bars and all joints should be accessible for repair and maintenance without disturbing feeder compartment.
- b) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker.
- c) An adequately sized compartment or alley for power and control cables having sufficient provision for easy maintenance.
- d) A compartment for relays and other control devices including ACB for the feeders having provision of ACBs.

Sheet steel barriers shall be provided between two adjacent vertical panels running to the full height of the Distribution Board, except for the horizontal bus bar compartment. Each shipping section shall have full metal sheets at both ends for safe transportation and storage.

All equipment associated with a particular circuit shall be housed in a separate compartment of the vertical section. The compartment shall be sheet steel enclosed on all sides with drawable units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities using universal key.

After isolation of power and control circuits connections it shall be possible to safely carryout maintenance in a compartment with the bus bar and adjacent circuits live. Necessary shrouding arrangement shall be provided for this purpose over the cable terminations located in cable alley.

Cable alleys shall be provided with suitable hinged doors. It shall be possible to carryout maintenance work on cable connections to any circuit with the bus bars of adjacent circuit live. Adequate number of slotted cable support shall be provided for cleating the LT power cable.

All single front switch boards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.

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All doors shall be provided with concealed type hinges and captive screws.

The AC & DC distribution board cubicles should comply with the requirement of relevant Indian Standard and Indian Electricity Rules for providing minimum clearance between phases of the bus and live parts from metallic parts. The drawing showing full dimension of the cubicles should be got approved from the purchaser before starting the fabrication of these cubicles.

Distribution Board shall be of single front/double front type. Bidders shall have to quote for both types of distribution boards along-with detailed over all dimensional drawings of each distribution board.

All identical circuit breakers and module chassis of same size shall be fully interchangeable without having to carryout modifications.

Wherever, two breaker compartments are provided in the same vertical section, insulating barriers and shrouds shall be provided in the rear cable compartment to avoid accidental touch with the live parts of the one circuit when working on the other circuit.

All modules of Air Circuit Breaker and MCCB's shall be of draw out type. The tentative entries for LT bus-duct power and control cables are either from top or bottom of the panels. However, purchaser reserves the right to alter the cable entries, if required, during detailed engineering without any additional commercial implication.

All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to Purchaser's approval.

Suitable interlocks shall be provided for preventing access to live parts. instruments, relays, control and selector switches, indicating lamps, push-buttons and trip relays shall be flush-mounted and located at convenient heights on the front of the switchgear in a logical and clear manner. The arrangement of equipment in and on the enclosures shall be such that maintenance can be carried out easily without dismantling other equipment. Equipment shall be arranged so that devices requiring manual operation are mounted at a height between 750mm and 1800mm above floor level. The layout of these panels is subject to the approval of the Purchaser.

The design of the cubicles shall facilitate a possible extension at either end. Wherever the correct operation of instruments and relays makes it necessary, adequate vibration and shock-absorbers shall be installed. Adopter panels and dummy panels required to meet the various bus bar arrangements and layouts required shall be included in bidder's scope of work. In case of double front distribution boards, necessary provision of passage to go to the other side of distribution board shall be provided while adjusting the layout of SSB-1, SSB-2A, SSB-2B & SSB-3 in LT Room.

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All sheet work shall be pretreated, in tanks, in accordance with IS:6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed by pickling with acid. After pickling the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphate coating shall be Class-C as specified in IS:6005. The phosphated surfaces shall be rinsed and passivated prior to application of powder coating. Adequate thickness of powder coating with high voltage electrostatic appliance shall be applied. Final colour at the panel shall be pebble grey as per RAL-7032 (Glossy Finish) for both Exterior & Interior except component mounting plate which shall be brilliant white (dull finish). Panels shall be uniformly powder coated and Paint thickness shall be min. 60 microns.

Doors shall be provided where access is necessary during normal operation of the plant, e.g. for replacing fuses, resetting relays, taking equipment out of service or routine inspection of contactors, relays or similar equipment, but where access is necessary only for cleaning or repair, or to equipment such as current transformers, removable covers may be provided. Where a removable cover is provided which is larger than can be handled by one man working alone then hinges shall be provided. Covers shall be fixed in place by captive bolts. Doors (Concealed Hinged, lift off with min. Door Swing 150 degree) and covers shall either lap or be rebated with the enclosure. Doors shall be constructed of steel sheet 2.5mm minimum thickness with double returned edges and additional stiffeners if necessary to prevent distortion. Door opening stops shall be provided on all doors. All cubicles and cabinets shall have permanent door handles having Integral lock with master key, which shall be possible to padlock. Suitable Eye Bolts/Hooks in sufficient nos. shall be Provided for Lifting Arrangement of boards/cubicles/panels.

The arrangement of equipment in and on the enclosures shall be such that maintenance can be carried out easily without dismantling other equipment. Equipment mounted on doors shall be kept to a minimum and no electrical relays shall be mounted on doors. Min. Clearance between Gland Plate & Bottom Most Terminal Block shall be 300 mm and Min. Spacing between adjacent Terminal Row/Columns shall be 150 mm. Terminal blocks provided shall be inclined towards the door for facilitating terminations.

Detachable gland plates of sufficient size and number shall be provided for either top or bottom cable entry or both (to be decided during detailed engineering), except that outdoor enclosures shall not have top entry. Gland plates for single core cables shall be of non-ferrous material. Floor- mounted indoor enclosures may have their bottom entry gland plates substituted by channel-mounted cable clamps for cable support. Separate gland plates or channel pieces shall be provided for the exclusive use of each contractor terminating in each enclosure. Undrilled Gland plates of thickness min. 3.2 mm M.S. or 6.0 mm Aluminium shall be provided.

Thermostatically operated anti-condensation heaters, 230 VAC, complete with isolating switch, shall be provided in junction boxes and enclosures containing control or relay equipment in each compartments. They shall be installed in enclosures located outdoor or indoor, whether or not they are ultimately to be

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located in an air-conditioned area. A thermostat shall be provided to control the heater. All heaters shall be provided with covers to prevent mechanical and accidental touching.

All enclosures fitted with anti-condensation heaters shall have ventilation openings in the doors which shall be screened with vermin-proof fine brass gauze or a suitable filter and arranged to minimize entry of dust and prevent entry of water. Ventilation shall be sufficient enough to prevent the installed equipment to be exposed to excessive temperatures. Necessary isolating switches and fuses shall also be provided.

CFL type Luminaries shall be provided to light the inside of each enclosure large enough for a man to work inside, except for smaller boxes. Luminaries shall be controlled by a fully enclosed door-actuated switch.

Finish painting inside enclosures shall be light and the finished surfaces outside shall present a first class appearance free from all blemishes. Equipment contained in enclosures shall be finish painted as if it were exposed to view.

Busbars shall be made of high conductivity electrolytic copper suitably protected against corrosion and rigidly supported on approved type of insulators of adequate size. For The AC Distribution Board shall be provided with three phase and a neutral bus bars. All the sections bus bar and jumper connections shall be made of high electrolytic copper conductor of adequate size. The 415 volts copper bus bars shall be rectangular in cross section so as to be able to carry the required current within the limits of temperature rise at the site conditions. They shall be so designed and mounted in the chamber such that expansion or contraction does not subject either the bus bars or the insulating supports to any undue stresses. The bus bars shall be designed to withstand safely the dynamic forces due to short circuit. The size of neutral bus bar shall be 50% of phase bus bar and shall run continuously in the bus bar chamber and shall be connected at one point through disconnectable link to ground bus. Phase and neutral links shall be provided for individual feeders. The Cross-Section of the bus bars shall be uniform throughout the length of the distribution board and shall be adequately supported and braced to withstand the stresses due to the specified short circuit currents.

All bus bars shall be adequately supported by Non-hygroscopic, non-combustible, track-resistant and high strength type Polyester fibre glass Moulded Insulators/Epoxy Insulators. Separate supports shall be provided for each phase and neutral bus bar. If a common support is provided anti-tracking barriers shall be provided between the supports

Busbars shall be suitably mounted in enclosed compartments running the full length of the distribution boards. Access to the busbars shall be possible only by removing bolted covers.

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Opening the back or front door of any circuit-breaker cubicle shall not expose the busbars. Busbar connections laying outside the busbar compartment shall be insulated or shrouded to eliminate hazardous accidental contact while working on other parts of the switchgear. Means shall be provided for expansion and contraction of the busbars resulting from temperature variations.

All busbar joints and connections shall be smoothed and silver-coated or tinned on the contact surfaces. All bus bars joints shall be provided with high tensile steel bolts belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non silver plated bus bars joints shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint. All bus bars shall be colour coded as per IS:375.

The tenderer shall furnish calculations along with the bid, establishing the adequacy of bus bar size for specified current ratings. Auxiliary buses shall be provided for AC and DC Control power supplies. The material for all auxiliary buses for Control power supplies shall also be of high electrolyte copper. The supply for AC auxiliary buses shall be tapped from the main power buses before the incomer, for each switchboard. Individual fuse and neutral links shall be provided at each circuit of AC auxiliary bus bar and the circuit for space heater should include an isolating air break switch. The auxiliary bus bar compartment shall also run horizontally. The bus bars shall be provided with at least minimum clearance in air specified in IS 4237 for a 500V, 3 phase system.

All switchgear, busbars and connections shall be capable of withstanding all electrical, mechanical and thermal stresses they may be subjected to, under normal or fault conditions. Clearance between live parts and to earth shall be in accordance with the relevant standards. Each cubicle shall be provided with devices for earthing the incoming cables, preferably each phase separately. Enclosures containing control or relay equipment shall in all aspects have sufficient space for possible later expansion, minimum 20%.

Atleast following safety requirements shall be provided for all cubicles/panels / boards /enclosures.

- All metallic cases of devices to be connected to earth bus.
- Two Earthing terminals of Brass (one on each side of panel with earth symbol and complete with two nuts, two plain washer and one spring washer) and lugs suitable for connecting ground cable ranging from 70-150 sq. mm size. Earth symbol (Green colour) to be provided near Earth terminals.
- Door interlock for main switching device
- Safety shutters on power contact opening in draw out sections.
- Safety instruction, shrouded & danger warning labels near open live terminals (415V and above).

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Design Features for Power, Control & Instrumentation etc cables

All cables shall be designed to cope with

- The short-circuit conditions.
- The applied protective system in respect to cross-section and number of cores.

The cables shall be capable of satisfactory operation under a power supply system voltage variation of $\pm 10\%$ and frequency variation of $\pm 5\%$ and a combined frequency voltage variation of 10% (absolute sum). The cables shall have heat and moisture resistant properties. These shall be of type and design, with proven record of power station installation.

Power Cables - 600/1000 Volt Grade Single Core Cables

These cables shall be at least 600/1000 volt grade, heavy duty, single core, stranded Aluminium / Copper conductor, HR-PVC insulated and PVC sheathed, armoured and shall conform to the same design and properties as cables conforming to IS: 1554 (Part-I) / IEC. The outer sheath shall be of specially formulated PVC compound to give the following properties:

Oxygen index Min. 29 (Test performed on, 27 ± 2 deg C)

Smoke density Min. 40% light transmittance

Acid gas Max. 20% by weight

Flame propagation shall meet IEC 60332-1, IEEE 383

Power Cables - 600/1000 Volt Grade Multi core Cables :

The cable shall be at least 600/1000 volt grade, heavy duty multi core, stranded Aluminium conductor, PVC insulated, colour coded, laid up, armoured, inner sheathed with extruded PVC, 2/3.5 cores, conforming to IS 1554 (Part I) / relevant IEC. The outer sheath shall be of specially formulated PVC compound to give the following properties.

Oxygen Index Min. 29, (Test performed on, 27 ± 2 Deg C)

Smoke density Min. 40% light transmittance

Acid gas Max. 20% by weight

Flame propagation shall meet IEC 60332-I, IEEE 383

Control & Instrumentation Cables

The control & instrumentation cables shall be multi core, colour coded, armoured, annealed stranded high conductivity Copper, single conductor, insulated with HR-PVC insulation, PVC sheathed and armoured, conforming to IS 1554 (Part- I & II) / relevant IEC. The outer sheath shall be of specially formulated PVC compound to give the following properties.

Oxygen index Min. 29, (Test performed on, 27 ± 2 Deg C)

Smoke density Min. 40% light transmittance

Acid gas Max. 20% by weight

Flame propagation shall meet IEC 60332-1, IEEE 383

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Coaxial Cable (if used any)

Coaxial cable shall be offered to connect coupling unit installed in the switchyard to the PLCC terminals, installed in control room of powerhouse. The cable offered by the contractor shall be steel armoured. The cable shall have braided tinned Copper conductor. The capacitance of the cable shall be low so as to minimize attenuation in the carrier frequency range. The impedance of the cable shall be so as to match with the output impedance of the PLC terminals and secondary impedance of the coupling units. The cable shall be insulated to withstand a test voltage of 4 kV. The contractor shall supply H.F. cable with following properties:

- Co-axial H.F. cable with 75 ohms characteristic impedance (unbalanced)
- Capacitance per meter – 53-pf approx.
- Test voltage in kV – 4 kV RMS for 1 minute
- Size of conductor – 7 strands/0.4mm

The maximum attenuation at various frequencies shall be as follows

Frequency in KHZ	Attenuation in db/km
60	1.4
300	3.3
500	4.7

Size & Length of Cables

The number of cores and sizes of the cables required for various circuits shall be worked out during detailed engineering. The cables covered by this specification shall be supplied in one length or in standard length as approved by the Employer.

Colour Scheme and Identification

To facilitate easy identification of phases a colour scheme of Red, yellow and Blue for phases and black for neutral shall be adopted for power cables. Multi-core control cables shall be colour coded for identification of cores or numbered at equal interval as per relevant IS/IEC standards. All the cables shall carry manufacturer data and UJVNL embossing in a permanent, legible manner at an interval of at least 3 meter run. The manufacturer's data shall include the name, cable size, and voltage rating together with any other information.

Termination Kit

The termination kits wherever required for cables terminations shall be heat shrinkable type as per relevant IS / IEC. The contractor shall supply all hardware consumables such as plumbing metal, sealing compound, tapes and other materials required.

They shall be crimped to the conductor while other end will provide flat surface for better connections. The connectors shall be made of Copper electro tinned.

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Internal wiring

Internal wiring shall be done with Stranded copper conductor, annealed and tinned PVC insulated, conforming to IEC 60947-7-1 and followed as per the following.

1. Lugs - Crimping type, tinned copper with insulation sleeve. Ring type for device terminals.
Pin type or JAW type for terminal blocks.
2. Ferrules - PVC, white colour with Black Letters.
3. Ferrule Numbering - To read from device terminals outward.
4. Method - Bunch wiring or PVC duct wiring.
5. Size and Colours -

CIRCUIT	SIZE SQ. mm	COLOUR
CT, PT Secondary	2.5	R-Red, Y-Yellow, B-Blue, N-Black
Control, Auxiliary Ckt. - AC - DC	2.5 2.5	Black Grey
Earthing of Metallic Cases of Devices	2.5	Bicolour (green & Yellow)/Green
Power Ckt. - AC (3 Phase) - AC (1 Phase) - DC	As Per Ckt. Rating - Do - - Do -	R-Red, Y-Yellow, B-Blue, N-Black * Phase-Red, Neutral-Black Positive-Red, Negative-Blue

- Wiring originating from equipment/panels up to the terminal blocks forming part of such equipment, shall be tinned annealed copper wire with PVC insulation appropriate for tropical hot and moist climate and resistant to vermins as per relevant international standards. Insulation for small wiring shall be oil proof/oil vapour proof. Wiring shall be sized to fit with requirement and shall be subject to the approval of the purchaser.
- Internal wiring of the various equipment panels etc. shall be completed at the Contractor's works as far as possible and convenient. All wiring shall be arranged neatly into flat or rectangular groups adequately supported with cleats, with minimum number of bends or crossings without splices. Connections shall be made at the terminal studs, or terminal blocks. Similar circuits shall terminate on adjacent terminals to facilitate grouping and to minimize the number of interconnecting cables. Secondary wiring or control wiring including leads from the current-transformers, temperature-detectors, alarm-contacts, speed and pressure-switches etc. shall be enclosed in conduits and shall be carried to dust and water proof

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and oil tight cabinets located conveniently for connection to the control cables.

- All limit switches shall be of proximity type and shall be protected from condensation.
- Pressure circuits shall be suitably protected so that failure of one circuit shall not cause the progressive failure of adjacent circuit. AC circuits, DC circuits, and circuits operating at different voltages shall be grouped separately and the wiring for each of these groups shall, preferably, be segregated.
- For easy identification, tracing and reconnection, wiring shall be colour coded and shall be fitted near the terminals with ferrules or such other caps indelibly marked with the identification number corresponding with that of the associated terminal blocks. For electrical circuits extended to several pieces of equipment necessitating sectionalizing of circuit wiring at the terminal blocks of the corresponding equipment, common identification numbers shall be used for the designation of the circuits at all the terminal blocks and connections. The terminals and circuit designations for wiring shall be subject to the approval of the purchaser.

CONTROL AND SECONDARY WIRING

All Distribution Boards shall be supplied completely wired internally up to the terminal blocks ready to receive purchaser control cable.

All inter cubicle and inter panel wiring and connections between panels of same Distribution Board including all bus wiring for AC and DC supplies shall be provided by the tenderer.

All internal wiring shall be carried out with 660V grade, single core, 2.5 square mm or larger stranded copper wires having colour-coded, PVC insulation.

Provision of remote "ON" & "OFF" indications of each ACB's and MCCB's shall be provided in the distribution boards. Necessary control wiring from distribution board to RTU's for item numbers 1 to 8 in the schedule of requirement Annexure-I shall have to be carried out by the bidder. RTU's for this purpose are covered in other section. However, the bidder has to co-ordinate with the supplier of RTU's for detailed wiring etc. Transducers if any and the control cables required for the purposes are to be included in the scope of supply. Position of the RTU and AC distribution boards will be finalized at the time of actual engineering of the drawings and finalization of layout drawings.

Extra-flexible wires shall be used for wiring to device mounted on moving parts such as hinged doors.

All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminal and terminal blocks.

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Internal terminations of standard conductors shall be made with solderless crimping type tinned copper lugs which shall firmly grip the conductor, or by an equally suitable method. Insulating sleeves shall be provided over the exposed parts of lugs.

Engraved core identification ferrules marked to correspond with panel wiring diagram shall be fitted at both ends of each wire. The wire number shall be in accordance with IS:375.

5.2 AUXILIARY POWER SUPPLIES

The various auxiliaries and controls shall be suitable for 415V/240V AC and 220V DC supply respectively. Lower voltage if required by the contractor shall be arranged by contactor.

5.3 PROTECTIVE AND CONTROL GEAR EQUIPMENT

Necessary starting, protective and control gear shall be furnished by the contractor with each motor. Instantaneous and thermal overload protection shall be provided for the motor, together with remote indication of the operation of the protective gear, wherever necessary. In the case of essential motors, the stoppage of which would result in the serious damage, the thermal overload protecting devices shall be arranged to give alarm only without disconnecting the motors. Red and green indicating lamps shall be furnished for indication of the closed and open position, respectively, of motor contractors. The control and indication equipment shall be suitable for operation with 220 Volts DC supply. All indicating lamps shall be of LED type.

5.3.1 CIRCUIT BREAKER:

Air Break Circuit Breaker (ACB):

The circuit breaker shall be triple pole, horizontal electrically draw out type with built in Micro Processor release (LSIG, Overload (Phase & Neutral), short ckt., Instantaneous and Earth Fault)) and shall have breaking capacity $I_{cu} = I_{cs} = 50KA$ (min.).

Circuit breakers shall be mounted along with its operating mechanism on telescopic rails. The cradle should be designed and constructed so as to permit the smooth withdrawal and insertion of the breaker into it. The movement should be free of jerks and shall preferably be on rollers and not on the flat surface. Suitable guides shall be provided to minimize misalignment of the breaker.

There shall be service, test, isolated and maintenance positions for the breakers.

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All the three poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during closing shall not exceed half cycle of rated frequency.

The main contacts should be of appropriate silver alloys. Mere silver plating of the faces shall not be acceptable.

Arcing contacts should be of tungsten base alloy and mere silver plating of the faces shall not be acceptable. Arcing contacts must be separate from main contacts and one piece butt type contacts shall not be acceptable.

- a) The ACB cubicle shall have door interlocking facility so that the cubicle door cannot be opened when the ACB is closed or in "Test" position. Inbuilt interlock should be provided to prevent the closed circuit breaker being inserted into the panel.
- b) The ACB shall have provision of locking it in isolated position for keeping personnel and equipment safe during maintenance.
- c) Automatic safety shutters shall be provided to ensure that the cradle terminals are completely covered when the circuit breaker is drawn out. Complete removal of the breaker from the distribution board shall be simple and smooth. When the cubicle door is closed, the breaker shall be able to achieve three different positions "SERVICE/ISOLATED/TEST POSITION". When the cubicle door is open, the breaker should be capable of achieving "MAINTENANCE" position where free access is obtained to all parts of the breakers.
- d) An auxiliary switch with 12 NO and 12 NC contacts shall be provided with each breaker and wired up to terminal block. An earthing device shall be provided which, when in circuit, earths the bus bars of feeder side of the breaker.
- e) All the fault signals & Alarm shall be individually wired up to terminal block for further extending to SACDA System for logging and remote sequencing/interlocking/alarm.

Power Operated Mechanism

Circuit breaker shall be provided with motor operated spring charged mechanism. The motor shall be a universal motor suitable for operation from 240 $\pm$ 10%V AC.

The charging time for closing springs shall not be more than 30 seconds.

After failure of power supply, at least one open-close-open operation shall be possible.

Provision shall be made for emergency manual charging of closing spring.

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Circuit breakers shall be provided with closing and tripping coils. The closing coil shall operate correctly for voltage variation between 85% to 110% and trip coil for voltage variation between 70% to 110%.

Mechanical tripping shall be possible by means of front mounted red coloured trip push button. These push buttons shall be shrouded to prevent accidental operation.

Air Circuit breaker shall be provided with mechanical indicating devices to show OPEN, CLOSE, TEST and SPRING CHARGED conditions.

Air Circuit breaker shall be provided with no voltage release as it may be necessary to fulfill operation logic requirement. Provision shall be made to lock the breaker in "Isolated" position.

Interlocking of the incomer ACB's with the other associated tie ACB's shall also be provided as per the operation logic. In case sufficient number of auxiliary contacts are not available, auxiliary relay shall be provided for interlocking.

MOULDED CASE CIRCUIT BREAKERS (MCCB)

All the outgoing feeders (except where specifically mentioned) shall be provided with Molded Case Circuit Breakers (MCCB's) having suitably designed for adjustable thermal over load and magnetic short circuit protection.

The MCCB's shall be mounted in a trolley which shall be of draw out type. The draw out mechanism for MCCB's shall be such that it shall be held in the cradle made of welded steel by means of two telescopic rails on which it shall be supported. These rails shall slide over ball bearings which shall make the movement of the MCCB's on the cradle extremely smooth.

MCCB's shall be manually operated. The operating handle should give a clear trip indication.

Alarm Scheme - Audible and visual (Mechanical flag indication) alarm scheme suitable for operation from 220V DC supply shall be provided to indicate tripping of ACB and MCCBs.

The MCCB's shall be quick make/quick break, trip free and independent of manual speed for operation.

The breaking capacity shall be tested for P-1 class duty cycle as per IS-2516/IS-13947. The breaking capacity test report shall be enclosed with the bid from a Government approved test house.

MCCB's shall be fitted with direct acting magnetic thermal release for short circuit and overload protections. Settings of the thermal release shall be independently adjustable over a wide percentage range of nominal rating in all ranges. The MCCB's shall have a short circuit breaking capacity $I_{cu} = I_{cs} =$

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50KA (min.) at 415V AC application and for DC application the breaking capacity shall be min. 25KA at 220V DC. All the MCCBs shall be fitted with shunt trip mechanism for external tripping. This shall be wired up to terminal block. Alarm switch shall be provided with each MCCBs and the same shall be wired to terminal block.

An auxiliary switch with 6 NO and 6 NC contacts shall be provided with each moulded case circuit breakers and wired up to terminal block.

TEMPERATURE RISE

The distribution boards shall be designed to operate satisfactorily under the site conditions and the maximum temperature attained by any part of the equipment wherein service at an ambient temperature of 45 deg.C. shall not exceed the limits specified under IS-13947 (Part-I) corrected for the site conditions.

PROTECTION COORDINATION

It shall be the responsibility of the Contractor to fully coordinate the overload and short circuit tripping of the circuit breakers with the upstream and downstream circuit breakers to provide satisfactory discrimination.

5.3.2 AUXILIARY RELAYS, CONTACTS AND DEVICES

All relays and timers in protective circuits shall be flush mounted on panel front with connections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a draw out construction for easy replacement from the front. They shall either have built-in test facilities, or shall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-draw out cases.

All AC auxiliary relays shall be suitable for operation with VTs and CTs secondary's indicated in Single Line Diagrams (Attached with the technical specification) .

DC auxiliary relays shall be designed for 220V DC unless otherwise specified and shall operate satisfactorily between 70% and 110% of the rated voltage. Relays shall have adequate thermal capacity for continuous operation in circuits in which they are used.

All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on the relay cases for applicable relaying schemes.

Suitable number of auxiliary contacts or auxiliary relays shall be provided with each ACB's (incomers/outgoings/bus couplers etc.) for indication,

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remote indication, annunciation and automatic changeover and interlocking scheme.

Auxiliary relays shall be provided wherever necessary. Under voltage relays with timers, auxiliary relays and other auxiliary devices, shall be provided wherever required for proper operation of automatic changeover and interlocking scheme and proper switching sequence of circuit breakers as specified in the specification.

All protective relays, auxiliary relays and timers shall be provided with hand reset operation indicators (flag) for analyzing the cause of operation.

5.3.3 INSTRUMENT TRANSFORMERS

All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing inside the switchgear enclosure, when the distribution board is operating at its rated condition and the outside ambient temperature is 50 deg.C.

All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings of the associated switchgear.

All instrument transformer shall have clear indelible polarity markings. All secondary terminals shall be wired to a separate terminal on an accessible terminal block where star-point formation and earthing shall be done.

Current transformers may be multi or single core type. All voltage transformers shall be single phase type. The Bus VTs shall be housed in a separate compartment.

All VTs shall have readily accessible HRC current limiting fuses on both primary and secondary sides.

The current transformers shall comply in all respects to the latest edition of the IS-2705 and voltage transformers shall conform to the latest edition of IS-3156.

The current transformers shall have the following ratings:

- | | |
|---------------------------|--|
| a) Rated voltage | 433 volts |
| b) Frequency | 50 Hz |
| c) Earthing of the system | Solidly grounded |
| d) Short circuit current | 50kA for power house distribution boards and 35kA for distribution board at other sites. |

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5.3.4 CONTROL AND SELECTOR SWITCHES

Control and Selector switches shall be rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel front.

Switches with shrouding of live parts and sealing of contacts against dust ingress shall be provided.

Circuit breaker control switches shall have three positions and shall be spring return to "NEUTRAL" from "CLOSE" and "TRIP" positions and shall have pistol grip handles. They shall have at least two (2) contacts closing in close position, and two (2) contacts closing in trip position unless specified otherwise.

Ammeter and voltmeter selector switches shall have four stay out position with adequate number of contacts for three phase 4 wire system. These shall have oval handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries. Contacts of the switches shall be spring assisted and shall be of suitable material to give a long trouble free service.

Make and carry continuous current rating of the contact shall be at least 10 Amp.

5.3.5 PUSH BUTTONS

Push-buttons shall be of spring return, push to actuate type. Their contacts shall be rated to make, continuously carry and break 10A at 240V AC and 0.5A at 220V DC.

All push buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver alloy.

All push buttons shall be provided with integral escutcheon plates marked with its function.

The colour of the button shall be as follows:

Red	:	Breaker Close
Green	:	Breaker Open
Black	:	For overload reset

(The colour of Push Button shall be subjected to customer's approval. If the customer wants to change the above colour then bidder to accept the same).

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5.3.6 INDICATING LAMPS

Indicating lamps shall be of LED type and low watt consumption. Lamps shall be provided with series resistors, preferably built-in the lamps assembly. The lamps shall have escutcheon plates marked with its function, wherever necessary.

Lamps shall have translucent lamp-covers of the following colours, as warranted by the application.

Red	:	ACB's/MCCB's close
Green	:	ACB's/MCCB's open
White	:	Auto trip
Amber	:	For all healthy conditions e.g. control supply
Voilet	:	Circuit breaker spring charged
Blue	:	For all alarm conditions (e.g. overload) Also for "SERVICE" & "TEST" positions indicators

Lamps and lamp covers shall be easily replaceable from the front of the cubicle.

Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariably be located to the right of green lamps.

In case a white lamp is also provided, it shall be placed between the red and green lamps along the center line of control switch/push button pair. Blue and amber lamps should normally be located above the red and green lamps.

When associated with push buttons, red lamp shall be directly above the green push button and green lamp shall be directly above the red push button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

5.3.7 HRC-FUSES

HRC-Fuses shall have visible operation indicators.

HRC-Fuses shall be mounted on fuses carriers, which are mounted on fuse bases. Wherever it is not possible to mount fuses on carriers, fuses shall be directly mounted on plug-in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

HRC-Fuse rating shall be chosen by the tenderer depending upon the circuit requirements and these shall be subject to approval of purchaser.

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5.4 INSTRUMENTS/METERS

METERING INSTRUMENTS

All instruments and meters shall be suitable for operation under the climatic conditions prevailing at site. The instrument cases shall be dustproof, water tight, vermin proof specially constructed to adequately protect the instruments against damage or deterioration due to high ambient temperature and humidity. Electrical indicating instruments shall comply generally with the requirements of IS:1248 and shall be of the accuracy class specified.

Instruments mounted on panels, shall be of the semi flush type back connected, matching pattern, shape, and of approved finish to present neat and fitting appearance consistent with functional requirements.

All instruments and meters except energy meter shall be of 96 x96 sq.mm. in size and energy meter shall be of standard size. Energy meter shall be suitable for 3-phase, 4-wire unbalanced system and shall comply generally with the requirements of IS:722 and shall be of first grade for the purpose of accuracy classification.

The dials, pointer etc., shall be designed to facilitate accurate reading by minimizing parallax and glare from instrument window and by providing clear bold dial markings. The size of dial and length of the scales of the indicating instruments shall be large enough to suit the requirements. The scale plates of panel mounted indicating instruments shall have a permanent white mat finish with black graduations and the pointer shall also be of the black colour. Instruments mounted on panels shall be of flush type and shall be back connected. All instruments on a switchgear panel shall be of matching pattern, shape and finish so as to present a pleasing appearance consistent with the functional requirements. The finish of the instrument cases shall be subject to the approval of Purchaser.

All instruments shall be designed for accurate measurement of the quantity or state, under all conditions of operation and any error due to change in the ambient temperature over the entire range of temperature obtainable at site shall be kept to a minimum. The range shall generally be such that the normal operating values are indicated in the middle third of the scale.

The VA burden of instrument coils/elements shall be as low as possible, consistent with the best modern design.

The construction of instruments shall be mechanically sound and shall ensure accuracy in the performance. All instruments shall be tested in accordance with the requirements of relevant standards.

Mechanical quantity measuring instruments which are directly mounted on equipment shall have circular dials and shall be properly supported and guarded against accidental injury/breakage. These shall be placed in convenient locations.

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The instruments shall accurately measure and indicate the quantity under all conditions of operation with minimum instrument errors. Changes in ambient temperature within the range prevailing at site shall not affect the accuracy.

The reading scales on the dials shall be in metric units only and range shall be such that the normal operating values of the quantities are indicated in the middle 3rd of the scale.

Contact making instruments shall have contacts suitable for 240 V AC or 220 V DC circuits.

All instruments shall conform to relevant International or national applicable standards. These shall be subjected to tests prior to dispatch. The instruments shall be shock, vibration and moisture proof. The electrical instruments shall withstand dielectric test of 2000 V RMS to ground for one (1) minute as per standards.

The coils of electrical instruments shall be designed for continuous operation at 110% of the full load current at instrument potential. The coil rating of the measuring instruments shall be coordinated with those of the associated instrument transformers (i.e. CTs, PTs, etc.) by the Contractor. The VA burden of the instruments shall be as low as possible. The meters shall be of the first grade in respect of accuracy classification.

5.5 TERMINAL BLOCKS

Terminal block shall be made of suitable moulded plastic material with bases and integral barriers and shall be provided with brass stud inserts for terminals for incoming/outgoing wiring. Provision shall be made on each pillar for holding 20% extra connections. All terminal blocks shall be shrouded by easily removable shrouds moulded from transparent dielectric material. The terminal block shall be of disconnecting type and suitable for 660 volts service.

Sufficient space for receiving the control cables at bottom of the switchboard cubicles and mounting arrangements for the terminal glands shall be provided.

Terminal block compartments shall be separated from the equipment by oil proof/oil vapour proof barriers and seals, where necessary.

Each terminal block shall be one piece moulded, barrier type, 1.1 kV grade, complete with washers, heads, studs with two nuts and identification strips of an approved quality and shall have adequate continuous current rating. Each terminal shall have only one wire terminated on it. For tap offs, adjacent terminals with shorting strips shall be used. At least 20% spare terminal blocks shall be marked and numbered by the Contractor to show wiring designations. Wire identification on marking strips shall correspond to the designations on the wiring diagram. All terminal blocks shall be climate proof as per requirement of IS 3202-1965 or any authoritative International Standards.

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All wire terminals on the equipment shall also be marked with designations corresponding to those of the wiring diagrams.

The wire terminals shall have engraved or otherwise indelibly marked ferrules for easy identification and the wires shall preferably be colour coded. Wires shall be provided with numbered ferrules at both ends and drawings shall bear the same numbers. All auxiliary contacts whether spare or otherwise shall be wired and brought out to the terminal blocks. Provision shall be made to ground the P.T. and C.T. neutral terminals, where required.

Terminal blocks shall be of 650 volts grade rated for 10 Amps and in one piece moulding. It shall be complete with insulating barriers, clip-on-type terminals for Control Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring diagrams.

Terminal blocks for CT and VT secondary leads shall be provided with test links and isolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities.

All terminal blocks shall be suitable for terminating on each side, two (2) nos. of 2.5 mm square size stranded copper conductors.

All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

Terminals blocks shall be arranged with at least 100 mm clearance between two sets of terminal block. The minimum clearance between the first row of terminal blocks and the associated cable gland plate shall be 250mm.

Self aligning, spring loaded, silver plated, sliding contacts of proven design shall be provided as control terminals for withdrawable/drawout modules. Detachable plug and socket type control terminals shall also be acceptable.

5.6 EARTH BUS, EARTHING & EARTHING TERMINALS

Earthing terminals for equipment of these specifications shall form part of equipment supplies. The Contractor shall connect the earthing conductors to these terminals as required.

A galvanized steel /Tinned Copper earthing bus shall be provided at the bottom of each panel and shall extend throughout the length of each distribution board. It shall be bolted to the frame work of each panel and breaker earthing contact point, vertical earth bus shall be provided in each vertical section which shall in turn be bolted to main horizontal ground bus.

The earth bus shall have sufficient cross-section but not less than size 25x6 mm thick to carry the momentary short circuit and short time fault currents to earth without exceeding the allowable temperature rise. However the

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calculations for arriving at the size of the earth bus shall be furnished with the bid.

Suitable arrangements shall be provided at each end of the horizontal earth bus for bolting to purchaser's earthing conductors. All joints to earth bus shall be made through at least two bolts.

All non-current carrying metal work of the distribution board shall be effectively bonded to the earth bus. Electrical conductivity of the whole distribution enclosures frame work and the truck shall be maintained even after painting.

The truck and air circuit breaker frame shall get earthed while the truck is being inserted in the panels and positive earthing of the truck and breaker frame shall be maintained in all positions i.e. SERVICE & ISOLATED, as well as throughout the intermediate travel. All hinged doors shall be earthed through flexible earthing braid.

Each module frame shall get engaged to the vertical earth bus, before the disconnecting contacts on the module are engaged to the vertical bus bar.

All metallic cases of relays, instruments and other panel mounted equipments shall be connected to earth bus by independent stranded tinned copper wires of size not less than 2.5sq.mm. Insulation colour code of earthing wires shall be green. Earthing wires shall be connected to terminals with suitable clamp connectors and soldering is not acceptable. Looping of earth connection which would result in loss of earth connection to other devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

VT and CT secondary neutral point earthing shall be at one place only i.e. on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

"Caution" name plate and "Caution-Live Terminals" shall be provided at all points where the terminals are likely to remain live and isolation is possible only at remote end.

5.7 RATING PLATES, NAME PLATES AND LABELS

All switchgears, AC Distribution Boards, shall be provided with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

All name plates shall be of non rusting metal or 3-ply lamicoid with white engraved lettering on black back-ground, inscriptions and lettering sizes shall be subject to purchaser approval.

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Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so as to be clearly visible and shall give the device number, as mentioned in the module wiring drawings.

A rating plate of non-corrodible material shall be attached to each major and auxiliary item of equipment supplied. This plate shall be permanently engraved with the designed full load ratings, serial number, type, number, date of manufacture, and other identification deemed necessary. Wherever necessary, diagram plates shall also be supplied.

A nameplate shall be provided to identify the service of all items of plant supplied. The identifying inscription shall be approved by the purchaser. Devices shall be identified by nameplates on both front and rear of all desks, panels, cubicles etc.

Nameplates or labels shall be manufactured of non-hygroscopic materials with engraving of a contrasting colour or alternatively for indoor use, of transparent plastic material with lettering engraved on the back and filled with suitable colour. The materials used shall be non-fading, non-aging and suitable for tropical conditions.

Where the item of plant may be subject to handling, the nameplate shall be chrome plated brass 3mm thick with the engraved lettering filled with enamel.

6.0 TROPICAL TREATMENT

All equipment shall be suitably designed and treated for normal life and satisfactory operation under the climatic conditions prevalent at site and shall be dust and vermin proof. All parts and surfaces which are subject to corrosion shall be made of such material that would protect the equipment from any injurious effects such as excessive humidity. All electrical auxiliary equipment shall be specifically treated for tropical conditions and the materials and methods of treatment shall be got approved in advance.

7.0 COATINGS/PAINTINGS

The Bidders shall furnish in their bids details of the painting system and procedure that they propose to adopt for surfaces of components of equipment covered under these specifications, subject to varying operating conditions covering:

- Surface of components under flowing water pressure containing considerable quantity of silt.
- Surface of components under lubrication and hydraulic oil.
- Surface of components embedded in concrete.

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- Surface exposed to atmosphere.
- Various electrical panels.

The details shall cover surface preparation techniques, type of paint, method of paint application, number of primer coats, number of finishing coats, thickness of coatings both primer & finish, colour, standards, work in shop, and at site on erection.

The above information shall be given in a tabular form for brevity and quick reference.

8.0 GALVANIZING

All materials to be galvanized shall be of the full dimensions shown or specified and all punching, cutting, drilling, screw tapping and the removal of burrs shall be completed before the galvanizing process commences. All galvanizing shall be done by the hot dip process with smelter, not less than ninety eight percent (98%) of which must be pure zinc. No alternative process may be used without the approval of the purchaser. No components shall be galvanized which are likely to come into subsequent contact with oil. Bolts shall be completely galvanized including the threads, but the threads shall be left uncoated in the case of nuts. The zinc coating shall be uniform, clean, smooth and as free from spangle as possible. In the case of component parts the zinc coating shall weigh not less than 0.6 kg/m² over the area covered and be not less than 0.09mm in thickness. All galvanizing shall comply with the requirements of the relevant ASTM standards/Indian Standards. All galvanized parts shall be protected from injury to the zinc coating due to differential aeration and abrasion during the period of transit, storage and erection. Damaged areas of the coating shall be touched up with an approved zinc dust paint or other approved flake metallic compound.

9.0 RUST PREVENTION AND PROTECTION FOR TRANSIT

Bright steel parts shall be given a thick coat of tar or tallow or any other approved rust resisting paint in plain colour to prevent rusting during shipment and transport.

10.0 GENERAL TECHNICAL REQUIREMENTS

10.1 INTER CHANGEABILITY

All corresponding parts of similar equipment of the generating units and other plant and equipment shall be interchangeable with one another. The Bidders shall confirm the same in their Bids.

10.2 TECHNICAL DEVIATIONS

The Bidder shall make his offer in consonance with the specified requirements. In case the bidder wishes to depart from specifications in certain respects without affecting the basic functional requirements or stipulations he shall

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submit a complete and itemized list of such deviations/departures together with full particulars of the reasons for the departures, in a separate schedule with reference to sections and paragraph numbers of the bid specifications. The deviations shall be considered valid only in case the same have been accepted by the purchaser formally. In the absence of such acceptance the plant offered shall be deemed to comply in every respect with these specifications.

The Bidder, however, is free to offer special devices or equipment with a view to increase the performance/efficiency and life of the plant and to minimize the initial cost or maintenance cost of the plant as a whole.

10.3 FOUNDATIONS AND FIXTURES

Civil foundations for equipment of the generating units and other plant and equipment will be prepared by the Purchaser in accordance with the basic design data to be supplied by the Contractor.

All fixtures necessary for erection of embedded parts and equipment foundations etc. shall be the responsibility of the Contractor and supplied accordingly.

10.4 ELECTRICITY RULES

All design and works pertaining to the supplies and installations shall conform to the various rules in force under the Electricity Act/Rules and other legislation/regulations applicable at the place of the site.

10.5 BALANCING

All revolving parts of the equipment shall have proper alignment and statically balanced at the Contractor's works. Any out of balance that may occur upon erection at site shall be rectified by the contractor at his cost. The tenderer shall indicate whether rotating parts will be balanced both statically and dynamically at the Contractors works.

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10.6 NOISE AND VIBRATIONS

All equipment shall be designed to work quietly and smoothly without undue noise and vibrations. The bidders shall indicate the measures so provided in the designs in this regard.

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11.0 TRAINING

The supplier to give normal training for 3 three days to the customer's executives / BHEL Executives (max. 6 executives) at supplier's works/office during inspection and testing. For this no extra charges will be paid to supplier by purchaser. The supplier to agree the same.

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