

NTPC LTD
DCDB PANELS
RAMMAM HEP(3X40MW)

TECHNICAL SPECIFICATION FOR
LOW VOLTAGE SWITCHGEAR

BHEL DOCUMENT NO. : EPD-TS-CPBG-J049, REV-00



BHARAT HEAVY ELECTRICALS LIMITED
ELECTRIC & PHOTOVOLTAIC DIVISION
BANGALORE – 560012



**RAMMAM HEP (3X40MW)
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DATE: 22/04/2019

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1. INSTRUCTIONS TO BIDDERS FOR PREPARING TECHNICAL OFFERS

1. Two signed and stamped copies of the following shall be furnished by all bidders as technical offer:
 - a) Un-priced copy of Annexure-A, B, C, D, E duly stamped and signed by the bidder.
 - b) Complete dimension of all the boards including no. of panels, dimensions of each type of panels, module size of each type of feeders and minimum clearances required on all sides for each type of panels.
 - c) No. of Vertical consider by vendor for each boards are to be compulsory given along with offer.
 - d) A copy of the sheet "Instructions to Bidders for Preparing Technical Offer" duly stamped and signed by the bidder.
 - e) A copy of sheet "List of Contents" duly stamped and signed by the bidder.
 - f) Technical deviation/ clarification in BHEL Format, if any.
 - g) No. Of Breaker panels, No. of MCC panels, Weight & Dimensions of all boards.
2. Confirmations/ comments (if any) regarding delivery schedules shall be furnished as part of the commercial offer. Any reference elsewhere/ covering letter of technical offer shall not be considered by BHEL.
3. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
4. Any changes made by the bidder in the price schedule with respect to the Item description/ quantities, notes etc. from those given in various annexures of specification shall not be considered (i.e., technical description, quantities, notes etc. as per specification shall prevail).
5. Bidders to quote for all items/sub items even if those are not in their manufacturing range.
6. No raw material/Component/Sub Assembly/Assembly/Equipment shall be sourced from China directly or indirectly for manufacture or supply.
7. In case of any ambiguity in specification between various sections and end customer specification vendor should clearly brought out in technical deviations failing in which BHEL will have choice to prefer which ever it suits at later stage for which vendor should accept.
8. Vendor should bring out technical deviation clearly in deviation sheet if any.

BIDDER'S STAMP & SIGNATURE



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2. SCOPE OF ENQUIRY

1. This specification covers the design, manufacture, relay parameterization and site support, supply of networking hardware, site modification(if any), inspection and testing at manufacturer's works, proper packing and delivery to site of LOW VOLTAGE SWITCHGEAR as mentioned in different sections of this specification for RAMMAM HEP (3X40MW) Project .
2. It is not the intent to specify herein all the details of design & manufacture. However, the equipment shall conform in all respects to high standards of design engineering and workmanship and shall be capable of performing in continuous commercial operation up to vendor's guarantee.
3. The general terms and conditions, instruction to tenderer and other attachment referred to elsewhere are hereby made part of the tender specification.
4. The tendered shall be responsible for and governed by all requirements stipulated hereinafter.
5. Deviations, if any should be brought out very clearly on deviation sheet enclosed with specification only. Otherwise it will be presumed that the tenderer's offer is in line with what has been stated/ asked for in this specification.
6. The offer should be complete with technical data, catalogues, brochures and drawings as applicable.
7. Qualification data: In order to be able to propose to the client the proven-ness of the equipments/ item offered, the bidder is required to elaborate details of experience, capabilities, reference list etc. in the offer.
8. The documents shall be in English language and MKS system of units.

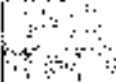
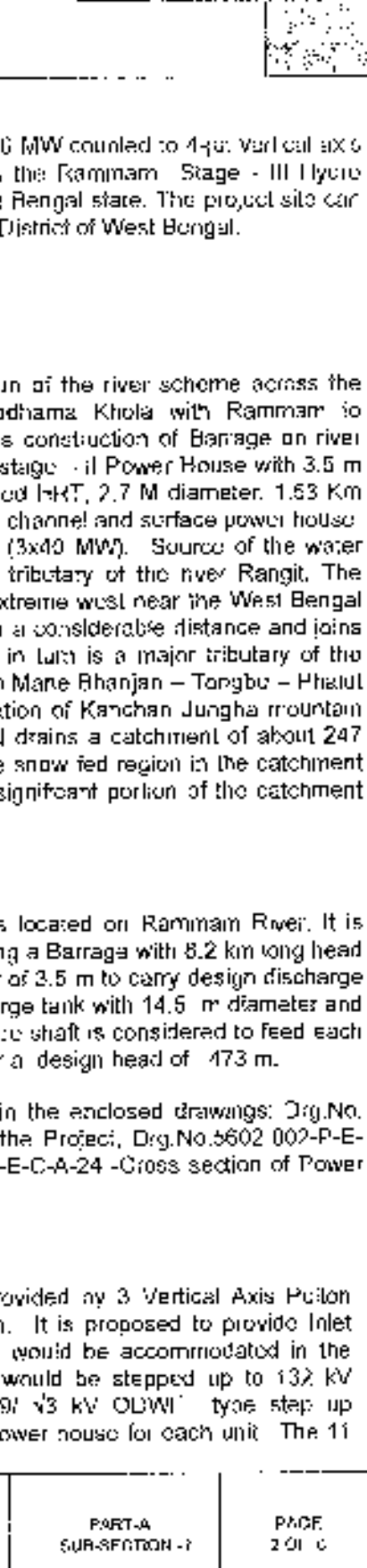


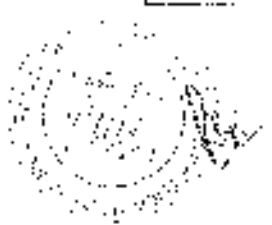
**RAMMAM HEP (3X40MW)
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3. PROJECT INFORMATION

CLAUSE NO.	PROJECT INFORMATION						
1.00.00	BACKGROUND 3 Nos. of vertical shaft, generating units each of 40 MW coupled to 4-pole Vertical axis Pelton Turbines, are required to be installed in the Ramnam Stage - III Hydro Electric Project located in Darjeeling Dist. of West Bengal state. The project site can be accessed from Siliguri via Ghoom in Darjeeling District of West Bengal.						
2.00.00	GENERAL FEATURES OF THE PROJECT						
2.01.00	General Ramnam Stage-III Hydro Electric Project is a run of the river scheme across the Ramnam river between the confluence of Lodhama Khola with Ramnam to Ramnam with river Rangit. The scheme involves construction of Barrage on river Ramnam approximately 240 m D/s of Ramnam stage - II Power House with 3.5 m finished diameter, 8.2 Km. long horse shoe shaped HRT, 2.7 M diameter, 1.53 Km long pressure shaft/penstock, 740 m long tailrace channel and surface power house. The installed capacity of the project is 120 MW (3x40 MW). Source of the water supply is Ramnam river which is an important tributary of the river Rangit. The Ramnam river originates in glacial area to the extreme west near the West Bengal and Nepal border, flows in a easterly direction for a considerable distance and joins the Rangit river near Naya Bazar. River Rangit in turn is a major tributary of the Teesta River. The Ramnam river originates from Mane Bhanjan - Tongbu - Phalut ridge of the lower Himalayas which are continuation of Kanchan Jungtha mountain ranges, at an elevation of about EL 3631 M and drains a catchment of about 247 KM ² up to the Barrage site. There is considerable snow fed region in the catchment area of Ramnam River in its upper reaches. A significant portion of the catchment area is covered with dense forest.						
2.02.00	Hydraulic and Civil features The Ramnam Stage-III Hydro Electric project is located on Ramnam River. It is developed as a run of river scheme by constructing a Barrage with 8.2 km long head race tunnel of horse shoe type having a diameter of 3.5 m to carry design discharge of 26 m ³ /s, one number restricted orifice type surge tank with 14.5 m diameter and 52.5 m height. One no. of 2.7 M diameter pressure shaft is considered to feed each unit turbine of 40 MW capacity that operate under a design head of 173 m. The general layout of the scheme is indicated in the enclosed drawings: Drg.No. 5602-002 P-E-C-A-01-Geographical Location of the Project, Drg.No.5602-002-P-E-C-A-09 -General Project Layout and 5602-002-P-E-C-A-24 -Cross section of Power House through Water Conductor System.						
3.00.00	SYSTEM DETAILS						
3.01.00	The installed capacity of 120 MW would be provided by 3 Vertical Axis Pelton turbines driven generating units of 40 MW each. It is proposed to provide Inlet Valve of spherical type for each turbine, which would be accommodated in the powerhouse. The generation voltage of 11 kV would be stepped up to 132 kV through three single phase 11/ 139/ $\sqrt{3}$ kV ODWT type step up transformers located near upstream wall of the power house for each unit. The 11						
RAMNAM STAGE-III HYDRO ELECTRIC PROJECT (3 x 40 MW) LLC (RO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO.: CS-5602-003-0					TECHNICAL SPECIFICATION SECTION - VI	PART-A SUB-SECTION - 1	PAGE 2 OF 6



CLAUSe NO.	PROJECT INFORMATION																							
3.02.00	kV isolated phase bus ducts would connect the 11 kV generator terminals with 11 kV bushings of step up transformers. The 132 kV terminal of the transformers would be connected with 132 kV switchyard through 132 kV XLPE Cables. Power from the project will be evacuated through three Nos. 132 kV lines to be laid by WDSLD. The power supply for unit auxiliaries is proposed to be obtained from three dry type 500KVA, 3 Phase, 11/0.433KV Unit Auxiliary Transformers. Auxiliary power for station services would be supplied from 11 kV and would be step down through 2 Nos. of 1600 KVA, 11/0.433 kV step down dry type Station Service Transformers. For emergency supply, 2 Nos. of 750 KVA, 11 KV DG sets would also be installed which would be connected to Station Auxiliary Board. The Overall Electrical Single Line Diagram is shown in the enclosed drawing. Drg.No. 5502-003-P E-L A-101 "SLD for Overall Electrical System".																							
3.03.00	E.O.T. Crane One no. E.O.T. Crane of 125/25/5 T capacity with main and auxiliary hooks are proposed to be installed in the power house for handling assembly and erection of generating units & associated equipment. The clearances, limits for hook approach and other dimensions of the crane shall be suitable for the proposed layout of the power station. One no EOT crane of 50/10/5T will be provided in the Valve House building for erection and handling of Butterfly valve.																							
4.00.00	CLIMATIC CONDITIONS The project lies between El 910m to 375 m. The area has moderate climatic conditions with no snow fall in the project area. Rainfall in the Project area is from June to August and in December, January. The Power House service bay floor is located at LL 412 m & the centre line of turbine runner has been set at El 400 m. The climatic conditions are given below:- <table><tr><td>i)</td><td>Maximum temperature in the project area</td><td>:</td><td>36 °C</td></tr><tr><td>ii)</td><td>Minimum temperature in the project area</td><td>:</td><td>3 °C</td></tr><tr><td>iii)</td><td>Maximum Relative humidity</td><td>:</td><td><95 %</td></tr><tr><td>iv)</td><td>Minimum Relative humidity</td><td>:</td><td>>35 %</td></tr><tr><td>v)</td><td>Average annual rainfall</td><td>:</td><td>2800 mm</td></tr></table>				i)	Maximum temperature in the project area	:	36 °C	ii)	Minimum temperature in the project area	:	3 °C	iii)	Maximum Relative humidity	:	<95 %	iv)	Minimum Relative humidity	:	>35 %	v)	Average annual rainfall	:	2800 mm
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iv)	Minimum Relative humidity	:	>35 %																					
v)	Average annual rainfall	:	2800 mm																					
5.00.00	SEISMIC FORCES The Ramam stage-II hydroelectric project is located at the margin of Zone-IV and Zone-V of the seismic zoning map of India. The equipment shall be designed to withstand seismic forces																							
RAMAM STAGE-II HYDRO-ELECTRIC PROJECT (3 x 40 MW) ELECTRO-MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO.:GS-6602-003-3		TECHNICAL SPECIFICATION SECTION -VI	PART-A SUB-SECTION -I	PAGE 3 OF 6																				

PROJECT INFORMATION

6.00.05

PETROGRAPHIC REPORT OF RIVER SEDIMENT

6.01.03

Grain size analysis of soil sample for Ramman Stage III project is given below:

Grain Size Analysis in Wt %

Clay %	Silt %	V.F. Sand %	F. Sand %	M. Sand %	Coarse Sand %	Total
(-)1.95 micron	(-)65.61 micron	(-)0.125 mm	(-)0.25 mm	(-)0.5 mm	(+)5mm	
0.20	6.0	60.34	25.23	4.98	1.25	100

6.02.00

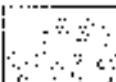
Petrographic Report on the Sedimentsa) Megascopic Observation

The samples are loose sediments and are brownish grey in colour. The samples range in size from coarse sand to very fine sand. The sand fraction is composed dominantly of mica flakes, quartz, feldspar and organic matter including wooden fragments.

b) Microscopic Examination

The mineral assemblages and organic matter with their relative volume percentages (as per visual estimate) of different size of sand fractions are furnished below.

Size fraction	Mineral Assemblages (with relative abundance based on visual estimate)
+ 500µm (Coarse Sand)	Quartz 40%, Biotite 30%, Muscovite 10%, Feldspar 10%, Lithic fragment (quartzite) 10%, Organic matter (with cellulose structure, low) and clay concretion (few)
+ 250µm (Medium Sand)	Biotite 40%, Quartz 20%, Feldspar 20%, Muscovite 10%, Garnet (5%) and Chlorite-Sillimanite – Lithic fragment (Granite, Quartz-Chlorite Schist) – Clay concretions Amorphous carbonate-iron concretions (5%) Organic matter (with cellulose structure, low)
+ 125µm (Fine Sand)	Biotite 70%, Muscovite 20% and Quartz- Feldspar-Garnet (10%)
+ 0.063mm (Very Fine Sand)	Quartz 60%, Biotite 20%, Feldspar 10%, Muscovite 5% and Amphibole-Chlorite (<5%)
Roundness	Both quartz and feldspar grains are generally sub rounded. But in coarse sand (+500 µm) the feldspar grains are subangular.

CLAUSE NO.	PROJECT INFORMATION		
	The Lithic fragments are well rounded.		
	Sphericity	Quartz grain show moderate to high sphericity but feldspar grains are of moderate sphericity only. The Lithic fragments show high sphericity.	
7.00.00	TRANSPORTATION		
7.01.00	Location and Access		
	The proposed Raimnam Stage-III is located on the Raimnam River in the state of West Bengal. The Raimnam River forms the boundary with West Bengal and Sikkim. The diversion structure is just downstream at the confluence of Raimnam with Lodhama Khola and the power house is near Baraotia village on right bank of the Raimnam River. The project lies between Latitude 27°-6'-00"N to 27°-9'-00"N and Longitude 85°-5'-00"E to 86°-14'-00"E. The project can be accessed from Siliguri via Ghoom in Darjeeling District of West Bengal or from Jorhang in Sikkim by road. Bagdogra is the nearest airport and New Jalpaiguri is the nearest broad gauge railway station. The proposed project site is connected by all weather metalled road from Siliguri, the main city near by and connected to all parts of the country. The proposed project site can be accessed through the following approach roads from Siliguri: a) Approach roads to Barrage site; i) Via Siliguri – Manobhanjan – Lodhama (about 140 Km) ii) Via Siliguri – Kurseong – Bjanban – Lodhama (about 130 Km). b) Approach road to Power House site: i) Via Siliguri – Melli – Jorhang (Naya bazaar) (about 120 km) To have accessibility to various components of the project within the project area, a road network has been proposed with a single lane width as per BRO specifications.		
7.02.00	Transport Limitations		
	The weights and dimension of the packages for transportation to site shall be limited to the following:- a) Max. Weight of the package not to exceed 50 t. F. b) Max. Size of the package not to exceed L = 8500 mm, W= 3000 mm, and H = 8000 mm. The above information is tentative and it is the contractor's responsibility to verify the actual transport limitation.		
RAIMNAM STAGE-III HYDRO ELECTRIC PROJECT (3 x 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC. NO. CS-5502-003-6		TECHNICAL SPECIFICATION SECTION - VI	PART-A SUB-SECTION - I PAGE 5 OF 6



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4. LT SWITCHGEAR TECHNICAL SPECIFICATION

 BHOPAL	TITLE:- PURCHASE SPECIFICATION (TECHNICAL) FOR 220V DC DISTRIBUTION BOARD	DOC. NO. HPE/RMM/PS/09	REV 00
	HYDRO PROJECTS ENGINEERING DIVISION	PAGE:- 2 OF 15	

1.0 SCOPE:

This specification covers design, manufacturing, assembly, shop testing, packing, delivery to site, supervision of erection, site testing & commissioning of **220V DC DISTRIBUTION BOARDS** in line with flowing documents

- Scope of supply (Annexure-C)
- List of Mandatory Spares (Annexure-E1)
- Single Line Diagrams (Drg No 5602-003-H209-PVE-B-002 R03, 5602-003-H209-PVE-B-003 R03, 5602-003-H209-PVE-B-004 R03)

Major Components under scope of supply shall be as follows:

Sl. No.	Description	Qty
For Power House		
1.	220V DC Main Distribution Board for Power house complete as per Single line Diagram & technical specification	1 Set
2.	220V DC Main Distribution Board for Barrage Area complete as per Single line Diagram & technical specification	1 Set
3.	220V DC Main Distribution Board for BF valve house complete as per Single line Diagram & technical specification	1 Set
4.	Mandatory Spares, (As per specification HPE/RMM/PS/07), Annexure-E)	1 Lot

This Clause specifies the principal equipment and components to be supplied and work to be done by the supplier. However the supplier is bound to provide complete work, even if the equipment or work to be done is not mentioned specifically in this Section.

2.0 REFERENCE STANDARDS:

The equipments shall comply to the following latest reference standards unless otherwise specified in following sections.

Standrad	Title
IEC62271-200	AC metal enclosed switchgear & control gear for rated voltages above 1KV and up to and including 52KV.
IEC 60376	Specification for technical grade SF6 for use in electrical equipments
IS 13118	High voltage alternating current Circuit breakers
IS 8623	Specification for low-voltage Switchgear & Control gear
IS 3156	Voltage transformers
IS 2705	Current transformers
IS 9921	AC disconnectors (Isolators) and earthing switches for voltages above 1000V
IS 3427	AC metal enclosed Switchgear & Control gear for rated voltages
IEC 60298	Above 1 kV and up to and including 52 kV
IS 5	Colour for ready mixed paints & enamels.
IS 1248	Direct acting Indicating analogue electrical Measuring Instruments and their accessories
IS 722	AC Energy meters
IS 13010	AC Watt-hour meters
IS 3231	Electrical Relays for power system protection

 BHOPAL	TITLE:- PURCHASE SPECIFICATION (TECHNICAL) FOR 220V DC DISTRIBUTION BOARD	DOC. NO. HPE/RMM/PS/09	REV 00
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IS 8686	Static protective relays		
IS 4794	Push button/ switches		
IS 2099	Bushings for AC voltages above 1000 V		
IS 6005	Code of practice of phosphate of iron and steel.		
IS 5082	Wrought Aluminium and Aluminium alloy bars, rods, tubes and sections for Electrical purposes.		
IS 2633	Methods for testing uniformly of coating of zinc coated articles.		
IS 13703	Low voltage fuses for voltages not exceeding 1000 V or 1500V DC		
IS 8828	Electrical accessories : Circuit Breakers for over current protection for household and similar installations.		
IS 13947	Low voltage switchgear & control gear		
IS 1554	PVC insulated (Heavy Duty) Electric cables for working voltage upto and including 1100V.		
IS 5578	Guide for marking of insulated conductors.		
IS 11353	Guide for uniform system of marking & identification of conductors and apparatus terminals.		
IEC 60694	Common specifications for high voltage switchgear and control gear standards		
IEC 62271-100	High voltage alternating current circuit breakers		
	Current transformers		
IEC 60044-1			
IEC 60044-2	Voltage transformers		
IEC 60529	Degree of protection provided by enclosure (IP code)		
IEC 61850	Communicable Numerical relays		
IS 513(2008)	Cold rolled low carbon steel sheets and strips		

3.0 DESIGN AND OPERATIONAL REQUIREMENTS OF THE SYSTEM:

The 220V DC Distribution Boards shall be intended to supply D.C. power to various control, protection and indicating equipment as well as to the emergency lighting of the building as per SLDs.

The D.C. distribution boards comprise of 220V Busbar system divided into two sections by a coupling circuit breaker, moulded case circuit breakers for incoming supply and no. of outgoing MCCB/MCB feeders. Single Line Diagrams for 220C D.C. System (Comprising of batteries, battery charging equipment and DC Distribution Boards) is enclosed with this specification. The no. of feeders and their ranges are shown in the drawing. There may be some changes in final rating and quantity of feeders during detail engineering. Vendor has to accept the same without any extra price implication.

Description	220V DCDB Power House	220V DCDB BF Valve House	220V DCDB Barrage Area
Type	Free standing on floor, Compartmentalized, Single front		
Busbar rated current	500 A		
Rated short time withstand current	20 kA		
Power frequency withstand voltage (1 min)	2500 V		
Protection degree of cubicles	IP 52 or better		
Sheet Thickness	2.0 mm Thick Rolled steel sheet.		

 BHOPAL	TITLE:- PURCHASE SPECIFICATION (TECHNICAL) FOR 220V DC DISTRIBUTION BOARD	DOC. NO. HPE/RMM/PS/09	REV 00
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A. Design and Construction:

All DC distribution boards (DBs) etc shall have following features:

- i) Shall be of metal enclosed, indoor, floor mounted and free standing type.
- ii) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of 2mm thickness.
- iii) Frame shall be enclosed in cold rolled sheet steel of 1.6mm thickness. Doors and covers shall also be of cold rolled sheet steel of thickness 1.6 mm. Stiffeners shall be provided wherever necessary. Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non-magnetic material) shall be provided for all panels.
- iv) All panel edges and cover/door edges shall be reinforced against distortion by rolling, bending or by the addition of welded reinforcement member.
- v) The complete structures shall be rigid, self-supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.
- vi) The equipment shall be installed indoor in a clean but hot humid and tropical atmosphere.
- vii) All switchboards/panels shall be of dust and vermin proof. All cut-outs shall have synthetic rubber gaskets.
- viii) Distribution Boards shall be easily extendable on both sides, by the addition of the vertical sections after removing the end covers.
- ix) Sheet steel barriers shall be provided between two adjacent vertical parts 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.
- x) 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 draw-able 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.
- xi) All outgoing feeders shall be provided with MCCB (moulded case circuit breakers).
- xii) For continuous operation at specified ratings, temperature rise of the various components of D.C. distribution boards shall be limited to the permissible values stipulated in the relevant standards and/or this specification.
- xiii) The equipment shall be designed to give satisfactory performance for all operational conditions including sudden variations of load and voltages including those, due to short circuits
- xiv) All DB s shall have following distinct sections.
 - a. Completely enclosed bus bar compartment for horizontal and vertical bus bars.

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- b. Completely enclosed switchgear compartments (one for each circuit housing circuit breakers, motor starter or MCCB feeder.
 - c. Adequately sized cable alley for power and control cables. In case cable alleys are not provided for DBs, segregated cable boxes with complete shrouding for individual feeders shall be provided at the rear for direct termination of cables in each individual feeder.
 - d. For cable connection to circuit breaker, a separately enclosed cable compartment shall also be acceptable.
 - e. Compartment for relays and other control devices associated with a circuit breaker, wherever necessary.
 - f. The DBs of 1600A and above rating shall be of DOP IP42 and IP52 for less than 1600A rating.
 - g. All DC distribution boards etc. shall be painted by powder coating process paint shall for complete panels excluding end covers shall be RAL 9002 and RAL 5012 for extreme end covers of all boards.
 - h. All draw-out modules shall have distinct service, test & isolated positions. Power contacts shall be disconnected in both test & isolated positions whereas the control contacts shall get disconnected in isolated position only.
- xv) Bus bars shall be of high conductivity copper alloy.
- xvi) Minimum air clearance in air between phases and phase-earth shall be 25 mm for busbars and cable terminations. For all other components, the Clearances shall be at least 10 mm. wherever, above is not possible except for horizontal and vertical busbars, insulation shall be provided by anti-tracking sleeving or barriers. However for horizontal and vertical busbars, clearances specified above shall be maintained even when busbars are insulated/sleeved.
- xvii) Busbar insulators shall be of track-resistant high strength non-hygro-sopic, 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 accepted.
- xviii) 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.
- xix) The supplier shall furnish calculations (consisting of current carrying capacity, temp. rise, support requirements and dynamic forces withstand capacity during short ckt. etc.) along with the offer, establishing the adequacy of bus bar size for specified current ratings for approval. Margin shall be kept at least 1.2 times for theoretical calculations above normal calculation criteria specified.

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- xx) 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.
- xxi) All types of relays and timer shall be subject to the BHEL/NTPC approval. They shall be flush mounted with connections from inside, and shall have transparent & dust tight cover, removable from front, draw-out construction for easy replacement and testing facility. The auxiliary relays and timer may be provided in fixed cases.
- xxii) The switchgears shall be designed to offer adequate level of safety to operating/maintenance personnel. Means shall be provided to prevent access to the live part to avoid accidents during service as well as maintenance period. Supplier shall bring out the safety means provided to achieve above. A detailed instruction plate suitable for wall mounting shall be provided for each switchgear room describing various safe operating procedure/safety precautions for safe operation and maintenance of switchgear.
- xxiii) All current and voltage transformers as required for metering and protection specified shall be completely encapsulated, cast resin insulated type. Incomers from transformers shall have CTs for transformers restricted earth fault protection. The accuracy shall be as below :

	CT'S	VT'S
Protection	5P20	3P
Metering	1.0	0.5

- xxiv) Indicative Lamps shall be cluster LED type. All overload relays shall have overload reset push button.
- xxv) 20% spare feeders of each type & rating used in the switchgear with a minimum one (1) number on each bus section shall be provided.
- xxvi) Suitable arrangement for power cable termination shall be provided, as required, for switchgear panels and shall be suitable for cable entry from the bottom. The bottom cable entry shall be fitted with removable gland plates of adequate size for fixing the cable glands. However, purchaser reserves the right to alter the cable entries, if required, during detailed engineering without any additional commercial implication.

Switchgear panels for the incomer and all outgoing feeder panels shall be suitable for terminating XLPE/PVC cables. Panels shall have adequate space inside, to accommodate the heat shrinkable type cable terminations. Each power cable shall be terminated independently.

B. Interlocking Scheme:

For the satisfactory operation of 2 sections of the DCDBs, the supplier should provide the necessary safety interlocks and operational interlocks for automatic shifting of loads of one section to the other section in case of failure of D.C. supply from one section. In

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case of tripping of incomer of any of the section, the bus coupler shall close automatically and extend supply from the other battery system. Interlocking scheme shall be finalized and approved during detail engineering.

C. Other Criteria:

- i) Breakers shall have inherent fault making and breaking capacities. They shall have shunt trip coils. In case releases are offered, the same shall have contact for energisation of lockout relay. All breakers shall have built in interlocks for equipment and personnel safety.
- ii) Paralleling of two supplies shall be avoided by interlocking except for switchgear where auto-changeover is provided. Breaker contact multiplication if required shall be through latch relays.
- iii) Mechanical tripping shall be through red 'Trip' push button outside the panels for breakers, and through switches for other circuits.
- iv) Provision of mechanical closing of breaker only in 'Test' and 'Withdrawn' position shall be made. Alternatively, mechanical closing facility should be normally inaccessible, accessibility rendered only after deliberate removal of shrouds. It shall be possible to close the door with breaker in test position.
- v) Clear status indication for each circuit shall be provided through lamps, switch positions or other mechanical means.
- vi) The 250A & above MCCB feeders (up to 630A) shall be provided with Microprocessor based inbuilt front adjustable releases(overload & short circuit) and shall have adjustable earth fault protection unit also . MCCB shall have current limiting feature. ON and OFF position of the operating handle of MCCB shall be displayed and the rotary operating handle shall be mounted on the door of the compartment housing MCCB. The compartment door shall be interlocked mechanically with the MCCB, such that the door cannot be opened unless the MCCB is in OFF position. MCCB shall be provided with padlocking facility to enable the operating mechanism to be padlocked.
- vii) Local push button stations shall have metal enclosure of die cast aluminium or rolled sheet steel of 1.6mm thickness. Push buttons shall be of latch type with mushroom knobs.
- viii) Where breaker/starter module front serves as compartment cover, suitable blanking covers, one for each size of modules per switchboard shall be supplied for use when carriage is withdrawn.
- ix) All non-current carrying metal work of boards/panels shall be effectively bonded to earth bus of galvanised steel, extending throughout the switchboard/MCC/DB. Positive earthing shall be maintained for all positions of chassis and breaker frame.

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- x) Suitable trolley arrangement shall be provided for breaker modules. Two trolleys per switchgear shall be provided so that breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.
- xi) 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.
- xii) 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.
- xiii) All single front switch boards shall be provided with removable bolted covers at the rear. The covers shall be provided with danger labels.
- xiv) All doors shall be provided with concealed type hinges and captive screws.
- xv) Distribution Board shall be of single front/double front type to be decided during detailed engineering. Suppliers to accept both type of construction for which no price implication shall be acceptable after award of contract.
- xvi) All identical circuit breakers and module chassis of same size shall be fully interchangeable without having to carryout modifications.
- xvii) 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.
- xviii) 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.
- xix) All sheet work shall be pre-treated, 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 phosphate 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.

3.3 OTHER DESIGN FEATURES

3.3.1 RELAYS:

The protective relays shall be communicable numerical relays. These numerical relays shall be of types as proven for the application and shall be subject to BHEL/NTPC approval. Numerical relays shall have appropriate setting ranges, accuracy, resetting

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ratio and other characteristics to provide required sensitivity. All equipments shall have necessary protections.

- i) All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Interrogation voltage for the binary inputs shall be suitably selected to ensure avoidance of mal operation due to stray voltages.
- ii) Relays shall be suitable for electrical measurement including voltage, current, power (active/reactive) and energy parameters.
- iii) All numerical relay shall have key pad I keys to allow relay settings from relay front. All hand reset relays shall have reset button on the relay front. Relay to be self or hand reset shall be software selectable. Manual resetting shall be possible from remote.
- iv) For Breaker control from Main SCADA, hardwired potential free contacts shall be provided from Main SCADA to the numerical relays. No separate coupling relays shall be provided.
- v) Trip circuit supervision shall be provided for all feeders to monitor the circuit breaker/contactor trip circuit both in pre-trip and post trip conditions.
- vi) Schematics requiring auxiliary relays /timers for protection function shall be a part of numerical relay. The number of auxiliary relay and timer function for protection function shall be as required. Auxiliary relays for interlocking purpose shall be of self-reset type.
- vii) The numerical processor shall be capable of measuring and storing values of a wide range of quantities, all events, faults and disturbance recordings with a time stamping using the internal real time clock. Battery back-up for real time clock in the event of power supply failure shall be provided.
- viii) Sequence of events shall have 1 ms resolution at device level.
- ix) It shall be possible to carryout open I close operation of breakers from a laptop by interfacing from the relay front port (RS232) during initial commissioning.
- x) The relays shall be stable and suitably protected against electro-static and electromagnetic influences or transients/induced over-voltages and noise signals. The relays shall not be affected by mechanical shock or vibrations and shall be immune to voltage spikes.
- xi) All protective relays, auxiliary relays and timers except the interlocking relays shall be provided with externally hand reset positive action operation indicators secured against inadvertent operation by vibrations.

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- xii) Hardwired contacts from the Numerical relays shall be wired to main SCADA system for controls. The numerical relay shall be capable of measuring and storing values of a wide range of quantities, events, faults and disturbance recordings. The alarm I status of each of protection function and trip operation shall be communicated to main SCADA through data Concentrators. The numerical relays shall have built in feature I hardware interface to provide such inputs to main SCADA for analog/digital values. All the numerical relays shall have communications on two ports; local front port communication to laptop and a second port on IEC 61850 port to communicate with the data concentrator through LAN and Ethernet switches. The Ethernet switches along with suitable cable for connecting the same to the numerical relays are also be included in Supplier's scope of supply.

3.3.2 Meters /Instruments

- i) All meters/ instruments shall be flush mounted on front panel, at least 96 sq.mm. size with 90 degree linear scales and accuracy class of 2.0.
- ii) All feeders of 30kW and above shall have an Ammeter. Bus-section shall have bus VT, voltmeter with selector switch, and other relay and timers required for protection. Adequate control and selector switches, push buttons and indicating lamps shall be provided. Thermostatically controlled space heaters with switches shall be provided to prevent condensation.
- iii) In case of remote controlled breaker panels, following shall be ensured:
- iv) Each feeder shall have local- Remote selection. Closing & tripping from local shall be possible only in test position whereas closing & tripping from remote shall be possible in either service or test position.
- v) Necessary hardware shall be provided in the switchgear panel, like coupling relays (24VDC with maximum burden of 2.5VA), auxiliary relays, current/voltage transducers (4-20 mA, dual output) etc. to effect interlocks, exchange of information /status and exercise control from remote.

3.3.3 Cable Compartments

Each cubicle in the assembly shall be provided with a separate vertical cable compartment or as per manufactures standard design subject to approval from customer. Entrance of incoming and outgoing cables into the cable compartment shall be from the bottom. Provisions shall be made to clamp and fasten cable inside the cable compartment.

3.3.4 Nameplates

Each incoming and outgoing feeder shall be clearly identified with suitably located nameplate(s). Nameplates shall be furnished for all instruments, control switches, etc. where the circuit and function of the particular device cannot readily be determined. Each section of an assembly shall have an identifying nameplate placed near the top edge. Sizes and types of nameplates are subject to approval

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3.3.5 Wiring

The insulation of all wires shall be rated for 1000V. All control wiring shall be done with stranded wires, of minimum size 1.5mm². All control wiring within the assembly housing shall be installed at the manufacturer's premises.

All connections shall be made with solder less lugs. All wires and connections to remote equipment shall be wired to terminal blocks, according to IEC Publication 60947-7-1 / IS 13947.

All terminals and terminal blocks shall be marked according to an approved system.

Terminal blocks shall have 20% extra terminals as spare and for future circuits.

3.3.6 Instruments

Control switches and instruments shall be installed in the respective circuit breaker compartment doors

4.0 TESTS AND INSPECTION:

Inspection and testing at Manufacturer's works shall be done as per approved Quality Assurance Plan. Routine Tests, Type Tests and Acceptance Tests shall be carried out at manufacturer's works as per relevant latest IS/IEC specification. Test requirements are specified in the following clauses. Format of QAP is enclosed herewith as **Annexure-I** for Supplier's reference. Model QAP from End customer (M/s NTPC) is also enclosed herewith as **Annexure – J**. However the Supplier/manufacturer has to submit their own QAP considering all the required tests as per relevant latest IS/IEC standard and in line with technical specification in the prescribed format and submit the QAP for NTPC/BHEL approval. Final inspection and tests will be witnessed by NTPC and BHEL representative before dispatch.

The Supplier must clearly indicate the details of testing equipments and other testing facilities available in their works. The tests reports shall be got approved from the BHEL/NTPC before dispatch of the equipments.

The Supplier is required to furnish the complete type test reports for the type tests as stipulated in relevant/applicable IEC/IS standards conducted in any approved laboratory/Institute and certified & issued by reputed certifying agency for the similar specification of equipment as per technical specification under scope of supply for BHEL/BHEL's Customer review and acceptance along with the offer. The type test reports must not be older than 5 years. In case complete type tests are not conducted earlier or reports submitted are incomplete and are not found to be meeting the specification / relevant standard requirements or in case of non-acceptance of type tests by customer, then all type tests as indicated in the following clauses of this technical specification shall have to be conducted by the supplier on one item/equipment of similar specification under scope, in the presence of BHEL/BHEL's customer for witnessing the tests without any extra price implication to BHEL. Supplier is bound to accept the same. If any non compliance in this regards then the supplier to clearly indicate in the technical deviation. Elsewhere mentioned shall not be considered.

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The acceptance tests shall be carried out by manufacturer as per purchase specification and the tests stipulated in relevant/applicable IEC/IS standards for witnessing by NTPC and BHEL representative during final inspection.

SITE TESTS -All site tests shall be carried out by supplier as per relevant/applicable IEC/IS standards. The supplier has to submit Field Quality Plan for the DC Distribution Boards. Format of field quality plan is also enclosed as **Annexure-L**.

TYPE TESTS:

Following Type tests certificates shall be submitted for each type and rating of distribution boards. Testes shall be conducted as per relevant IS/IEC.:

- a) Temperature rise test
- b) Short time withstand test with circuit breaker mounted inside the switchgear panel
- c) Type 11-Short circuit co-ordination test for any three rating of MCC module as selected by NTPC.
- d) Test sequence-1 & combined test sequence shall be carried out on each rating of circuit breaker mounted inside the panel.
- e) Degree of protection tests
- f) Type test certificates for Numerical relays.

5.0 MANDATORY SPARE:

Mandatory spares shall be supplied as per List of Mandatory Spares (**Annexure-E**) with item wise prices. Any additional spares if any recommended by the Manufacturer shall also be offered separately with itemized price.

6.0 GENERAL REQUIREMENTS:

6.1 ENVIRONMENTAL REQUIREMENTS:

In compliance with ISO 14001 & OHSAS 18001, the equipments supplied shall not contain any material which is detrimental to the safety of environment. Guide lines for the end user for handling & disposal of any harmful packing material shall be given in the instruction manual.

In addition, the supplier shall conform to all applicable regulations as well as the statutory requirements regarding the execution of construction and installation work, and shall follow all instructions issued by the competent Authorities and the Purchaser.

6.2 GUARANTEE:

DC Distribution boards shall be guaranteed for the specified period as mentioned in commercial terms & conditions against any defect or damage due to wrong workmanship/manufacturing process, defective or improper material used or omission in design.



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DCDB PANEL
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LOW VOLTAGE SWITCHGEAR**

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5. LT SWITCHGEAR DATA SHEET

ANNEXURE-B

CLAUSE NO.:	DC DISTRIBUTION BOARD		 नारायण नटपुर्वा नटपुर्वा	
	Bidder's Name: _____ TECHNICAL PARTICULARS			
1.00.00	SWITCHGEAR & MCC a) General i) Manufacturer's Name _____ ii) Country of origin _____ b) Rated voltage _____ c) Symmetrical short circuit withstands current at rated voltage of switchgear /MCC cubicles _____ d) Peak short circuit withstand current _____ e) Degree of protection as per IS:13847 _____ i) Breaker / MCC cubicles _____ ii) Busbar chamber _____ f) Earth busbar size & material _____			
2.00.00	POWER BUSBARS & INSULATORS a) Material & applicable standards _____ b) Bare/painted / epoxy insulated/sloved _____ c) Continuous current rating at an ambient temp. _____ d) Temperature rise over design ambient temperature for continuous current rating deg. C _____ e) Material of the support insulators _____ f) One second current rating (kA) _____			
3.00.00	CONTROL SUPPLY TRANSFORMER a) Make _____ b) Type _____ c) Material & class of insulation _____			
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5882-003-8		TECHNICAL DATA SHEETS	PART 9: SECTION-VI	PAGE: 1 OF 7



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ANNEXURE-B

CLAUSE NO.	DC DISTRIBUTION BOARD			
4.00.00	Bidder's Name:			
	d) Voltage rating & taps CIRCUIT BREAKER a) Manufacturer's name and country of manufacturer b) Rated Voltage c) Rated operating duty d) Design ambient temperature e) Rated current at ambient temperature f) Continuous current at ambient temp. h) Rated symmetrical breaking current i) Rated peak making current j) Rated short time rating (for 1 sec.) k) Rated peak momentary rating l) No. of breaker auxiliary contacts provided on fixed portion of breaker & their rating m) Power operating mechanism n) Spring charging motor details ii) Rating Watts iii) Rated voltage iv) Class of insulation o) Emergency Manual charging facility provided YES/NO p) Manual operating mechanism q) Telescopic trolley i) Make			
RAMBHAM STAGE-III HYDRO ELECTRIC PROJECT (1 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-5502-003-B		TECHNICAL DATA SHEETS	PART 0 SECTION VI	PAGE 2 OF 2

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ANNEXURE-B

CLAUSE NO.	DC DISTRIBUTION BOARD		
	Bidder's Name:		
5.00.00	AIR BREAK SWITCHES		
	(The following details shall be furnished for each type & rating)		
	a) Make	.....	
	b) Type	.....	
	c) Applicable standards	.....	
6.00.00	CONTROL/SELECTOR SWITCH		
	a) Make	.....	
	b) Type Designation	.....	
	c) Voltage grade	.....	
7.00.00	CONTACTOR		
	(The following details shall be furnished for each type and rating)		
	a) Make	.....	
	b) Type & applicable standards	.....	
	c) Rated voltage of main and auxiliary contacts	.....	
8.00.00	AUXILIARY CONTACTOR		
	a) Make	.....	
	b) Type	.....	
9.00.00	FUSES		
	a) Make	.....	
	b) Type	.....	
	c) Category	.....	
10.00.00	CURRENT TRANSFORMERS		
	(The following details shall be provided for each type & rating)		
	a) Make	.....	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-8882-003-8			
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ANNEXURE-B

CLAUSE NO.	DC DISTRIBUTION BOARD	
	Bidder's Name: _____	
11.00.00	b) Applicable standards _____ c) Class & type of insulation _____ VOLTAGE TRANSFORMERS a) Make _____ b) Ratio _____ c) Class & type of insulation _____	
12.00.00	Numerical relays a) General Technical Details and Drawings Enclosed _____ b) Make/Model No _____ c) Place of Manufacture _____ d) Hardware version number _____ e) Firmware version number _____ f) Rated Voltage Vn (phase-to-neutral) _____ g) Rated Current In _____ h) Rated Frequency _____ i) Over voltage capability - continuous _____ j) Over voltage capability - 3s _____ k) Burden on voltage transformers (VA per phase) _____ l) Over current capability - continuous _____ m) Over current capability - 1s _____ n) Burden on current transformers (VA per phase) _____ o) Reference standards _____ p) Operating principle _____ q) No Of communication Ports _____	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 40 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CE-5603-003-3 TECHNICAL DATA SHEETS PART-G SECTION-VI PAGE 4 OF 7		



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ANNEXURE-B

CLAUSE NO.	DC DISTRIBUTION BOARD	
	Bidder's Name: r) Compliance to IEC-61850	
	s) Built-in functions provided in the relay (list out) t) Protection Functions u) Measurements v) Monitoring Functions w) Control functions x) Detailed Technical Catalogue for offered Relays enclosed y) Spares and Repairs a) State availability of spares in country and spares holding in country of origin b) Maximum repair turnaround time c) Define the proposed repair strategy d) Recommended spares list	
13.00.00	z) List of reference sites in operation for more than 1 year THERMAL OVERLOAD RELAY & SINGLE PHASING PREVENTER (The following details shall be furnished for each type & rating) a) Make & type designation b) Catalogue	
14.00.00	VOLTMETER a) Make b) Type	
15.00.00	AMMETER a) Make b) Type	
16.00.00	LOCAL STARTERS a) Make & Type	
RAMMAM STAGE-III HYDRO ELECTRIC PROJECT (3 X 45 MW) ELECTRO MECHANICAL WORKS EPC CONTRACT PACKAGE BIDDING DOC NO.: CS-0602-003-B		TECHNICAL DATA SHEETS
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6. SCOPE OF SUPPLY

ANNEXURE-A

Sr.No.	ITEM NO.	ITEM NAME	UOM	TOTAL QTY.	RATING(A)	UNIT PRICE	TOTAL PRICE
1	ELRAMMDCDBJ04901	POWER HOUSE BOARD DCDB	EA	1			
2	ELRAMMDCDBJ04902	BFV HOUSE DCDB	EA	1			
3	ELRAMMDCDBJ04903	BARRAGE DCDB	EA	1			
4	ELRAMMDCDBJ04904	MANDATORY SPARE	LOT	1			
		TOTAL					
NOTES:							
1. SUMMATION OF ALL UNIT RATES OF MODULES SHALL BE EQUIVALENT TO TOTAL BOARD COST QUOTED, VARIANCE OF +/- 5% IS ACCEPTABLE. BEYOND 5% OFFER WILL NOT BE CONSIDER AS VALID OFFER. IN UNIT ADDITION-DELETION PRICES, PRICES QUOTED FOR COMPONENTS SHALL BE AS PER LIST PRICE OF CONCERNED MANUFACTURES. IF ANY ABNORMAL PRICES ON HIGHER SIDE OBSERVED OFFER MAY BE REJECTED.							
2. ALL LT PCC/ MCC/ DBs SHALL BE SUPPLIED ALONGWITH THE INTEGRAL BASE FRAMES, FOUNDATION BOLTS, CABLE GLANDS & LUGS AND TOOLS & TACKLES AS MENTIONED IN DIFFERENT SECTIONS. ALL FIXING NUTS & BOLTS TOGETHER WITH FOUNDATION BOLTS SHALL ALSO BE SUPPLIED.							
3. ITEM WISE PRICES WITH DESCRIPTION AND RATING OF EACH ITEM COMPLYING TO LIST FURNISHED IN THE SCHEDULE OF UNIT PRICES SHALL BE FURNISHED IN SCHEDULE OF UNIT PRICE.							
4. FOR DETAILED BOARD WISE BOM, REFER ANNEXURE-B.							
5. FOR DETAILED MODULE WISE BOM, REFER ANNEXURE-C.							
6.ADDITION/DELETION OF QUANTITIES SHALL BE APPLICABLE AT THE QUOTED PRICE.THE UNIT RATE OF SUPPLY OF ALL EQUIPMENTS & SERVICES QUOTED BY THE BIDDER SHALL BE FIRM FOR A VARIATION OF QUANTITIES , WHICH MAY BE TO THE EXTENT OF ±30% OF THE TOTAL CONTRACT VALUE DERIVED ON THE BASIS OF ORDERED QUANTITY. SUM OF INDIVIDUAL MODULE SHALL EQUAL TO BOARD PRICE.							
a. COMPLETE DIMENSIONS OF ALL THE BOARDS INCLUDING NO OF ACB, MCC. GA DRAWING SHALL BE DULY SUBMITTED FOR ALL							
b. DIMENSIONS OF EACH TYPE OF PANEL.							
c. MODULE SIZE OF EACH TYPE OF FEEDER.							
d. MINIMUM CLEARANCES REQUIRED ON ALL SIDES FOR EACH TYPE OF PANEL.							
e. NO. of VERTICAL (including PCC, MCC etc.) of EACH PANLES TO BE GIVEN, ELSE YOUR OFFER WILL BE REJECTED..							
7. DOUBLE COMPRESSION, NICKLE PLATED BRASS CABLE GLANDS & HEAVY DUTY LUGS OF APPROVED MAKE FOR EXTERNAL POWER, CONTROL & EARTHING CONNECTIONS AT SUPPLIED EQUIPMENT END AND FOUNDATION BOLT ARE IN THE SCOPE OF BIDDER. BIDDER TO QUOTE ALL EQUIPMENT WITH CABLE GLANDS, LUGS AND FOUNDATION BOLTS.							



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7. LIST OF MANDATORY SPARES

RAMMAM HEP (3X40MW)
DCDB PANEL

ANNEXURE-E
MANDATORY SPARE LIST

		FOR EACH TYPE&RATING	TOTAL QTY	UNIT RATE (Rs)	TOTAL COST (Rs)
1	Circuit breaker (triple pole)/ MCCB/isolator/Switch	1NO FOR EACH TYPE&RATING			
2	AMMETER	1NO FOR EACH TYPE&RATING			
3	Voltmeter	1NO FOR EACH TYPE&RATING			
4	HRC fuses links	6NO FOR EACH TYPE&RATING			
5	Voltmeter selector switches	7NO			
6	timer	1NO			
7	Indication Lamp	2NO FOR EACH TYPE&RATING			
8	Relays (including Anti pumping relay, Aux. relay,Lockout relays/times)	DC UNDER VOLTAGE RELAY	2		
		DC OVER VOLTAGE RELAY	2		
		CAEM21 EARTH FAULT RELAY	2		



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8. DRAWINGS/DOCUMENTS REQUIRED FROM VENDOR

SL.NO	DESCRIPTION	PRINTS	CD-ROM	MANUALS
1	DRAWING /DOCUMENTS –FIRST SUBMISSION	3		
2	DRAWING /DOCUMENTS-SUBSEQUENT REVISED SUBMISSION	5		
3	DRAWING /DOCUMENTS-FINAL (AFTER CATEGORY –I APPROVAL)	5	5	
4	DRAWING AS BUILT	5	5	
5	O/M MANUAL-DRAFT			3
6	O/M MANUAL-FINAL		3	10
7	TYPE TEST CERTIFICATES	5		

ALL DRAWINGS SHALL BE SUBMITTED IN BOTH PDF AND AUTOCAD (.DWG 2004) FORMATS.



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9. LIST OF CODES & STANDARDS

Notes:

1 Equipment, accessories, components, material and tests shall confirm, to the specifications of latest revision of applicable standards.

2 Equipment, accessories, components, material and tests shall confirm, in general, to the Specifications of
☒ S ☐ BS ☐ IEC

Unless marked otherwise in the list below. Applicable standards are to be ticked ☐

1	Switchgear General Requirements	☒ IS : 4237	☐ BS : 162	☐ IEC :
2	Factory built assemblies of LV Switchgear control gear	☒ IS : 8623	☐ BS:5486	☐ IEC : 439
3	Selection , installation and maintenance of switchgear and control gear	☒ IS : 10118	☐ :	☐ IEC :
4	Busbar main connections and accessories	☒ IS: 5578	☐ BS : 159	☐ IEC :
5	Rail mounting in switchgear and control gear installation	☒ IS :11039	☐ BS :	☐ IEC : 715
6	Marking and identification of conductor and apparatus terminal	☒ IS:11053	☐ BS :	☐ IEC :
7	Marking of insulated conductors	☒ IS: 5578	☐ BS :	☐ IEC : 391
8	Item designation	☒ IS :8270	☐ BS :	☐ IEC :
9	Climate proofing of electrical equipment	☒ IS: 3202	☐ BS : CP 1014	☐ IEC :
10	Degree of protection (enclosure)	☒ IS:13947	☐ BS :	☐ IEC : 144
11	Wrought aluminium & Al. alloys	☒ IS:5082	☐ BS: 2898	☐ IEC : 114
12	Copper of bus bars	☒ IS :	☐ BS :	☐ IEC : 28
13	LV circuit breakers	☒ IS :2516 Pt. I& II	☐ BS: 4752 ☐ BS:3871 SEC 1	☐ IEC : 157 -1
14	Starters	☒ IS : 8544	☐ BS: 4941	☐ IEC : 292-1
15	Identification of terminals of contractors and associated overload	☒ IS :10705	☐ BS:	☐ IEC : 158-1C
16	Air break switch	☒ IS :4064	☐ BS: 5419	☐ IEC : 408
17	Contactors	☒ IS:2959	☐ BS: 775	☐ IEC : 158-1
18	HRC cartridge fuses	☒ IS:13703	☐ BS: 88	☐ IEC : 269-1

LV SWITCHGEAR



**RAMMAM HEP (3X40MW)
DCDB PANEL
TECHNICAL SPECIFICATION FOR
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19	Indicating instruments	☒ IS:1248	☐ BS: 89	☐ IEC : 51
20	Dimensions for panel mounted indicating instruments	☒ IS:2419	☐ BS:	☐ IEC :
21	AC electricity meters	☒ IS:722	☐ BS: 5685	☐ IEC : 521
22	Relays	☒ IS:3231	☐ BS:142	☐ IEC : 255
23	Static protective relays	☒ IS :8686	☐ BS:	☐ IEC :
24	Current transformers	☒ IS :2705	☐ BS: 3938	☐ IEC : 185
25	Voltage transformers	☒ IS: 3941	☐ BS: 3941	☐ IEC :
26	LV Control Transformers	☒ IS: 12021	☐ BS :	☐ IEC :
27	Miniature circuit breakers	☒ IS: 8828	☐ BS : 3871	☐ IEC :
28	Control switches & push button	☒ IS: 13947	☐ BS:	☐ IEC :
29	Thermostatic Bimetals	☒ IS: 8588	☐ BS:	☐ IEC :
30	Phosphating of iron & steel	☒ IS: 6005	☐ BS: 3189	☐ IEC :
31	"Colours for ready mixed paints and enamels"	☒ IS: 5	☐ BS:	☐ IEC :
32	Environmental tests	☒ IS: 2106	☐ BS:	☐ IEC :
33	Maintenance & field testing of relays	☒ IS:9124	☐ BS:	☐ IEC :
34	Specification for PVC insulated cables for working voltage upto & including 1100volts	☒ IS: 694	☐ BS:	☐ IEC :



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LPB & Local Starters:-

1	Factory built assemblies of LV Switchgear and control gear	☒ IS: 8623 PART -II	☐ BS :5486	☐ IEC : 439
2	Degree of protection	☒ IS: 13947	☐ BS :5420	☐ IEC : 144
3	Push button	☒ IS: 13947	☐ BS :	☐ IEC : 337
4	Climatic proofing of electrical equipment	☒ IS: 3202	☐ BS :CP1014	☐ IEC :
5	AC motors starters for voltage not exceeding 1000 V	☒ IS: 8544	☐ BS : 4941	☐ IEC : 292
6	Code of practice for phosphating iron & steel	☒ IS: 6005	☐ BS :3189	☐ IEC :
7	Colour for ready mixed paints & enamels	☒ IS: 5	☐ :	☐ IEC :



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10. GENERAL PACKING SPECIFICATION



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LOW VOLTAGE SWITCHGEAR**

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DATE: 22/04/2019

11. GENERAL PAINTING SPECIFICATION

GENERAL PAINTING SPECIFICATION
OF
LT SWITCHGEAR

Document No: EP- 4 - CP- SD - 001



BHARAT HEAVY ELECTRICALS LIMITED
CONTROL PANEL BUSINESS GROUP
ELECTROPORCELAINS DIVISION,
BENGALURU-560012

Date of issue: 13.04.2018



**GENERAL PAINTING SPECIFICATION
FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EP-4-CP-SD-001

VOLUME -

SECTION -

REVISION
00

DATE: 13/04/2018

SHEET 1 OF 2

1. General Specification:

All 415V switchgears, MCC's, AC & DC distribution boards etc. shall be painted by powder coating process.

2. Pre-Treatment or Surface Preparation:

Minimum 7 tank process or better shall be used for pre-treatment or surface preparation of sheet steel used for enclosures. The sequence of pre-treatment process shall include but not be limited to the following steps:

TANK-1: DEGREASING

Sheet Metal Surface shall be cleaned of grease, oils, soils, lubricants, oxide films, Heat Treatment / welding Scales etc. by using ALKALINE DEGREASER at Room Temperature for a Duration of 30-40 Minutes

TANK-2: WATER RINSE-I

Sheet Metal Surface shall be rinsed with water

TANK-3: DERUSTING

Sheet Metal Surface shall be cleaned of Rust by using Mixed HYDROCHLORIC ACID at Room Temperature for a Duration of 20 Minutes.

TANK-4: WATER RINSE-II

Sheet Metal Surface shall be rinsed with water

TANK-5: SURFACE ACTIVATION

Sheet Metal Surface shall be activated for Zn & Mn phosphate Coating by using ACTIVATION CHEMICALS ACID at Room Temperature for a Duration of 20 Minutes.

TANK-6: PHOSPHATING

Sheet Metal Surface shall be smoothly & uniformly coated with Zn Phosphate by using ZINC PHOSPHATE SOLUTION at Room Temperature for a Duration of 5 - 20 Minutes

TANK-7: WATER RINSE-III

Sheet Metal Surface shall be rinsed with water

TANK-8: PASSIVATION

For Sealing Pores of Sheet Metal Surface for obtaining Maximum Corrosion Resistance over Phosphate Coating by DECXYLITE SOLUTION at Room Temperature for a Duration of 15 - 20 Minutes



**GENERAL PAINTING SPECIFICATION
FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EP-4-CP-5D-001

VOLUME -

SECTION -

REVISION
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DATE: 13/04/2018

SHEET 2 OF 2

3. Powder Coating:

The following steps shall be followed to complete the powder coating process -

• OVEN DRYING

Sheet Metal Parts shall be dried by HOT AIR at 150 Deg C Process, Duration-10-20 Minutes.

• POWDER COATING

Within 24 Hours of Oven Drying, Sheet Metal parts shall be coated with Powder of shade desired by client through Spraying in Spray Booths, and then Epoxy-Powder Coated/Sprayed Sheet Metal parts are BAKED in an electrically fired oven at 140-150 Deg C for 10-15 Minutes.

4. Paint Thickness:

To be followed as per Customer Specifications or Project-wise Technical Specification documents.

5. Paint Shade:

To be followed as per Customer Specifications or Project-wise Technical Specification documents.

6. Testing and Verification of Painting Process:

To be followed as per Customer Approved or Project-wise approved Quality Plan.

Routine tests:

- a. Test for Paint shade with reference to shade card
- b. Paint thickness measurement
- c. Adhesion test

Special Tests:

If any special tests are specified, the same shall be carried out as per approved Quality Plan



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12. MANUFACTURING QUALITY PLAN FOR LV SWITCHGEAR

DC DISTRIBUTION BOARD

(MCC, PCC, ACDB, DCDB, FUSE BOARDS, LOCAL PUSH BUTTON STATION, LOCAL MOTOR STARTERS)

ATTRIBUTES / CHARACTERISTICS												
	Make, Model, Type, Rating & TG	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec	Item to conform to relevant Standards	Pretreatment as per IS 8005	Paint, Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR - HV - IR Test
ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY												
Sheet Steel (IS - 513)	Y	Y		Y	Y		Y					
Aluminium Bus bar Material (IS : 5082)	Y	Y	Y	Y	Y		Y					
Copper Bus bar Material (IS : 613)	Y	Y	Y	Y	Y		Y					
Support Insulator	Y	Y	Y	Y			Y					
Air Circuit Breaker (IS: 13947)	Y	Y				Y	Y			Y	Y	Y
Energy Meters (IS : 13010, 13779)	Y	Y				Y	Y			Y		Y
Power & Aux. Contactors (IS - 13947)	Y	Y				Y	Y			Y		
Protection & Aux. Relays (IS : 3231)	Y	Y				Y	Y			Y		Y
Control & Selector Switches (IS : 13947)	Y	Y				Y	Y			Y		
CT's & PT's (IS 2705 / 3156)	Y	Y					Y					Y
MCCB (IS : 13947)	Y	Y					Y			Y		
Indicating Meters (IS : 1248)	Y	Y				Y	Y			Y		Y
Indicating Lamps (IS : 13947)	Y	Y				Y	Y			Y		
Air Break Switches (IS : 13947)	Y	Y				Y	Y			Y		
Control Terminal Blocks	Y	Y				Y	Y					



ATTRIBUTES / CHARACTERISTICS														
	↓ ITEMS/ COMPONENTS/ SUB SYSTEM ASSEMBLY													
	Make, Model, Type, Rating & TC	Dimensions & Finish	Electrical properties	Mechanical Properties	Chemical properties	Functional & Operational Features as per NTPC Spec.	Item to conform to relevant Standards	Pretreatment as per IS 6005	Paint Shade, Adhesion, Thickness & Finish	Functional Checks	Milli-volt drop Test	IR – HV – IR Test	Degree of Protection Routine test as per NTPC spec	All Routine tests as per NTPC spec. & IS
Fuse (IS 13703)	Y	Y				Y	Y							
Control Transformer (IS : 12021)	Y	Y				Y	Y			Y				Y
Push Buttons (IS : 4794)	Y	Y				Y	Y			Y				
Transducer (IEC : 60688)	Y	Y				Y	Y			Y				Y
MCB (IS : 8828)	Y	Y				Y	Y			Y				
Breaker Handling Trolley	Y	Y				Y			Y	Y				Y
Synthetic Rubber Gasket (IS : 11149)	Y	Y		Y	Y		Y							
SWITCHGEAR (IS : 8623)	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes:

- This is an indicative list of tests / checks. The manufacturer is to furnish a detailed Quality Plan indicating the practice and procedure along with relevant supporting documents.
- Makes of all major Bought Out items will be subject to NTPC approval.



750



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13. MAKE OF COMPONENT

COMPONENT	MAKE
ACB	C&S ELECTRIC, NOIDA
	L&T, MUMBAI
	GE, BANGALORE
	SIEMENS, GERMANY
	SCHNEIDER, FRANCE
BOI'S	WITH VDE/CE/UL/CSA MARKED OR BIS APPROVED WITH VALID CML NO.



BHEL-EPD BANGALORE

LIST OF SUB-VENDORS

Sl. No.	Components List	Name of Sub-Vendor
1	Air Circuit Breaker (ACB)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
2	Data Concentrator (DCS)	ABB
		Schneider
		SIEMENS
		SEL
		GE(ALSTOM)
3	Ethernet Switches	RUGGEDCOM
		GARRETTCOM
		NETGEAR
		HIRSCHMANN
		MOXA
		CISCO
4	a)Molded case circuit breakers (MCCB) , b) Motor Protection Circuit Breaker (MPCB),c)AC Power Contactor, d)Thermal Overload Relay (OLR)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
5	SWITCH FUSE UNIT (SFU)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
6	Miniature Circuit Breaker (MCB)	ABB
		Schneider
		L & T



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		Siemens
		C & S Electric
		GE-POWER
		LEGRAND
		STANDARD
		HAVELLS
7	Electronic Motor Protection Relay (EMPR)	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
8	Current transformer / Voltage Transformers (VT/PT)	Automatic Electric
		Precise Electricals
		Kappa Electricals
		Pragati Electricals
		KALPA
		Indcoil
9	Control Transformers(CST)	Automatic Electric
		Precise Electricals
		Kappa Electricals
		Pragati Electricals
		KALPA
		Indcoil
10	Interposing Relays	Jyoti
		OEN
		PLA
		Schneider
		GUARDIAN
		OMRON
11	Numerical Protection Relay	ABB
		Siemens
		GE (ALSTOM)
		Schneider
		SEL
12	Electromechanical Protection Relay	ABB
		Siemens



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		GE (ALSTOM)
		JVS
		L&T
13	Timer/ TIME DELAY RELAY	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
14	Multifunction Meter (MFM)	Conzerve(Schneider)
		L&T
		Rishabh
		Secure
		AE
		MECO
		ELMEASURE
15	Energy Meter(TVM)	Schneider
		Secure
		ABB
16	AC/DC Aux. Contactor	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
17	Auxiliary Relay	ABB
		GE(ALSTOM)
		L&T
		Siemens
		JVS
18	DC Power Contactor	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
		BCH electric ltd
19	Ammeter(Analog)	AE
		Rishabh



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		IMP
		MECO
20	Voltmeter(Analog)	AE
		Rishabh
		IMP
		MECO
21	Ammeter(DIGITAL)	AE
		Rishabh
		L&T
		MECO
		Secure
		Schneider/conzerv
22	Voltmeter(DIGITAL)	AE
		Rishabh
		L&T
		MECO
		Secure
		Schneider/conzerv
23	FUSE Base with holder	ABB
		Schneider
		L & T
		Siemens
		C & S Electric
		GE-POWER
24	FUSES (Power/Control)	GE-Power
		Siemens
		L & T
		C & S Electric
		Schneider
		COPPER BUSSMANN
		ABB
25	Control Switchs	Kaycee
		Salzer, L&T
		SWITRON
		RECOM
26	Indicating Lamp	Siemens
		RASS (C & S Electric)
		Vaishno
		L & T (ESBEE)



BHEL-EPD BANGALORE

Sl. No.	Components List	Name of Sub-Vendor
		Schneider
		ABB
		SECO
		TEKNIK
27	Push Button	Siemens
		RASS (C & S Electric)
		Vaishno
		L & T (ESBEE)
		TEKNIK
		Schneider
		ABB
28	Transducer	Southern Transducer
		AE
		Rishabh
		Secure
		MECO
29	Terminals Block	Phoenix
		Connect well
		Elemex
		Wago
30	Cable Glands	HEX
		Commet
		DOWELLS
		Jainson
		3D
		Sunil & Co.
31	Cable Lugs	HEX
		Commet
		DOWELLS
		Jainson
		3D
		Sunil & Co.
32	Local Motor Starter	L & T
		C & S Electric
		ABB
		BCH



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14. MODULE WISE BOM

RAMMAM HEP(3X40MW)
DCDB PANEL

RATING	FEEDER NAME	COMPONENTS	COMPONENT RATING	MAKE	QTY FOR EACH UNIT	UNIT	UNIT PRICE OF EACH COMPONENT	TOTAL PRICE
300A	MCCB INCOMER	MCCB WITH OVERLOAD & SHORT CKT RELEASE	300A, 2P, 20KA DC		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Auxiliary contactor 2 NO+2NC	230VAC		1	EA		
		Rotary Handle			1	EA		
		DC SHUNT 75mV	75mV		1	EA		
		0-300A DC AMMETER	0-300A		1	EA		
		UNDervOLTAGE RELAY			1	EA		
		DC VOLTMETER	*-300 TO 300VDC		1	EA		
		MCB	6A, 2P,AC		1	EA		
		MCB	6A, 2P,DC		1	EA		
		FUSE	6A		2	EA		
		INDICATING LAMP	230VAC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 300A MCCB IC MODULE								0
300A	MCCB BUSCOUPLER	MCCB WITH OVERLOAD & SHORT CKT RELEASE	300A, 2P, 20KA DC		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		Auxiliary contactor 2 NO+2NC	230VAC		1	EA		
		DC SHUNT 75mV	75mV		1	EA		
		0-300A DC AMMETER	0-300A		1	EA		
		DC VOLTMETER	*-300 TO 300VDC		1	EA		
		MCB	6A, 2P,AC		2	EA		
		MCB	6A, 2P,DC		1	EA		
		FUSE	6A		2	EA		
		INDICATING LAMP	230VAC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF300A MCCB BC MODULE								0
32A	MCCB INCOMER	MCCB WITH OVERLOAD & SHORT CKT RELEASE	32A, 2P, 20KA DC		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		

RAMMAM HEP(3X40MW)
DCDB PANEL

		Rotary Handle			1	EA		
		DC SHUNT 75mV	75mV		1	EA		
		Auxiliary contactor 2 NO+2NC	230VAC		1	EA		
		0-40A DC AMMETER	0-40A		1	EA		
		UNDervOLTAGE RELAY						
		DC VOLTMETER	*-300 TO 300VDC		1	EA		
		MCB	6A, 2P,AC		2	EA		
		MCB	6A, 2P,DC		1	EA		
		FUSE	6A		2	EA		
		INDICATING LAMP	230VAC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 32A MCCB IC MODULE 0								
63A	MCCB INCOMER	MCCB WITH OVERLOAD & SHORT CKT RELEASE	63A, 2P, 20KA DC		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		DC SHUNT 75mV	75mV		1	EA		
		Auxiliary contactor 2 NO+2NC	230VAC		1	EA		
		0-40A DC AMMETER	0-40A		1	EA		
		UNDervOLTAGE RELAY						
		DC VOLTMETER	*-300 TO 300VDC		1	EA		
		MCB	6A, 2P,AC		2	EA		
		MCB	6A, 2P,DC		1	EA		
		FUSE	6A		2	EA		
		INDICATING LAMP	220V DC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 63A MCCBIC MODULE 0								
63A	MCCB BUSCOUPLER	MCCB WITH OVERLOAD & SHORT CKT RELEASE	63A, 2P, 20KA DC		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		DC SHUNT 75mV	75mV		1	EA		
		0-40A DC AMMETER	0-40A		1	EA		
		DC VOLTMETER	0-350V		1	EA		
		MCB	6A, 2P,AC		2	EA		
		FUSE	6A		2	EA		
		INDICATING LAMP	220V DC		2	EA		

RAMMAM HEP(3X40MW)
DCDB PANEL

		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 63A MCCB BC MODULE								0
	BUS METERING MODULE	OVERVOLTAGE RELAY			1	EA		
		EARTHFAULT (CAEM21 OR EQV.)			1	EA		
		TIMER	ON DELAY TIMER, 0.5-5SEC., 220V DC, 2NO+2NC		1	EA		
		INDICATING LAMP	220VDC		3	EA		
		MCB-6A	6A ,DP,DC		2	EA		
		DC VOLTAGE METER (0-350V)	0-350VDC		1	EA		
		VOLTMETER SELECTOR SWITCH	16 AMP		1	EA		
		AUXILIARY CONTACTOR,2NO+2NC,CV 220DC			1	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF BUS METERING MODULE								
16A	MCCB OG FEEDER	MOULDED CASE CIRCUIT BREAKER(FIXED OVERLOAD & SHORT CKT RELEASE)	16A,2P,20KA DC MCCB		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		MCB	6A		1	EA		
		INDICATING LAMP	220V DC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 16A MCCB OG MODULE								0
32A	MCCB OG FEEDER	MOULDED CASE CIRCUIT BREAKER(FIXED OVERLOAD & SHORT CKT RELEASE)	32A,2P,20KA DC MCCB		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		MCB	6A		1	EA		
		INDICATING LAMP	220V DC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 32A MCCB OG MODULE								0

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63A	MCCB OG FEEDER	MOULDED CASE CIRCUIT BREAKER(FIXED OVERLOAD & SHORT CKT RELEASE)	63A,2P,20KA DC MCCB		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		MCB	6A		1	EA		
		INDICATING LAMP	220V DC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 63A MCCB OG MODULE								0
125A	MCCB OG FEEDER	MOULDED CASE CIRCUIT BREAKER(FIXED OVERLOAD & SHORT CKT RELEASE)	125A,2P,20KA DC MCCB		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		MCB	6A		1	EA		
		INDICATING LAMP	220V DC		2	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 125A MCCB OG MODULE								0
200A	MCCB OG FEEDER	MOULDED CASE CIRCUIT BREAKER(FIXED OVERLOAD & SHORT CKT RELEASE)	200A,2P,20KA DC MCCB		1	EA		
		Auxiliary 1 C/O + TAC 1 C/O			1	EA		
		Rotary Handle			1	EA		
		MCB	6A		2	EA		
		INDICATING LAMP	220VDC		2	EA		
		DC SHUNT 75mV	75mV		1	EA		
		DC AMMETER	0-200A DC		1	EA		
		C-CLASS MATERIAL+LABOUR COST			1	LOT		
		ENCLOSURE COST			1			
TOTAL PRICE OF 200A MCCB MODULE								0



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15. BOARDWISE BOM

**RAMMAM HEP (3X40MW)
DCDB PANEL**

ANNEXURE-C

SL No.	BOARD NAME	FEEDER TYPE	RATING KW/A	TOTAL NO.OF FEEDER S	UNIT PRICE	TOTAL PRICE
1	POWER HOUSE BOARD	INCOMER	300A	2		
		BUS COUPLER	300A	1		
		BUS METERING MODULE		2		
		MCCB SUPPLY FEEDER	16A	36		
		MCCB SUPPLY FEEDER	32A	10		
		MCCB SUPPLY FEEDER	63A	5		
		MCCB SUPPLY FEEDER	125A	3		
		MCCB SUPPLY FEEDER	200A	4		
		SINGLE FRONT FIXED TYPE				
TOTAL BOARD PRICE						0
2	BFV HOUSE DB	INCOMER	32A	1		
		BUS METERING MODULE		1		
		MCCB SUPPLY FEEDER	16A	10		
		SINGLE FRONT FIXED TYPE				
TOTAL BOARD PRICE						0
3	BARRAGE DCDB	INCOMER	63A	2		
		BUS COUPLER	63A	1		
		BUS METERING MODULE		2		
		MCCB SUPPLY FEEDER	16A	20		
		SINGLE FRONT FIXED TYPE				
TOTAL BOARD PRICE						0
TOTAL PRICE OF ALL BOARD						0



**RAMMAM HEP (3X40MW)
DCDB PANEL
TECHNICAL SPECIFICATION FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EPD-TS-CPBG-J049

DATE: 22/04/2019



**RAMMAM HEP (3X40MW)
DCDB PANEL
TECHNICAL SPECIFICATION FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EPD-TS-CPBG-J049

DATE: 22/04/2019

16. GENERAL NOTES

SL.NO.	GENERAL NOTES:	
1	ITEM	220 V DCDB
2	TYPE OF PRODUCT	FLOOR MOUNTING
3	CABLE ENTRY	BOTTOM
4	DEGREE OF PROTECTION FOR ENCLOSURE	IP 52 or better
5	SHORT CKT LEVEL	20KA
6	SUPPLY VOLTAGE	
	POWER VOLTAGE	220VDC 2Ph 2WIRE
7	FABRICATION (ENCLOSURE)	
7.01	LOAD BEARING MEMBER	2 mm THICK CRCA SHEET
7.02	NON LOAD BEARING	1.6mm THICK CRCA SHEET
7.03	GLAND PLATE	3 mm THICK CRCA SHEET
7.04	TYPE OF GLAND PLATE	REMOVABLE UNDRILLED
7.05	BASE FRAME	ISM100(BLACK)
8	EARTH BUS	50X6mm COPPER
9	PAINTING	POWDER COATING TYPE
9.01	POWDER TYPE	EPOXY BASED POWDER COATING
9.02	POWDER SHADE	
	END COVER	RAL 5012(WILL BE FINALISED DURING DETAILED ENGG.)
	COMPLETE PANEL(INTERIOR&EXTERIOR	RAL 9002
		PAINT SHADE THICKNESS: MIN 60 MICRON
10	BUSBAR	
10.01	BUSBAR CLEARANCE (MINIMUM)	PHASE TO PHASE- 25.4 mm
		PHASE TO EARTH- 25 mm
10.02	BUSBAR LAMINATION	COLOUR HEAT SHRINKABLE PVC SLEEVE
10.03	BUSBAR MATERIAL	Cu for DCDB
11	SPARE TERMINALS	20% OF CONTROL TERMINALS 20% OF POWER TERMINAL
12	WIRING	

12.01	DC CONTROL	2.5 SQ MM MULTI STRANDED Cu FLEXIBLE WIRE BLUE AND WHITE COLOUR
12.02	EARTHING	2.5 SQ MM MULTI STRANDED Cu FLEXIBLE WIRE GREEN/YELLOW COLOUR OF 1100V GRADE
12.03	DC POWER	MULTI STRANDED Cu WIRE GREY COLOUR OF 1100V GRADE
13	GASKET	POLYURETHANE / NEOPRENE
14	FERRULES	PVC WHITE COLOUR WITH BLACK LETTERS NUMBER / CRISS-CROSS
15	TB	ONE SIZE HIGHER FROM OUTGOING POWER CABLE CROSS SECTION
16	NAME PLATE DETAILS	
	MATERIALS	ANODIZED ALUMINIUM
	COLOUR	WHITE LETTERS ON BLACK BACKGROUND



**RAMMAM HEP (3X40MW)
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LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EPD-TS-CPBG-J049

DATE: 22/04/2019

17. MANDATORY SPARE LIST

		FOR EACH TYPE&RATING	TOTAL QTY	UNIT RATE (Rs)	TOTAL COST (Rs)
1	Circuit breaker (triple pole)/ MCCB/isolator/Switch	1NO FOR EACH TYPE&RATING			
2	AMMETER	1NO FOR EACH TYPE&RATING			
3	Voltmeter	1NO FOR EACH TYPE&RATING			
4	HRC fuses links	6NO FOR EACH TYPE&RATING			
5	Voltmeter selector switches	7NO			
6	timer	1NO			
7	Indication Lamp	2NO FOR EACH TYPE&RATING			
8	Relays (including Anti pumping relay, Aux. relay, Lockout relays/times)	DC UNDER VOLTAGE RELAY	2		
		DC OVER VOLTAGE RELAY	2		
		CAEM21 EARTH FAULT RELAY	2		

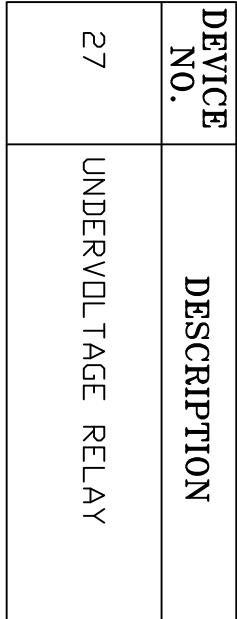
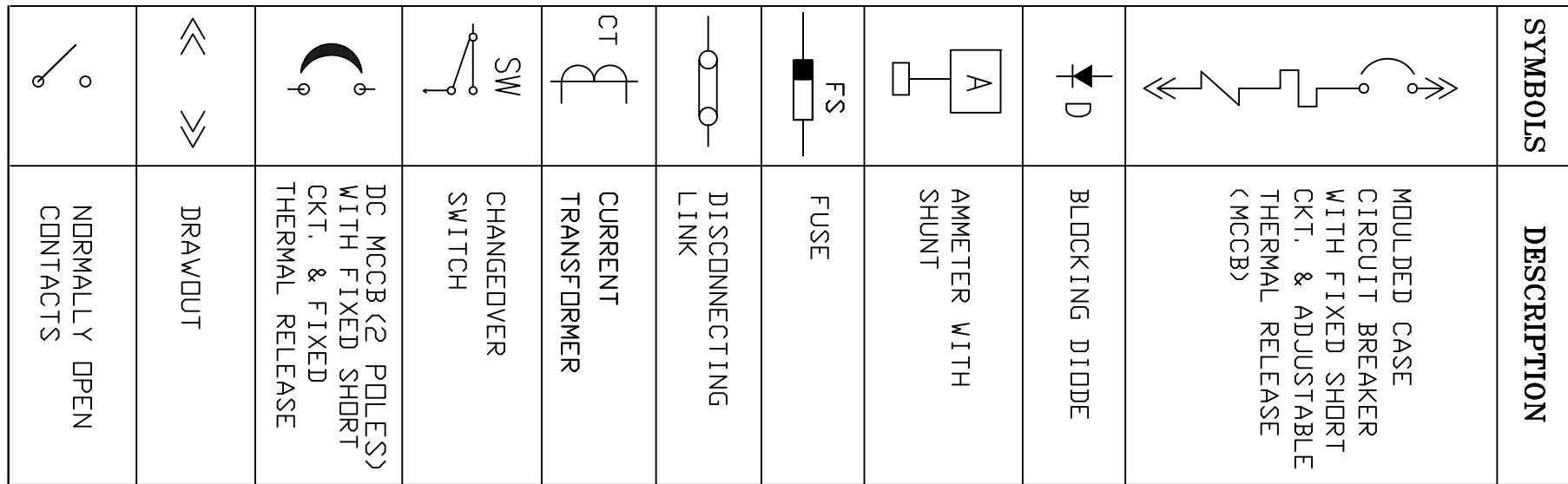


**RAMMAM HEP (3X40MW)
DCDB PANEL
TECHNICAL SPECIFICATION FOR
LOW VOLTAGE SWITCHGEAR**

SPECIFICATION NO. : EPD-TS-CPBG-J049

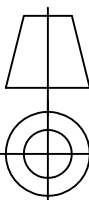
DATE: 22/04/2019

18. SINGLE LINE DIAGRAM



LEGEND	DESCRIPTION	LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER	NCB	NO. OF CTS. CIRCUIT BREAKERS
AMP	AMPERE	1A	BEST CONTACTOR(AUX.)
ASS	AMPERE/SELECTOR SWITCH	1B	BEST CONTACTOR(MAND)
VOL	VOLTMETER	1C	FLUAT. CONTACTOR(MAND)
VSS	VOLTMETER SELECTOR SWITCH	2	THIRDER
		PA	BEST CONTACTOR(AUX.)
		PB	BEST CONTACTOR(MAND)
		PC	FLUAT. CONTACTOR(MAND)

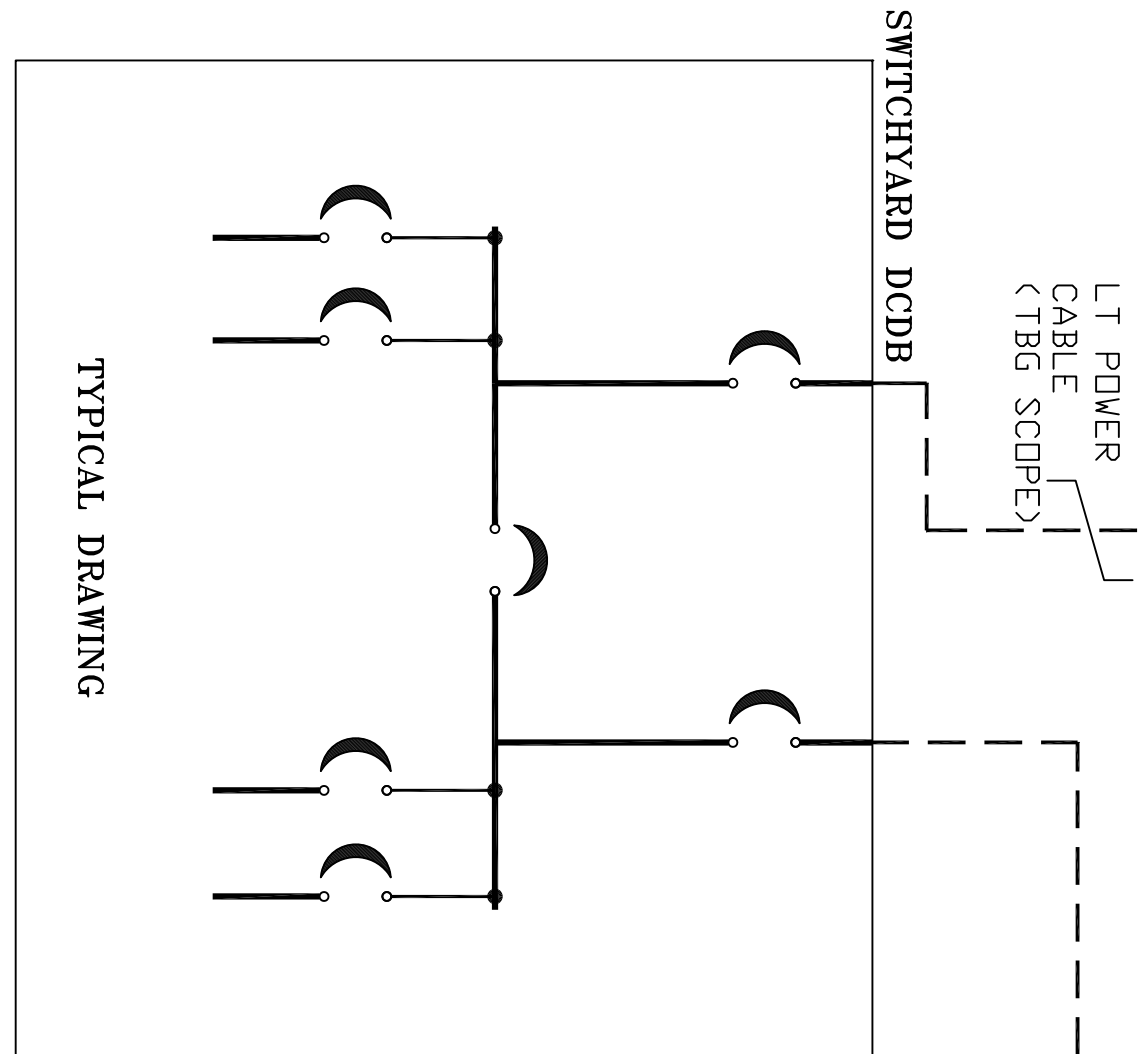
REV.	DATE	ALTERED	VKG	REV.	DATE	ALTERED	VKG	REV.	DATE	ALTERED	VKG
03	17.05.16	CHECKED	RMP	02	29.04.16	CHECKED	RMP	01	15.01.16	CHECKED	RMP
		APPROVED	ASB			APPROVED	ASB			APPROVED	ASB
DRAWING REVISED BASED ON NTPC COMMENTS DATED	06.05.2016			DRAWING REVISED BASED ON NTPC COMMENTS DATED	28.01.2016.			DRAWING REVISED BASED ON NTPC COMMENTS DATED	28.12.2015.		

पूँजी की सी NTPC		पूँजी की सी लिमिटेड N.T.P.C. LIMITED A GOVERNMENT OF INDIA ENTERPRISE (FORMERLY NATIONAL THERMAL POWER CORPORATION LTD.) ENGINEERING DIVISION	
PROJECT		RAMMAM HYDROELECTRIC POWER PROJECT (3x40MW)	
TITLE		BHARAT HEAVY ELECTRICALS LTD. BHOPAL, INDIA	
SLID FOR POWER HOUSE-220 V DC		NTPC DRG. NO. 5602-003-H209-1YE-B-002	
SUB-VENDOR NAME		BHEL DRG. NO. 12926158001	
WEIGHT (kg)		REV. 03	
SCALE		SHEET NO. NO. OF SHEET	
			

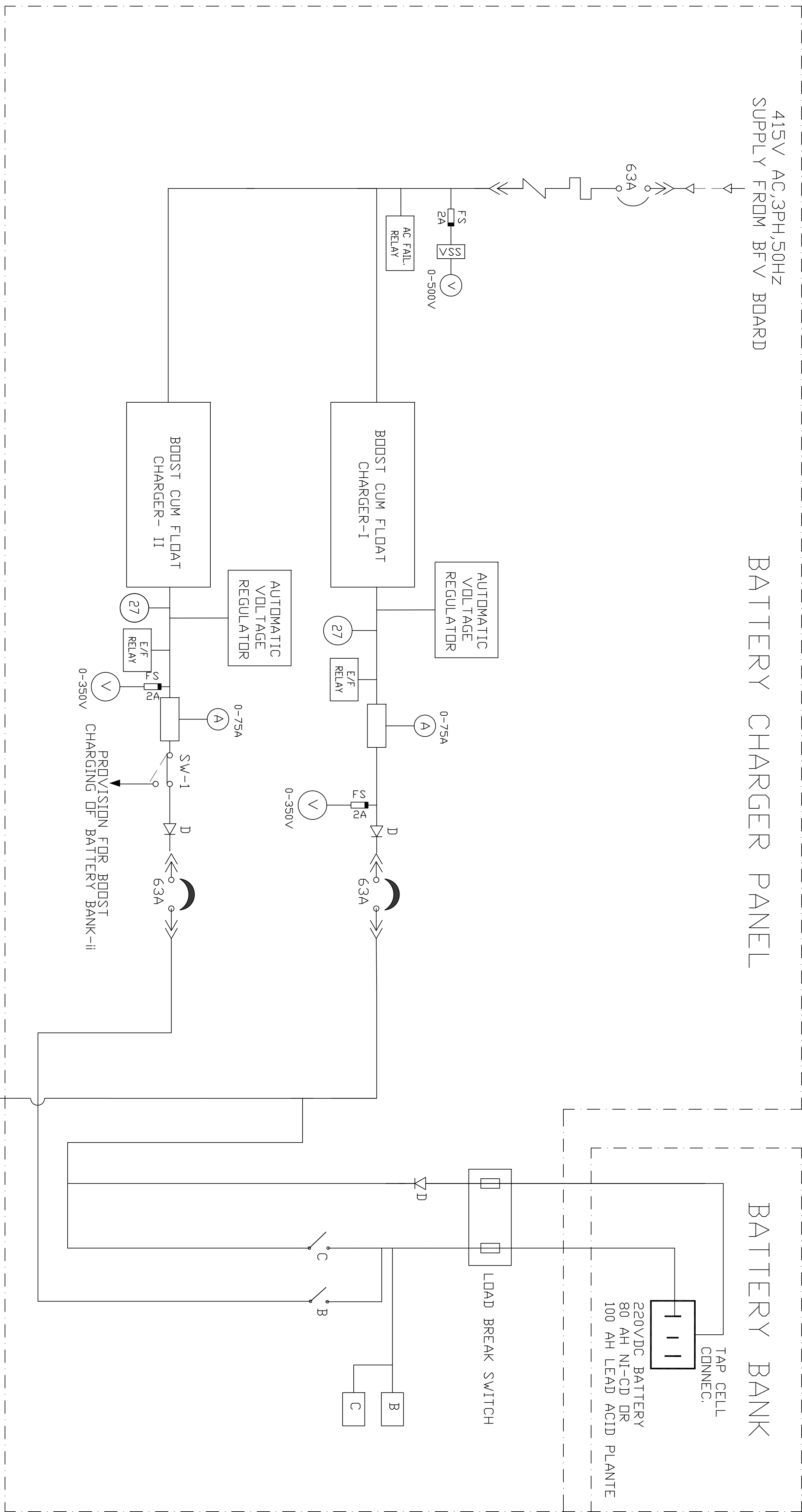
NOTE : 1. CONFIGURATION OF BATTERY CHARGER IS TYPICAL & SUBJECT TO CHANGE AS PER DETAILED DESIGN OF VENDOR.

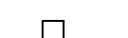
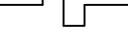
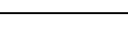
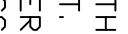
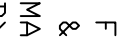
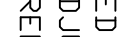
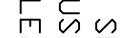
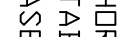
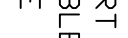
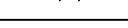
2. RATING OF BATTERY CHARGER EQUIPMENT WILL BE GIVEN AFTER DETAILED DESIGN BY VENDOR.

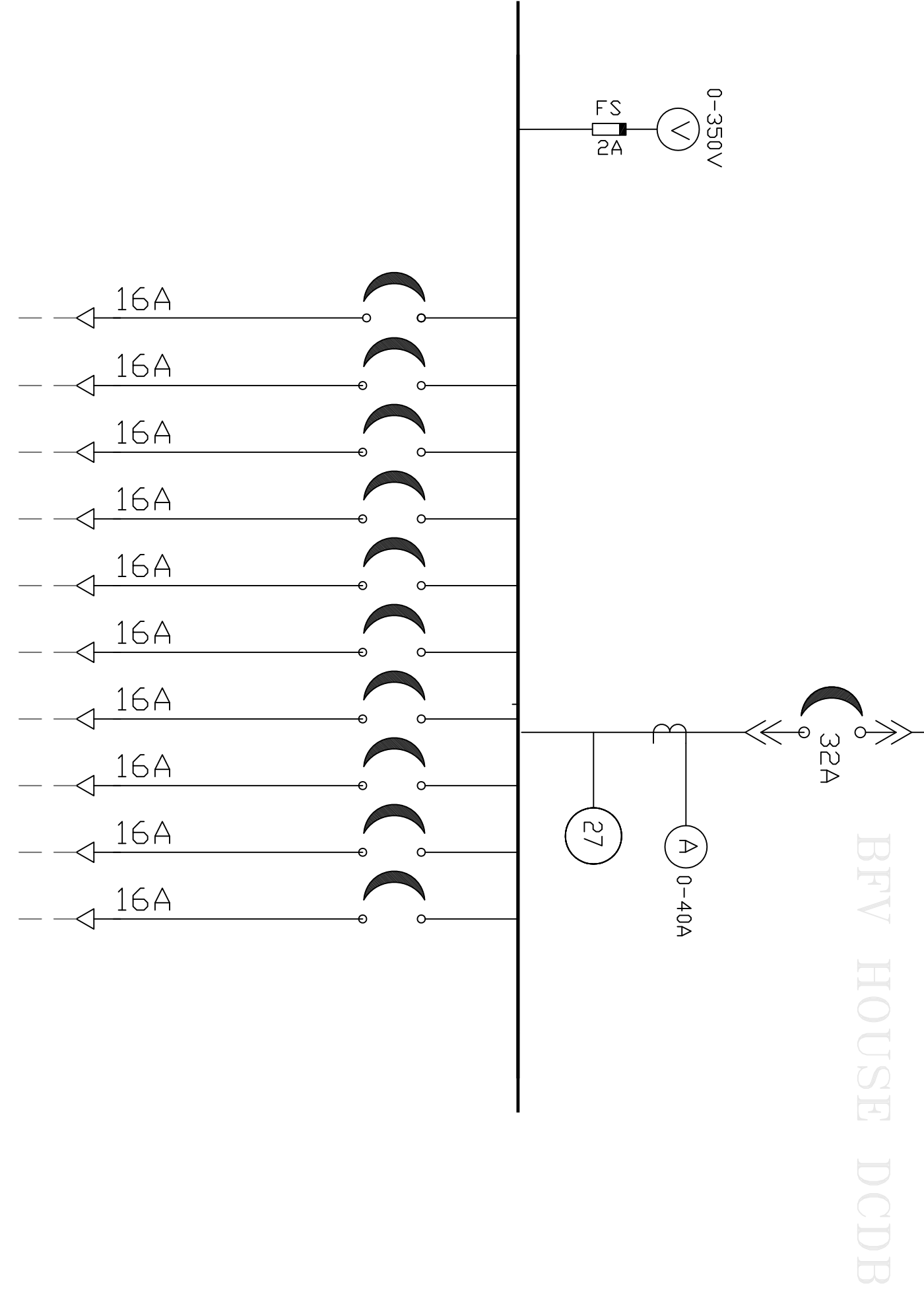
3.FEEDERS RATING OF DISTRIBUTION BOARD MAY CHANGE AS PER FINAL-APPROVED RATING OF EQUIPS.



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SYMBOLS	DESCRIPTION
	MOLDED CASE CIRCUIT BREAKER
	MINIATURE CIRCUIT BREAKER
	THERMAL MAGNETIC RELEASE
	GROUNDING
	BLOCKING DIODE
	AMMETER
	SHUNT
	FUSE
	DISCONNECTING LINK
	CURRENT TRANSFORMER
	CHANGEOVER SWITCH
	DC MCCB OR POLES (CUT & FIXED THERMAL RELEASE)
	BRAKOUT
	NORMALLY OPEN CONTACTS

[illegible]

LEGEND	DESCRIPTION	LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER	MCB	MOLDED CASE CIRCUIT BREAKER
A	AMMETER		
ASS	ARMATURE SELECTOR SWITCH	B	BUSBARS
V	VOLTMETER	C	CAPACITOR
VSS	VOLTMETER SELECTOR SWITCH		

DEVICE NO.	DESCRIPTION
27	UNDERVOLTAGE RELAY

INVENTORY NO.	SIGN. & DATE	RE
H NOTE : 1. CONFIGURATION OF BATTERY CHARGER IS TYPICAL & SUBJECT TO CHANGE AS PER DETAILED DESIGN OF VENDOR. 2. RATING OF BATTERY CHARGER EQUIPMENT WILL BE GIVEN AFTER DETAILED DESIGN BY VENDOR. 3.FEEDERS RATING OF DISTRIBUTION BOARD MAY CHANGE AS PER FINAL APPROVED RATING OF EQUIPS.		

REV.	DATE	ALTERED	VKG	REV.	DATE	ALTERED	VKG
03	17.05.16	CHECKED	RMP	02	29.04.16	CHECKED	RMP
		APPROVED	ASB			APPROVED	ASB
NO CHANGE IN DRAWING REPLY LETTER ATTACHED.				DRAWING REVISED BASED ON MEETING DATED 16-17.03.16			
				DRAWING REVISED BASED ON NTPC COMMENTS DATED 28.12.2015.			

 પ્રજેક્ટ નામ N.T.P.C. LIMITED (A GOVERNMENT OF INDIA ENTERPRISE) (FORMERLY NATIONAL THERMAL POWER CORPORATION LTD) ENGINEERING DIVISION									
PROJECT RAMMAM HYDROELECTRIC POWER PROJECT (3x40MW)									
TITLE BHARAT HEAVY ELECTRICALS LTD. BHOPAL, INDIA									
SLID FOR BPV HOUSE-220 V DC									
SUB-VENDOR NAME									
WEIGHT (Kgs)									
SCALE 1:10									
									
SHEET NO.									
NO. OF SHIT.									
REV 03									

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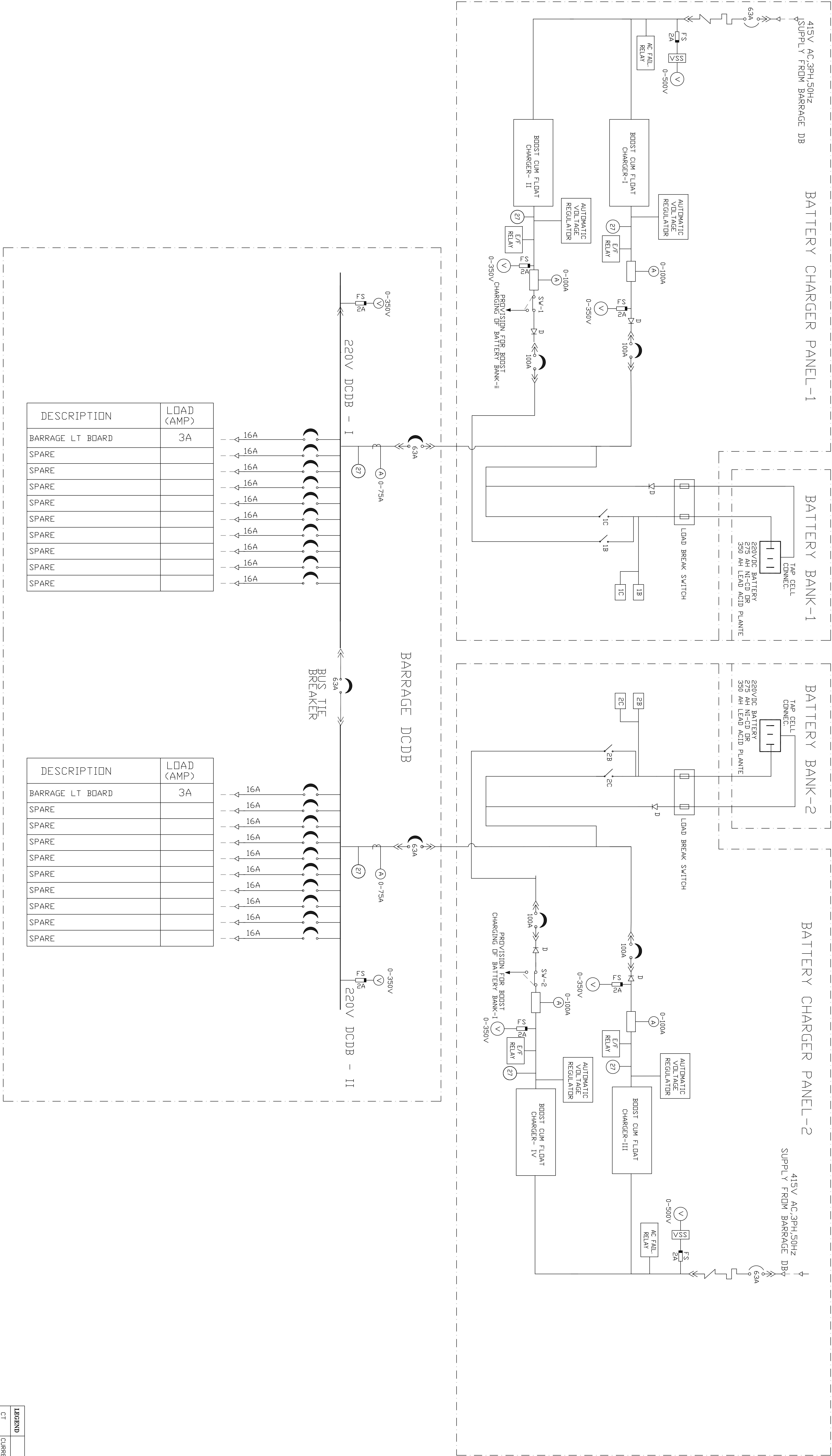
NOTE : 1. CONFIGURATION OF BATTERY CHARGER IS TYPICAL & SUBJECT TO CHANGE AS PER DETAILED DESIGN OF VENDOR.

2. RATING OF BATTERY CHARGER EQUIPMENT WILL BE GIVEN AFTER DETAILED DESIGN BY VENDOR.

A1 SIZE

30085192621 'ON '9RD

SYMBOLS	DESCRIPTION
	MOLDED CASE CIRCUIT BREAKER WITH FIXED SHORT TRIP, ADJUSTABLE THERMAL RELEASE (MCCB)
	BLOCKING DIODE
	AMMETER WITH SHUNT
	FUSE
	DISCONNECTING LINK
	CURRENT TRANSFORMER
	CHANGEOVER SWITCH
	DC MCCB (2 POLES) WITH FIXED THERMAL RELEASE
	DRAWOUT
	NORMALLY OPEN CONTACTS



DESCRIPTION	LOAD (AMP)
BARRAGE LT BOARD	3A
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	

DESCRIPTION	LOAD (AMP)
BARRAGE LT BOARD	3A
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	
SPARE	

DEVICE NO.	DESCRIPTION
27	UNDERVOLTAGE RELAY

LEGEND	DESCRIPTION	LEGEND	DESCRIPTION
CT	CURRENT TRANSFORMER	MCCB	MOLDED CASE CIRCUIT BREAKER
A	AMMETER	ASS	AMMETER SELECTOR SWITCH
V	VOLTMETER	1C	BOOST CONTACTOR(MAIN)
VSS	VOLTMETER SELECTOR SWITCH	1B	BOOST CONTACTOR(MAIN)
		2C	BOOST CONTACTOR(MAIN)
		2B	BOOST CONTACTOR(MAIN)
		2C	BOOST CONTACTOR(MAIN)

NOTE : 1. CONFIGURATION OF BATTERY CHARGER IS TYPICAL & SUBJECT TO CHANGE AS PER DETAILED DESIGN OF VENDOR.
2. RATING OF BATTERY CHARGER EQUIPMENT WILL BE GIVEN AFTER DETAILED DESIGN BY VENDOR.
3.FEEDERS RATING OF DISTRIBUTION BOARD MAY CHANGE AS PER FINAL APPROVED RATING OF EQUIPS.

REV.	DATE	ALTERED	VKG	REV.	DATE	ALTERED	VKG
03	17.05.16	CHECKED	RMP	02	29.04.16	CHECKED	RMP
		APPROVED	ASB			APPROVED	ASB
		NO CHNAGE IN DRAWING REPLY LETTER ATTACHED.				DRAWING REVISED BASED ON NTPC COMMENTS DATED 28.12.2015.	

PROJECT		PROJECT	
RAMMAM HYDROELECTRIC POWER PROJECT (3x40MW)		RAMMAM HYDROELECTRIC POWER PROJECT (3x40MW)	
(A GOVERNMENT OF INDIA ENTERPRISE)		(A GOVERNMENT OF INDIA ENTERPRISE)	
(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD) ENGINEERING DIVISION		(FORMERLY NATIONAL THERMAL POWER CORPORATION LTD) ENGINEERING DIVISION	
BHARAT HEAVY ELECTRICALS LTD.		BHARAT HEAVY ELECTRICALS LTD.	
BIHOPAL, INDIA		BIHOPAL, INDIA	
TITLE		SUB-VENDOR NAME	
SLD FOR BARRAGE-220 V DC		SUB-VENDOR NAME	
WEIGHT (kg)		SCALE NTS	
SHEET NO. 1		NO. OF SH.T. 12	
NTPC DRG. NO. 5602-003-H209-PVE-B-004		BHEL DRG. NO. 12926158003	
REV. 03		REV. 03	
DEPT. DRN YAG 18/12/2016		HPE CKO BHP 18/12/2016	
415 APD 18/12/2016		SUB-VENDOR DRG. NO. PO REF	

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INVENTORY NO.	SIGN. & DATE	REF. DRG. NO.
G	H	G