



An ISO 9001
Company

Bharat Heavy Electricals Limited
(High Pressure Boiler Plant)
Tiruchirappalli – 620014, TAMIL NADU, INDIA
CAPITAL PURCHASE / MATERIALS MANAGEMENT / MANUFACTURING

ENQUIRY	Phone: +91 431 257 75 75 Fax : +91 431 252 07 19 Email : rmanohar@bheltry.co.in Web : www.bhel.com
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	Enquiry Number:	Enquiry Date:	Due date for submission of quotation:
	2620600058	02.09.2006	12.10.2006


Your are requested to quote the Enquiry number date and due date in all your correspondences. This is only a request for quotation and not an order

Item	Description	Quantity	Delivery Schedule
10	Design, Engineering, Supply, Erection, Testing & Commissioning of 110 kV Substation as per the technical specification & commercial conditions applicable (to be downloaded from web site www.bhel.com)	1 Set.	20.07.2007

Note:

- (1) The detailed Technical Specification along with technical point-by-point confirmation, Commercial Terms & Conditions applicable for this Enquiry, Confirmation of acceptance for BHEL commercial terms & conditions and Price Bid formats have been posted in BHEL Corporate web site www.bhel.com under Enquiry reference “2620600058”. Your offer should be based on all the above documents.
- (2) Also, you are requested to fill in the Supplier Registration formats available in www.bhel.com (under Advancement – Supplier Registration) and send it along with your offer.

Tenders should reach us before 14:00 hours on the due date Tenders will be opened at 14:30 hours on the due date Tenders would be opened in presence of the tenderers who have submitted their offers and who may like to be present	Yours faithfully, For BHARAT HEAVY ELECTRICALS LIMITED Dy. Genl. Manager / Capital Purchase / MM / Manufacturing
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	<u>BHARAT HEAVY ELECTRICALS LIMITED</u>				Enquiry No. :	
	<u>HIGH PRESSURE BOILER PLANT</u>				Due Date :	
	<u>TIRUCHIRAPALLI- 620 014</u>					
	PH: 0431-2577575				Supplier Qtn. No.:	
CONTACT PERSON	R.RAJAMANO HAR SR. DGM/ CAPITAL PURCHASE PH:0431-2577575 E-MAIL: rrmanohar@bheltry.co.in				Date :	
<u>SPECIFICATION CUM COMPLIANCE CERTIFICATION FOR</u>						
<u>110KV SUBSTATION</u>						
NOTE:-						
1. Vendor must submit complete information against clause no. 9.0 The offer meeting this clause would only be processed.						
2. The "Offered" Column and where applicable, the "Deviations" & "Remarks" Column of this format shall be filled in by the Vendor and submitted along with the offer. Inadequate / incomplete, ambiguous, or unsustainable information against any of the clauses of the specifications/requirements shall be treated as non-compliance.						
3. The offer and all documents enclosed with offer should be in English language only.						
ADDRESS OF THE SUPPLIER :			ADDRESS OF THE INDIAN AGENTS :			
TELEPHONE NOS.:			TELEPHONE NOS.:			
FAX NOS.:			FAX NOS.:			
E-MAIL ADDRESS :			E-MAIL ADDRESS :			
SCOPE: DESIGN, ENGINEERING,SUPPLY, ERECTION, TESTING & COMMISSIONING OF 110KV SUBSTATION COMPLYING WITH SPECIFICATION AS BELOW						

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
1.0	PURPOSE				
1.1	Purpose:	At present the units of BHEL, Tiruchi receive power supply from Tamil Nadu Electricity Board (TNEB) at 11KV voltage. It is intended to receive supply henceforth at 110KV voltage. Hence installation of 110KV switchyard involving step down of voltage to 11KV and retaining the existing 11KV distribution system to the plant is contemplated.			
1.2	Place of Installation	On the southern side of High Pressure Boiler plant and within BHEL, Tiruchi complex.			
2.0	SCOPE OF WORK				
2.1	The scope of work for the Substation Package and associated items covered under this specification shall include but not limited to the following:				
2.2	Supply				
2.2.1	Engineering , Design, fabrication, manufacture, assembly, shop testing including routine tests and inspection at manufacturer's works				
2.2.2	Providing all labours, materials and equipment for testing at shop as required				
2.2.3	All spare parts required for the commissioning of the equipment / system covered under this specification.				
2.2.4	Special tools and tackles, as required, for operation and maintenance , inspection and repair of the equipment/systems offered.				
2.3	Services under Scope of Supply				
2.3.1	Inspection and expediting, handling, packing, forwarding, port clearance, transporting, transit / storage / erection insurances, obtaining statutory approvals and documentation (including presentation and submission of drawings to the statutory authorities like CEA, furnishing completion reports, arranging for inspection and obtaining safety certificates), erection & commissioning and performance testing.				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
2.3.2	Furnishing of complete document / drawings for foundation arrangement drawings along with load details of all the switchyard equipment and transformers,				
2.4	Scope of supply and services of basic equipment				
2.4.1	This section details out the scope of supply and services for 110 KV substation with associated auxiliaries as indicated. Components and services not specifically mentioned here but necessary to complete the stipulated work in all respects, regardless of any omission in this specifications or drawings, is deemed to have been included in this section.				
2.4.2	All equipment covered under this scope shall be in accordance with attached specification and generally as per TNEB standards.				
2.4.3	Submission of drawings, documents & calculations for information / approval of BHEL including those required for submission to Central Electricity Authority.				
2.4.4	Scope of Supply, Erection, Testing & Commissioning of Basic Equipments:	AS PER ANNEXURE - I			
2.5	Schematic diagram of 110 KV Substation	AS PER ANNEXURE - II			
2.6	Consumables				
2.6.1	Supply of all consumables required for start-up, commissioning, initial filling and performance tests is included in the scope.				
2.7	Commissioning Spare Parts				
2.7.1	Supply of commissioning spares along with the main equipment, for replacement of damaged or unserviceable ones during the execution of the project at site, to avoid delay in the Project Schedule.				
2.8	Special Maintenance Tools and Tackles				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
2.8.1	One set of special tools and tackles required for operation maintenance, inspection and repair, neatly packed in steel boxes complete with instructions for all Equipment covered in this scope of work.				
2.9	Scope of work for Erection and Commissioning				
2.9.1	Unloading, handling and storage at site, pre-fabrication / assembly if any, erection, interconnection of switchyard equipments by ACSR conductors/ busbars/ cables, testing, commissioning, trial operation, final painting and performance testing of Switchyard equipment as specified in this tender document with all necessary accessories and auxiliaries. The scope of work shall include all the systems and equipment included in the schedule.				
2.10	Services under Scope of Erection and Commissioning				
2.11	Providing warehousing, testing facilities, facilities for vendor's personnel, obtaining approvals from statutory authorities and providing required documentation, data etc. All Equipment and Instruments required for erection, start-up, initial filling, commissioning and performance test.				
2.12	Training of BHEL's personnel at site on operation and maintenance				
3.0	LIST OF PREFERED MAKES				
3.1	110 KV/11 KV Power Transformer	BHEL, ABB, AREVA, SIEMENS, CGL			
3.2	110 KV SF6 Circuit Breaker	BHEL, ABB, AREVA, SIEMENS, CGL			
3.3	11 KV Vacuum Circuit Breaker	BHEL, ABB, AREVA, SIEMENS, CGL			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
3.4	Potential and Current Transformers	BHEL, MEHRU, ITC, ABB, CGL,			
3.5	110 KV Isolator	ELPRO, GR Power, PR Engg., G.K. Electricals, Electrolite			
3.6	Lightning Arrestor	WS, ELPRO, CGL, OBLUM, LAMCO			
3.7	Insulators	BHEL, WS, MODERN, BIRLA NGK, IEC, Jayashree			
3.8	HT Power cable	Fort Gloster, Asian Cables, CCI, Universal, NICCO, Torrent, Polycab, Central, Crystal			
3.9	LT Power and Control Cables	Fort Gloster, Asian Cables, CCI, Universal, NICCO, Torrent, Polycab, Crystal, Gemscab, Mayur, Rollex, Ecko			
3.10	Conductor/ Bus	INDAL, HINDALCO, Lumino, Omega cables			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
3.11	Protection & Auxiliary Relays	AREVA, ABB, SIEMENS, EASUN REYROLLE			
3.12	Realy, Metering and Control Panel	AREVA, ABB, SIEMENS, Pyrotech Electronics, Meditron			
3.13	Battery	EXIDE, AMARA RAJA, AMCO			
3.14	Battery Charger cum DCDB	Amara Raja, statcon, HBL Nife, Caldye, Chhab			
3.15	Light Fittings	Philips, GE, Bajaj, Crompton			
3.16	Indicating meters	AE, IMP, Rishab, Meco			
3.17	Clamp & Connectors	Megha Engg., Utsav, Rashtriya Udyog, Klemen			
3.18	Cable end termination kits	M-seal, CCI, Raychem			
3.19	Annunciators	Sun Industrial Automation, Minilec, PROCON, Alan electronics.			
3.20	Energy/ Trivector meters	L&T, ABB, SEMS			
3.21	Indicating Lamp (LED Type)	Binay, Technik			
3.22	HRC Fuses	GE, L&T, Siemens			
3.23	Treminal Block	Elmex, Connectwell			
3.24	Pushbuttons, Control switch, selector switch, PVC wires, MCCB, MCB, Structures, fasteners, earthing materials, etc.	Reputed make- Vendor to specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
4.0	DESIGN BASIS				
4.1	Standards	Relevant IS/ IEEE Standards			
4.2	Service	Outdoor			
4.3	Space Provision for future Extension	1 no. 110 KV bay for one additional transformer. 4 nos.11 KV outgoing bays with provision for one additional buscoupler breaker.			
4.4	Nominal System Voltage	110 KV (rms)			
4.5	Highest System Voltage	123 KV (rms)			
4.6	Power frequency withstand voltage	230 KV (rms)			
4.7	Impulse withstand voltage	550 KV (peak)			
4.8	System Grounding	Solidly grounded			
4.9	Number of Phases	3			
4.10	Frequency	50 HZ +/- 3%			
4.11	Max. ambient temperature	45 deg. C			
	Fault Level Parameters:				
4.12	Max. system fault level	750 MVA			
4.13	Magnitude of 3 Phase fault current at 110 KV side	31.5 KA			
4.14	Duration of fault at 110 KV side	1 sec.			
4.15	Magnitude of 3 Phase fault current at 11 KV side	18.4 KA			
4.16	Duration of fault at 11 KV side	3 sec.			
4.17	Creepage distance for insulators	25 mm/KV			
	Busbar Arrangement:				
4.18	Type of Bus	Rigid and strung			
4.19	Bus System	Single Bus			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
4.20	Material of Bus	ACSR/ Alumionium Tube			
	Earthing System:				
4.21	110 KV side	Solidly grounded			
4.22	11 KV side	Vendor to specify			
4.23	Average Electrical soil resistivity	Vendor to do soil resistivity measurement			
4.24	Area to be covered for laying earthmat	Complete switchyard including fencing and future bays.			
4.25	Type of material for earthmat	Min. 65 x 10 mm GI flat			
4.26	Depth of burying earth conductor	Vendor to specify			
4.27	Fault time duration for sizing the earth conductor	1 sec.			
4.28	Type of joint for earth mat	Welded joints			
	Minimum Clearances for 110 KV side:				
4.29	Between Phase and Earth	1000 mm			
4.30	Between Phase to Phase	2800 mm			
4.31	Sectional Clearance	4000 mm			
4.32	Ground Clearance	4600 mm			
	Lightning Protection System:				
4.33	System Type	Vendor to specify			
4.34	Angle of Shield (As per IS:2309)	Vendor to specify			
4.35	Earthing down conductors	Vendor to specify			
	Auxiliary and Control Supply				
4.36	DC supply for Protection Relays	110 V			
4.37	AC supply for control purpose	240 V, 1Ph, 50 HZ			
	Illumination				
4.38	Substation outdoor illumination using HPSV lamp	Vendor to specify			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
4.39	Indoor illumination of Control room	Vendor to specify			
	Cable Trays				
4.40	Ladder/ perforated type G.I. Cable trays of 2mm thick, 75mm height to the required length.				
5.0	TERMINAL POINTS				
5.1	110 KV Power	At the terminals of 110KV transmission line incoming gantry at the incoming bay			
5.2	11 KV Power	At the outgoing terminals of 11KV switchgear			
5.3	415 V Power	At the outgoing of 415V distribution board			
6.0	CIVIL SERVICES WORKS				
6.1	Foundation for Individual Yard Equipment All foundations shall be conventional pad and pedestal type and designed as per IS:456 and IS:4091. All foundations shall be of RCC M20 grade minimum. All steel used for reinforcement shall be HYSD bars of grade Fe 415. Minimum thickness of PCC below foundation shall be 100mm of 1:4:8 mix. Foundations shall be designed for a normal soil bearing capacity of 10 T/sq.m. Min. depth of foundation shall be approx. 2 M for switchyard gantries and approx. 1.5 M for equipments. Plinth height of foundation shall be 300 mm.				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
6.2	Construction of Cable trench RCC cable trench with Pre-cast cover shall be designed for a live load of 200 kg. per sq.m and weight per piece shall not be more than 50Kgs.				
6.3	Construction of single storey control room building using brick masonry with RCC roof. Control room shall be designed taking into consideration future expansion as stipulated in clause 4.3. Involving extension of 11KV breaker panel and control and relay panel. Aluminium doors and windows and water proofing/ weathering course for roof shall be considered. Battery room to be provided with acid proof tiles. Room for Shift-in-charge/ operator to be provided. Foundation shall be with size stone masonry.				
6.4	Chainlink Fencing of the switch yard Total height from FGL 2.7 mtr. (2.2 mtr. Straight and 0.5 mtr. Inclined on outer side) post of angle 65x65x6 mm spaced at 3 mtr. C/C. Grouting of post by PCC 1:4:8 of size 0.3x0.3x0.5 mtr. Deep. Strain post at every 30.0 mtr.C/C or at change of direction. 12 gauge G.I. chainlink jali 2.0 mtr. wide of mesh size 75x75 mm fixed with 10 swg. Total of 4 no. of barbed wire in inclined portion of post. 350 mm thick toe wall of stone masonry 300 mm high above GL.				
6.5	Storm water drain within switchyard. Open Rectangular/ trapezoidal drain in R.R. masonry in C.M. 1:5..				
6.6	Gravelling of Switchyard				
6.7	Walkway RCC Foot path slab for walkway shall be provided within the switchyard for approach to various equipments for operation and maintenance.				
6.8	Scope of Civil works involve supply of all required civil materials.				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
6.9	G.A. drawing for the civil works shall be enclosed with the offer.				
7.0	STRUCTURAL WORKS				
7.1	<p>All structures shall be lattice type with bolted connections.</p> <p>All structural steel shall be of Grade A conforming to IS:2062</p> <p>All structures shall be galvanized as per IS:4759 and thickness shall be 87 microns equivalent to 610 gm per sq.m.</p> <p>All fasteners shall be galvanized and shall conform to provisions of IS:1363 and 6639.</p> <p>All structures shall be designed as per provisions of IS:802.</p> <p>All foundation bolts shall be galvanized and shall conform to IS:5624.</p> <p>Minimum size of the fasteners shall be 12 mm.</p>				
8.0	Detailed Equipment Specification & documents				
8.1	110 KV Circuit Breaker	AS PER ANNEXURE III			
8.2	110/11 KV Power Transformer	AS PER ANNEXURE IV			
8.3	11 KV Switchgear	AS PER ANNEXURE V			
8.4	Control and Relay Panel	AS PER ANNEXURE VI			
8.5	Busbars, Insulators and Accessories	AS PER ANNEXURE VII			
8.6	Isolators	AS PER ANNEXURE VIII			
8.7	Earthing and Lightning Protection	AS PER ANNEXURE IX			

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
8.8	Erection of Electrical Equipment	AS PER ANNEXURE X			
8.9	List of documents/ drawings to be submitted	AS PER ANNEXURE XI			
9.0	REFERENCE LIST / QUALIFYING CONDITIONS :				
9.1	Only those vendors, who have supplied and commissioned at least one Substation of same (Voltage rating, transformer capacity) or higher sizes for similar applications in the past ten years and such substation(s) is(are) presently working satisfactorily for more than one year after commissioning, should quote. However, if such substation(s) has/have been supplied to BHEL, then such substation should be presently working satisfactorily for more than six months after its commissioning and acceptance in BHEL, should quote. The following information should be submitted by the vendor about the companies/ utilities where similar substations have been supplied and commissioned. This is required from all the vendors for qualification of their offer.				
9.2	Name of the customer / company where similar substation is installed.				
9.3	Complete postal address of the customer.				
9.4	Year of commissioning.				
9.5	Name and designation of the contact person of the customer.				
9.6	Phone, FAX no. and e-mail address of the contact person of the customer.				
9.7	Performance certificate from the customers, if available, regarding satisfactory performance of the equipments supplied to them				
10.0	PACKING:				

SNO	DESCRIPTION FOR BHEL REQUIREMENT	SPECIFIED / TO BE CONFIRMED BY	OFFERED	DEVIATIONS	REMARKS
10.1	Sea worthy & rigid packing for all items of substation, all Accessories and other supplied items to avoid any damage/loss in transit. When items are despatched in containers, all small loose items shall be suitably packed in boxes				
11.0	GUARANTEE :				
11.1	24 months from the date of acceptance.				

ANNEXURE- I

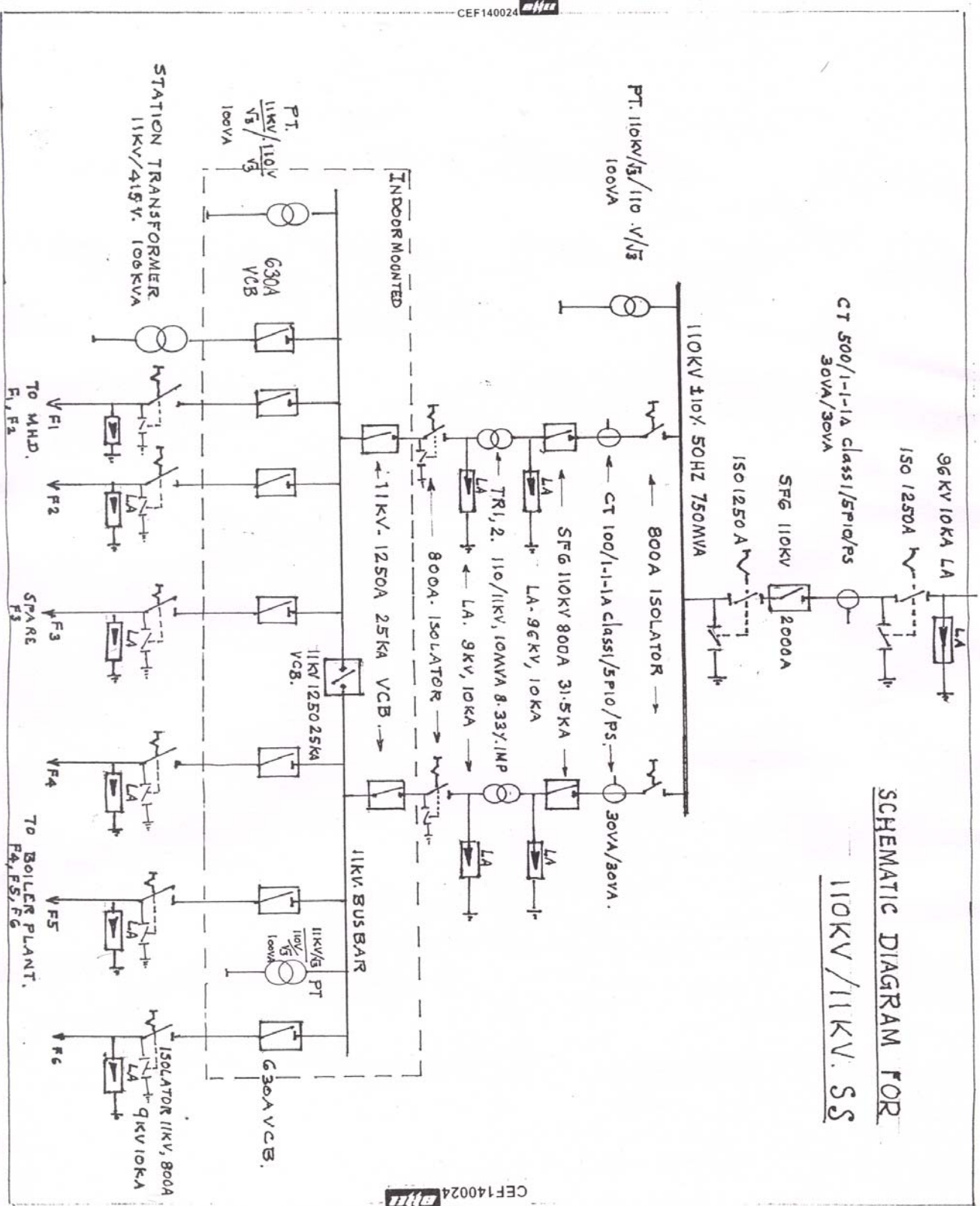
110 KV SUBSTATION

Scope of Supply, Erection, Testing & Commissioning of Basic Equipments

S.No	Description	Qty
1	110/11kV, 3 Phase, 10MVA, ONAN outdoor power transformer with Dy11 connection and OLTC	2 Nos
2	110kV, 3 Phase, 2000A, 31.5 kA for 1second, Outdoor mounted SF6 Circuit breaker	1 No
3	110kV, 3 Phase, 800A, 31.5 kA for 1second, Outdoor mounted SF6 Circuit breaker	2 Nos
4	110kV, 3 Phase, 1250A, 31.5 kA for 1second, Double break, Motorised operated Isolator with earth switch	2 Nos
5	110kV, 3 Phase, 800A, 31.5 kA for 1second, Double break, Motorised operated Isolator without earth switch	2 Nos
6	11kV, 3 Phase, 800A, 25 kA for 1second, Double break, Manually operated Isolator with earth switch	8 Nos
7	110kV Current Transformer, Single Phase, 50Hz, Oil cooled Outdoor type 100A/1-1-1A, Class I/5P10/PS, 30VA/30VA for Transformer feeders	6 Nos
8	110kV Current Transformer, Single Phase, 50Hz, Oil cooled Outdoor type 500A/1-1-1A, Class I/5P10/PS, 30VA/30VA for Incoming feeders	3 Nos
9	96kV, 10kA, Single Phase, Outdoor mounted, Station Class, ZNO surge arrester complete with Surge counter and insulating base	9 Nos
10	9kV, 10kA, Single Phase, Outdoor mounted, Station Class, ZNO surge arrester complete with Surge counter and insulating base	24 Nos
11	110kV/ $\sqrt{3}$ /110V/ $\sqrt{3}$, 100VA Potential transformer, Single Phase, Oil cooled and Outdoor type, Class I/3P	3 Nos
12	Control and relay panel for control and protection of 110kV system	1 set
13	110V DC, 100AH, Battery and Battery Charger	1 No
14	11kV, Indoor Sheet steel, Vacuum Circuit Breaker with suitable protection for each feeder consisting of the following: <ul style="list-style-type: none">- 2 Nos. 1250A, 18.4 kA for incoming feeder- 1 No. 1250A, 18.4 kA for bus coupler feeder- 6 Nos. 630A, 18.4 kA for outgoing feeders	1 Set

	<ul style="list-style-type: none"> - 2 Nos. PT feeder - 1 No. Station transformer feeder 	
15	Galvanised steel support structure for equipment and bus formation	30 MT
16	Clamps and terminal connectors	1 Lot
17	ACSR conductor, Bus bar materials	1 Lot
18	Lightning protection	1 Lot
19	11kV XLPE (E), 1C x 300 sq.mm cable, Aluminium	1500m
20	LT power and control cable 1.1kV grade	1 Lot
21	Cable accessories and termination kits	1 Lot
22	Marshalling kiosk	3 Nos
23	Ladder/Perforated type cable tray 300mm width	1 Lot
24	String insulator, Bus support insulator and hardware	1 Lot
25	Earthing material such as earth strip for equipment earthing, earth mat and earth pit	1 Lot
26	AC distribution board	1 No
27	DC distribution board	1 No
28	Illumination system for switch yard and control room	1 Lot
29	11kV / 415V, 100 kVA, cast resin, dry type, AN, Outdoor mounted station transformer.	1 No
30	Civil works for outer yard and construction of Single storey control room	1 No

ANNEXURE - II **SCHEMATIC DIAGRAM FOR 110KV SS**



ANNEXURE - III

SPECIFICATION FOR 110 KV CIRCUIT BREAKERS

1.0 Scope

- 1.1 This specification covers requirements of 110 kV outdoor circuit breaker.

2.0 Codes and Standards

- 2.1 The design, material, construction, manufacture, inspection, testing and performance of outdoor high voltage circuit breaker shall comply with all currently applicable statutory regulations and safety codes in the locality where the equipment will be installed.
- 2.2 Circuit breakers shall conform to the latest applicable standards. In case of conflict between the standards and this specification, this specification shall govern.

IS:2099	-	Bushings for alternating voltages above 1000 V
IS:2544	-	Porcelain post-insulators for systems with nominal voltage greater than 1000 V
IS:2629	-	Recommended practice for hot-dip galvanizing on iron and steel
IS:2633	-	Methods for testing uniformity of coating of zinc coated articles
IS:13118	-	High Voltage alternating - current circuit breakers
IEC:62271	-	HVAC circuit breakers
IEC:137	-	Bushings for Alternating Voltages above 1000 V
IEC:376	-	Specification and acceptance of new sulphur hexafluoride

3.0 Construction Features

- 3.1 SF6 circuit breakers shall be of single pressure type and shall utilise puffer cylinder for interrupting circuit currents.
- 3.2 In the live tank type of construction, the tank containing SF6 gas and the interrupters, which is at the potential of the circuit to which the circuit breaker is connected when the breaker is in service, shall be insulated from earth by providing suitable support insulators.
- 3.2.1 SF6 gas shall serve as the quenching medium and insulation between open contacts of the

circuit breaker.

- 3.2.2 SF6 circuit breaker pole shall be provided with self-contained gas system.
- 3.2.3 The service connections for gas handling shall be located on each pole tank to facilitate servicing.
- 3.2.4 Unit type gas handling system shall be provided for above purpose.
- 3.2.5 The SF6 gas supplied shall conform to IEC-376 specification.

4.0 Operating Mechanism

- 4.1 The breaker shall be with spring operated mechanism for closing and tripping. Manual provision for closing (if available as standard feature) and tripping shall be provided in the breaker control cabinet for maintenance and emergency operation. This device shall be so interlocked that while it is in service, the breaker cannot be operated from remote.
- 4.2 Operating mechanism shall normally be operated by remote electrical control. Electrical tripping shall be performed by shunt trip coils, for which two nos. shunt trip coils shall be provided. Provision shall be made for local electrical control. Local / Remote selector switch shall be provided in the operating mechanism cubicle.
- 4.3 Closing release shall operate correctly at all values of voltage between 85% to 110% of the rated voltage. A shunt trip shall operate correctly under all operating conditions of the circuit breaker upto the rated breaking capacity of the circuit breaker and at all values of supply voltage between 70% and 110% of rated voltage.
- 4.4 Circuit breaker operating mechanisms capable of storing energy for atleast two complete closing and tripping operations.
- 4.5 Each mechanism shall have an operation counter.
- 4.6 The operating mechanism shall be mounted and enclosed in a weather-proof, vermin-proof, sheet steel cabinet of not less than 2 mm thick conforming to IP55. The cabinet shall also house relays, control and auxiliary equipment of each breaker and for terminating all control, alarm and auxiliary circuits. It shall be provided with hinged doors with provision for locking and removable gland plates to be drilled at site. Inspection window shall be provided for observation of the instruments without opening the cabinet. It shall be mounted so as to provide convenient operation from ground level.
- 4.7 A mechanical indicator shall be provided inside the operating mechanism box to show open and closed positions where it will be visible through a glass window to a man standing on the ground with the mechanism housing closed.
- 4.8 The cabinet shall be fitted with a thermostatically controlled anti condensation heater, a 15A socket and switch and a cubicle lamp suitable for operation on 240V, 50 Hz

supply.

4.9 All controls, gauges, relays, valves, hard drawn copper piping and all other accessories shall be provided including the following:

4.9.1 Low pressure alarm and lock out relay with adjustable pressure setting suitable for operation on the specified DC supply.

4.9.2 A No-volt relay for remote indication of loss of compressor motor supply

4.9.3 Two nos. independent trip coils

5.0 Spring Operated Mechanism

5.1 Spring operated mechanism, if offered, shall be complete with motor, opening / closing spring with limit switch for automatic charging and all necessary accessories to make the mechanism a complete operating unit.

5.2 After failure of power supply to the motor, atleast one open-close-open operation of the circuit breaker shall be possible.

5.3 Breaker operation shall be independent of the motor that shall be used solely for compressing the closing spring.

5.4 Closing action of the circuit breaker shall compress the opening spring ready for tripping.

5.5 When closing springs are discharged, after closing the breaker, closing springs shall automatically be charged for the next operation. Facility for manual charging of closing springs shall be provided.

5.6 The time required to charge the closing spring after the closing operation shall not exceed 10 seconds.

5.7 Under-voltage alarm relay to permit remote indication of loss of circuit supply to the spring charged motor and controls.

5.8 Spring charge indicator to indicate the state of energy stores in the system.

5.9 The spring charging motor shall be suitable for operation on 240V AC and 110V DC supply.

6.0 Bushings

6.1 Porcelain used for the manufacture of bushing shall be homogeneous, free from laminations, cavities and other flaws or imperfections that might affect the mechanical or dielectric quality and shall be thoroughly vitrified, tough and impervious to moisture. Bushings and insulators shall have creepage distance to suit heavily polluted atmosphere.

6.2 Glazing of the porcelain shall be of uniform brown colour free from blisters, burns and similar other defects. Bushings shall be designed to have ample mechanical strength and

rigidity for the conditions under which they will be used. All bushings of identical ratings shall be interchangeable.

- 6.3 Puncture strength of bushings shall be greater than the dry flashover value. When operating at normal rated voltage, there shall be no electric discharge between the conductors and bushing which would cause corrosion or injury to conductors, insulators or supports by the formation of substances produced by chemical action. No radio interference shall be caused by the bushings when operating at the normal rated voltage.
- 6.4 All iron parts shall be hot dip galvanised and all joints shall be air-tight. Surface of the joints shall be trued-up, porcelain parts by grinding and metal parts by machining. Bushing design shall be so as to ensure a uniform compressive pressure on the joints.
- 6.5 All current carrying contact surfaces shall be silver faced. Silver facing shall not be less than one mil. in thickness.
- 6.6 Bushings shall satisfactorily withstand the insulation level specified in relevant standards.

7.0 Contacts

- 7.1 Main contacts shall have ample area and contact pressure for carrying the rated current and the short time rated current of the breaker without excessive temperature rise which may cause pitting or welding. Contacts shall be adjustable to allow for wear, easily replaceable and shall have minimum of movable parts and adjustments to accomplish these results. Main contacts shall be the first to open and the last to close so that there will be little contact burning and wear.
- 7.2 Arcing contacts, if provided, shall be the first to close and the last to open and shall be easily accessible for inspection and replacement. Tips of arcing and main contacts shall be silver faced or have tungsten alloy tipping.
- 7.3 Positive mechanical interconnection shall be provided between interrupting contacts, resistor switches (when used), blast valve mechanism, if any, to ensure maximum operating reliability and retention timing.
- 7.4 If multi-break interrupts are used, they shall be so designed and augmented that a fairly uniform voltage distribution is developed across them.

8.0 Terminals

- 8.1 Two clamp type earthing terminals each suitable for clamping earthing conductor shall be provided on each circuit breaker.

9.0 Interlocks

- 9.1 Key release mechanical interlocks shall be incorporated in the operating mechanism for interlocking with the associated isolators, so that operation of the circuit breaker is dependent on a "Key-trapped" situation. In addition, electrical interlocks with associated isolators shall be provided.

10.0 Additional Requirements

- 10.1 Circuit breakers shall be of restrike free.
- 10.2 Circuit breakers shall be capable of clearing short line faults with the same impedance behind the bus corresponding to the rated fault current.
- 10.3 Circuit breakers shall be capable of breaking 25% of rated fault current at twice rated voltage under out of phase conditions as per standards specified.
- 10.4 The manufacturer shall furnish the design features provided to effectively deal with:
 - 10.4.1 Breaking of inductive currents and capacitive currents.
 - 10.4.2 Charging of long lines and cables.
 - 10.4.3 Clearing developing faults within the full rating of the breaker.
 - 10.4.4 Opening on phase opposition.

11.0 Name Plate

Each breaker shall be provided with a name plate in English, with data indelibly marked on it like Sl.no. Type, Rated voltage, current, frequency, breaking capacity, eight, insulation level, rated short time current etc.

12.0 Fittings and Accessories

A partial list of some of the major fittings and the accessories to be furnished by the **SUPPLIER** as an integral part of the equipment is given below. Number and exact location of these parts shall be indicated in the Bid.

- 12.1 Operating mechanism housing complete with :
 - 12.1.1 Padlocks and duplicate keys.
 - 12.1.2 Space heaters equipped with automatic thermostatic control.
 - 12.1.3 Local / Remote changeover switch.
 - 12.1.4 Manually operated tripping push button / lever (mechanical) conveniently located to trip all three phases simultaneously.
 - 12.1.5 Operation counter.
 - 12.1.6 Terminal boards with minimum 6 spare terminals.
 - 12.1.7 Control switches to cut off control power supplies.
 - 12.1.8 Fuses as required.
 - 12.1.9 Two earthing terminals.
 - 12.1.10 Auxiliary relays required for satisfactory operation.

- 12.1.11 Motor contactor with thermal release for spring charging motor.
- 12.1.12 Breaker local control switch, 3 pin 15 A socket outlet and cubicle lamp.
- 12.2 Miscellaneous Accessories
 - 12.2.1 Floor clamps.
 - 12.2.2 Earthing pads (two).
 - 12.2.3 Hand operated lifting and lowering devices.
 - 12.2.4 Manually operated device for breaker closing under failure of normal power
(if applicable).
 - 12.2.5 Foundation templates.
 - 12.2.6 Foundation bolts.
 - 12.2.7 Steel frames for frame mounted breakers.
 - 12.2.8 Under carriage with flanged rollers and rail fixing clamps for rail mounted breakers.
 - 12.2.9 Gas pressure detector.
 - 12.2.10 Position indicator.

13.0 Spare Parts

- 13.1 The Supplier shall furnish detailed list of spares as per his recommendations and quote separately for the same with their suggested quantities.

14.0 Tests and Test Reports

- 14.1 All routine tests shall be witnessed by the Purchaser.

ANNEXURE – IV

Specification of 110/11 KV Power Transformer

1.0 Transformer Specification:

Conformation to Specification: IS 2026-1977 (Part I to V)

Type	: Two winding Transformer
Primary Voltage	: 110 KV
Secondary Voltage	: 11 KV
No. of Phases	: 3
Frequency	: 50 HZ
Power Rating	: 10 MVA
Transformer Connection	: Dy11
Winding	: Copper
Type of cooling	: ONAN
Tap Changer	: On load tap changer
Application	: Outdoor application
Cooling Equipment	: Radiator
Primary Terminals Type	: Condenser Type Bushing as per IS:2099
Secondary Terminal	: Outdoor terminal bushing
No. of Taps	: Vendor to specify
Suitability	: To suit Parallel operation
Max. ambient temperature	: 50 deg. C
% Impedance at rated current	: Vendor to specify
Value of load and no load loss	: Vendor to specify
Details of aux. Power supply	: Vendor to specify
Insulation level for each winding	
(Power frequency & Impulse)	: Vendor to specify

2.0 Protection Devices and accessories:

- 2.1 Oil surge relay / Bucholz relay
- 2.2 Pressure relief valve/ Explosion vent
- 2.3 Dehydrating Breather

- 2.4 Temperature Indicator to indicate oil and winding temperature and to operate an alarm/ trip circuit at preset temperatures.
- 2.5 Oil level indicators
- 2.6 Insulating oil as per IS:335-1993.
- 2.7 Conservator tank
- 2.8 Oil drain Valve
- 2.9 Air release device
- 2.10 Oil filling hole with cover
- 2.11 Filter Valve
- 2.12 Lifting lugs
- 2.13 Jacking lugs
- 2.14 Rollers/skids
- 2.15 Inspection cover
- 2.16 Rating Plate
- 2.17 Terminal Marking Plate
- 2.18 Two Earthing Terminals

- 3.0 Tests and Measurements : As per IS:2026

ANNEXURE - V

Specification for 11 KV Switchgear

Type of Switchgear: Indoor metalclad Vacuum switchgear

System Details:

System	11 KV, 3 phase, 50 HZ
Highest system voltage	12 KV
Breaking Capacity	18.4 KA at 11 KV
Short time current	18.4 KA for 3 seconds
Impulse level	75 kvp
PF withstand	28 KV
Neutral Earthing	Solidly earthed

Other Details:

Control Supply	110 VDC	Closing/Tripping/Indication
	240 V AC	Spring charging motor/ Heater/Illumination/ Socket
Paint	Electrostatic Powder Coating Pebble gray to shade No. RAL:7032	

Standards Applicable:

Switchgear : IEC:56/IS:13118-1991/ IS:3427-1969
CT : IEC:185/ IS:2705-1992
PT : IEC:186/ IS:3156-1992

Statutory Regulations:

Meets Indian Electricity Rules 1956
Clause No. 29, 35, 48, 51, 64A, 67&120

Description of Vacuum Switchgear:

Fixed Portion:

Metalclad sheet steel cubicle, comprising:	
1	Breaker chamber with automatic safety shutters & Hinged door
2	Current transformer cum cable termination chamber
3	Busbar chamber
4	Instrument panel
5	Set of manually isolated multiway secondary sockets
6	Primary fixed isolating contacts
7	Lifting arrangement of panel for shipping

Moving Portion:

Horizontally drawout, Horizontally isolated Truck with:

1	Vacuum interrupters / PTs
2	Set of Primary moving isolating contacts
3	Set of multiway secondary plugs
4	Motor/ manually charged independent spring closing mechanism with mechanical On/Off & Spring charge indicator, operation counter, manual Trip/Close device, spring charging limit switch
5	Auxiliary switch having 6NO+6NC contacts
6	Spring release coil
7	Shunt trip coil
8	Spring charging motor

Standard Fitments on Fixed Portion:

Set of completing items such as:	
1	Fuses and links, Labels, Terminal blocks
2	Sliding type terminal blocks for CT & PT circuits
3	Small wiring
4	Illumination lamp and switch
5	Three pin socket and switch (5/15A, 240 VAC)
6	Foundation bolts
7	Set of earth bars
8	Anti-condensation heaters, thermostats & switch
9	Set of dust & vermin proofing

Details of Fitments on Incomer Module:

Sl.No.	Description	Quantity
1.	Breaker Panel with truck mounted VCB	1 no.
2.	Arrangement for terminating XLPE power cable without sealing kits, glands or lugs	1 set
3.	Cast resin current transformers Ratio : 600 / 5-5 A Core-I : 15VA Class 1.0 Core-II : 15VA Class 5P10	3 nos.
4.	Indicating Lamps (LED type)	3 nos.
5.	Trip / Neutral/ close switch	1 no.
6.	Ammeter (MI, 96 sq.mm) with selector switch, 0-600 A range	1 no.
7.	Digital energy meter with test link block with settable CT, PT ratios.	1 no.
8.	3 pole IDMT 2 O/C & 1 E/F relay, CDG31 of Alstom make with 3 sec. operating time at 10 times plug setting or numerical relay	1 no.

9.	Anti-pumping relay	1 no.
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Details of Fitment on Module: OG

Sl.No.	Description	Quantity
1.	Breaker Panel with truck mounted VCB	1 no.
2.	Arrangement for terminating XLPE power cable without sealing kits, glands or lugs	1 set
3.	Cast resin current transformers Ratio : 300 / 5-5 A Core-I : 15VA Class 1.0 Core-II : 15VA Class 5P10	3 nos.
4.	Indicating Lamps (LED type)	3 nos.
5.	Trip / Neutral/ close switch	1 no.
6.	Ammeter (MI, 96 sq.mm) with selector switch, 0-300 A range	1 no.
7.	Digital energy meter with test link block with settable CT, PT ratios.	1 no.
8.	3 pole IDMT 2 O/C & 1 E/F relay, CDG31 of Alsthom make with 3 sec. operating time at 10 times plug setting or Numerical relay	1 no.
9.	Anti Pumping Relay	1 no.

ANNEXURE – VI

SPECIFICATION FOR RELAY AND CONTROL PANELS

1.0 Scope

- 1.1 This specification covers the requirements of relay, metering and control panels and the associated equipment mounted therein.

2.0 Codes and Standards

- 2.1 The design, manufacture and performance of equipment covered by this specification shall conform to the relevant Indian Standards and Codes. Where Indian Standards are not available, they shall conform to relevant British, IEC and American Standards.

- 2.2 The equipment shall conform to following standards in particular.

IS:375	-	Marking and arrangement of switchgear, busbars, main connections and auxiliary wiring.
IS:722	-	AC electricity meters
IS:1248	-	Direct acting indicating analogue electrical measuring instruments and their accessories
IS:2208	-	HRC cartridge fuse links for voltage upto 650 V.
IS:2705	-	Current transformers
IS:3156	-	Voltage transformers
IS:3202	-	Code of practice for climate proofing of electrical equipment.
IS:3231	-	Electrical relays for power system protection
IEC:44	-	Instrument Transformers
IEC:185	-	Current Transformers
IEC:186	-	Potential Transformers
IEC:255	-	Electrical Relays
IEC:269	-	LV Fuses
IEC:1036	-	Static Meters

3.0 Scope of Work

- 3.1 The scope of design, manufacture, testing and supply of equipment covered under this

specification shall include but not necessarily be limited to the following:

- 3.1.1 Design, engineering and fabrication of panels as per the specifications.
- 3.1.2 Supply and mounting of all the equipment and auxiliary equipment like auxiliary relays, test switches, test blocks, plugs, timers, indicating instruments, etc., necessary for satisfactory functioning of the control and protection system.
- 3.1.3 The protection system shall be provided with additional auxiliary contacts to integrate system with the **PURCHASER**'s DCS for the purpose of Data Acquisition.
- 3.1.4 All internal wiring between all equipment upto the terminal blocks and the inter-panel wiring.
- 3.1.5 Preparation and furnishing of all data / drawings / documents as per the specifications.
- 3.1.6 Testing at works of the panels and the mounted equipment.

4.0 Design Requirement

4.1 Constructional Features

- 4.1.1 The panels shall be 'Simplex' type.
- 4.1.2 Panels shall be sheet steel enclosed dust and vermin proof type. Panels shall be floor mounting, free standing, formed on a framework of standard sections. The enclosure shall be of cold rolled sheet of 3 mm for front and back and 2.5 mm thick for rest. Panel supporting structure shall be so designed to form a rigid structure.
- 4.1.3 All doors and openings shall be provided with neoprene gaskets.
- 4.1.4 The panels shall be suitable to be installed on a base frame supplied in one piece along with foundation bolts. Amply dimensioned oblong holes shall be provided at the bottom of all the panels for their installation on base frame in addition the panels shall have an additional base channel at the bottom with smooth surface. Anti vibration type mounting shall be provided.
- 4.1.5 A suitable removable undrilled gland plate shall be provided for cable entry from bottom. Suitable double compression type cable glands for control cables of required size quantity and material shall be included in the scope of supply.
- 4.1.6 The degree of protection of the panels shall be IP52.

4.2 Mounting

- 4.2.1 All instrument and control gears and relays shall be mounted on the front. All equipment shall be flush or semi-flush type.
- 4.2.2 Checking and removal of components shall be possible without disturbing the adjacent equipment. It shall be possible to set all the measuring relays "insitu". All mounted equipment inside the panels shall have "identification tags of self sticking Engraved tapes; in addition identification numbers shall be painted on panel wall to give permanent identification mark. The mounting of terminal blocks and any other auxiliary equipment such as transducers, interposing CTs etc. shall be done in such a way so as to be readily accessible but without impeding the access to internal wiring and components.

- 4.2.3 The centre line of switches, push buttons and indicating lamps shall be not less than 750 mm from the bottom of the panel. The centre line of relays, meters, recorders shall not be less than 450 mm from bottom of the panel. All switches, push buttons, indicating lamps, relays, etc. shall be neatly arranged in a matching manner.
- 4.2.4 The control panels shall be matched with other panels in dimension, colour and mimic.
- 4.3 Type of Panels
- 4.3.1 The simplex panels shall consist of vertical front panels with mounted equipment and rear wiring access. Doors shall have handles with locking facility.
- 4.4 Wiring
- 4.4.1 All wiring shall be done with PVC insulated, 650V grade, single-core multi strands (minimum 3 strands) annealed copper conductors suitable for temperature and humidity specified. The cross section of the wires for voltage, current and control circuits shall be 2.5 Sq.mm and that for the alarm circuits shall be 1.5 Sq.mm. The wires shall be vermin proof and shall be laid in plastic troughs. Respective phase colour shall be used for PT & CT circuits. Black colour shall be used for auxiliary AC supply & neutral of CT & PT circuits and gray colour shall be used for DC control circuits.
- 4.4.2 Each wire shall be identified at both ends with wire numbers by means of PVC ferrules. Colour coding for the wires shall be as per IS:375. Each cable shall be identified with aluminium tags.
- 4.4.3 Minimum 20% spare terminals shall be provided on the panels.
- 4.4.4 The terminals shall be suitable to receive crimped wires to give positive connection. All terminals shall be properly shrouded against accidental contact. Sufficient terminals shall be provided so that not more than one wire is connected to each terminal.
- 4.4.5 The terminal blocks shall be 600V grade 10 amps rated, one piece moulded complete with insulated barriers, stud type terminals, washers, nuts and lock nuts and identification strips.
- 4.4.6 Terminal blocks for the CT and PT secondary leads shall be provided with test links and isolation facilities. Also CT secondary leads shall be provided with short circuiting and earthing links. Test terminal blocks shall be provided in TVM / kWH circuits.
- 4.5 Painting
- 4.5.1 All metal surface shall be thoroughly cleaned and degreased to remove mill scale, rust, grease and dirt. Fabricated structure shall be pickled and then rinsed to remove any trace of acid. The under surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under surface shall be made free from all imperfections before undertaking finishing coat.
- 4.5.2 After preparation of the under surface, the relay and control panel shall be spray painted with two coats of final paint. Colour shade of final paint shall be pebble / flint grey, shade RAL 7032 with glossy finish and shall be duly approved by the **PURCHASER** before final painting is done. The finished panel shall be dried in stoving oven in dust free atmosphere. Panel finish shall be free from imperfections like pin holes, orange peels, run off paint etc. The **SUPPLIER / SUB-SUPPLIER** shall furnish painting procedure details along with the bids.

4.5.3 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust corrosion. If these parts are moving element then these shall be greased.

4.6 Panel Illumination

4.6.1 CFL lamps working on 240V AC, operated by door switches shall be provided for internal panel illumination. These shall be fully shrouded.

4.6.2 A 240V, 1-Phase, 5 Amp., 3 Pin Socket shall be provided in the panel corridor or interior of each cubicle with on-off switch for connection of hand lamps. This socket shall be metal clad type with a spring loaded flap.

4.7 Earthing

4.7.1 A continuous 25 mm x 3 mm copper (tinned) earth bus shall be provided running along the full lengths of the panels. Suitable arrangement shall be provided at the two ends for connection to the plant earthing system.

4.7.2 Each panel and the equipment mounted on each panel shall be securely connected to the earth bus. For this purpose, the earth wire shall be looped from equipment to equipment and both ends of the earth wire shall be connected to the earth bus.

4.8 Space Heaters

4.8.1 Panel space heaters shall operate off 240V AC and shall be supplied complete with on-off switch, fuse and thermostat. A common thermostat shall be provided for the entire panel. The thermostat shall maintain the internal temperature above the ambient temperature to prevent moisture condensation.

4.9 Mimic

4.9.1 Mimic diagram shall be provided on panels. Mimic diagram shall be screwed on to the panels and shall be made of anodised aluminium or plastic of approved fast colour. The mimic shall be 10 mm wide for horizontal run and 5mm wide for vertical run.

4.9.2 Semaphore indicators used for isolator positions, they shall be so mounted in the mimic that isolator (or breaker) closed position shall complete the continuity of the mimic. The mimic diagram shall incorporate red and green lamps for isolator position indication and controlling switches with indicating lamps for breakers.

4.9.3 The colors for various voltages in the mimic diagram shall be as below.

	Voltage Level	Mimic Colour	Shade as per IS:5
a.	11 kV	Canary Yellow	309
b.	110 kV	Signal Red	537

5.0 Equipment Specifications

5.1 Instruments

5.1.1 All instruments shall be switchboard type, back connected, flush mounted, dust tight and tropicalized. They shall be of square pattern and comply with IS:1248 and shall be

of accuracy class 1.0. They shall have 90deg. scale range. All power measuring meters / transducers shall be suitable for measuring import & export parameters.

5.1.2 Zero adjustment for pointers shall be accessible from the front of the instruments. All auxiliary equipment such as shunts, transducers, interposing CT / PT etc. that are required shall be included in the scope of supply.

5.1.3 All instruments shall be subjected to an applied potential test of 2.0 kV for one minute. Wherever specified, digital meters shall be provided to indicate frequency and power factor parameters.

5.1.4 Frequency Meters

a. The Frequency Meters shall be long range, calibrated for 45-50-55 Hz. These shall be of digital type.

5.1.5 Ammeters, Voltmeters, KVAR meters, KVA meters

- a. These shall be of moving iron type, with centre zero provision. The KVAR meter and KVA meter shall be suitable for measuring unbalanced loads on a 3-phase, 3 wire system.
- b. The kW meter, digital type and voltmeter shall operate off PT secondary voltage of 110 V. These shall be suitable for export / import parameters.
- c. kWH and kVARH meters shall be provided with a separate 3 phase 4 wire type test blocks for the testing of the meters without disturbing the CT and PT secondary connections.

5.1.6 Power Factor Meters

- a. This meter shall be of digital and the range of pf meters shall be 0.5 - 1 - (-0.5).
- b. These shall operate on 110V PT secondary.
- c. This meter shall be suitable for measuring PF in four quadrant.

5.1.7 Transducers

- a. Transducers with output of (4-20) mA shall be arranged for voltage, frequency, current, power factor, MW, MVA and MVAR for hooking up to DCS system. Transducers need not be provided wherever the analog signal could be made available from PQM meter.

5.2 Indicating Lamps

5.2.1 These shall be switchboard type of low power consumption, LED cluster type lamps and shall be supplied complete with necessary resistors. Lamps shall be provided with screwed translucent covers to diffuse light. The lamp covers shall preferably be unbreakable, moulded, heat resistant material and shall be provided with chromium plated bezels.

5.3 Control Switches

5.3.1 All control switches shall be rotary, back connected type having cam operation contact mechanism. Phosphor bronze contacts shall be used on switches.

5.3.2 The handle of control switches used for circuit breaker operation shall turn clockwise for closing and anti-clockwise for tripping and shall be spring return to neutral

from close / trip with lost motion device. Each switch shall be provided with external red and green indicating lamps.

- 5.3.3 Ammeter selector switches shall be with make before break feature and shall have 3-position, suitable to read phase voltages.

5.4 Control Devices

- 5.4.1 All control devices shall be of MCB type. MCBs shall generally be mounted on the top half of the panels. All MCBs shall be provided with suitable identification labels.

5.5 Annunciator

- 5.5.1 Facia type microprocessor based annunciators shall be provided on the control panels for all alarm / trip functions of the system.
- 5.5.2 Unless stated otherwise, the annunciators shall be suitable for operation with normally open fault contact which closes on a fault.
- 5.5.3 One common audible alarm, one common acknowledge push button, one reset push button and one 'all lamp test' push button shall be provided common to all annunciators.
- 5.5.4 DC supply failure indication shall be provided separately with DC under voltage relays with reverse flag indication. On failure of DC supply to the panel, a lamp and a horn with AC supply shall operate. There shall be provision for canceling AC horn. The DC bell and AC horn shall have distinctly separate tones.
- 5.5.5 All transformer internal faults shall be hooked-up to annunciator and windows of 20% shall be provided as spare for Purchaser's use.

5.6 Relays

- 5.6.1 All relays shall be switchboard pattern, back connected draw out type suitable for flush mounting and fitted with dust tight covers. The relays conform to IS:3231 or BS:3950 and BS:142.
- 5.6.2 A set of test block and test lead for necessary secondary injection tests shall be included. All relays in draw out cases shall have suitable spring loaded contacts for inserting test block.
- 5.6.3 Relays shall be provided with hand / auto reset type contacts and flag indicators. The flag indication shall be suitable for external hand resetting and mechanically interlocked to prevent falling when relays is subjected to vibration. The rating of the auxiliary contacts shall not be less than 5 amp at 240V AC and 1.5 amp for 110V DC. Relay coils to be suitable for the specified DC voltage.
- 5.6.4 The detailed lists of relays for each panel is listed elsewhere. The relays shall be supplied with the necessary accessories to make the system complete.
- 5.6.5 Test terminal block shall be provided, wherever multifunction relays are envisaged.

5.7 Name and Identity Plates

- 5.7.1 All instruments, relays and other electrical devices mounted on the control panel shall

be provided with plates bearing the manufacturer's name, serial number and the electrical rating data.

- 5.7.2 Plastic plate at least 10 mm wide bearing suitable identification marks shall be fixed in the interior of the switchboard, at the test blocks, at the fuse blocks and at the cable terminals. Similar plates shall be fixed to the exterior of the switchboard in appropriate places to indicate the functions of control switches, push buttons, lamp and other equipment not incorporated in the mimic diagram.

5.8 Auxiliary PT and CTs

- 5.8.1 Necessary auxiliary potential transformers for open delta potential polarisation and auxiliary current transformers, wherever required, shall be included in supply.

- 5.8.2 The instrument transformers shall have the required accuracy class and the same shall be specified in the offer.

5.9 Trivector Metering for tariff purposes

- 5.9.1 Integrating meters of the Trivector or equivalent types capable of indicating kWh, kVARh, kVAh directly shall be provided for measuring and recording grid parameters. Meters shall be suitable for measuring import as well as export parameters, including 'lag' and 'lead' functions for reactive kVARh for import & export

- 5.9.2 They should be suitable for 3 phase, 4 wire 50 Hz circuits with unbalanced loading and with three elements connected to current and potential transformers of specified ratio.

- 5.9.3 The trivector meters for tariff purposes shall be of digital type, class 0.5 accuracy with RS485 communication port.

- 5.9.4 Test terminal blocks (TTB) shall be provided in the panels, wherever the trivector meters are installed.

6.0 Details of Protective Relays

6.1 Protections for Plant side Switchyard:

- 6.1.1 Protection of the transformer shall be achieved through microprocessor based, composite protective digital relay to cover differential, restricted earth fault and over fluxing function. Alternatively, static / microprocessor based discrete relays can also be offered.

- 6.1.2 All transformer in-built protective functions should be connected through individual auxiliary relays.

- 6.1.3 Numeric relay to cover the following protective functions and features shall be envisaged:

- Directional over current and earth fault relays
- Non-directional over current and earth fault relays for primary
- Vector surge relay
- Over and under voltage relay on EHV end
- PT fuse failure relay
- Breaker struck up protective relay

- Trip Circuit Supervision
- DC supply failure relay
- Alpha numeric display
- Communication port, RS485 interface
- Necessary software, for processing of data
- Event recording facility, for minimum of 5 events

6.1.4 Additional discrete relays, with make & type as furnished in the list of approved makes, shall be provided for the following main functions (even if some of the protections are covered in the numeric / multifunction relays):

- Vector surge relay (microprocessor based)
- Transformer HV side standby earth fault relay
- Under and over voltage relays for 11 kV bus
- Neutral displacement relay for 11 kV bus
- Transformer LV side over current relays
- 'No-volt' relay for circuit breaker interlocking

6.2 Line Protections at plant end

6.2.1 Numeric type distance relay to cover the following minimum protective functions and features shall be provided:

- Four zone distance protection, with polygonal and circular characteristics
- Back-up over current and earth fault functions
- Switch-on to fault blocking function
- Circuit breaker struck-up protection
- Trip Circuit Supervision
- DC supply failure relay
- PT fuse failure blocking
- Fault locators
- Alpha numeric display
- Communication port, RS485 interface
- Necessary software, for processing of data
- Event recording facility, for minimum of 5 events

6.2.2 Additional discrete relays, with make & type as furnished in the list of approved makes, shall be provided for the following main functions (even if some of the protections are covered in the numeric / multifunction relays):

- Non-directional over current and earth fault relays
- Directional over current and earth fault relays
- No-volt' relay for circuit breaker interlocking

7.0 Inspection and Tests

- 7.1 Following tests shall be carried out on the control panel in the presence of Purchaser or his authorised representative:
- 7.1.1 Checking of correctness of wiring of circuits and continuity.
 - 7.1.2 Electrical control, interlock and sequential operation test.
 - 7.1.3 High voltage test 2000 volts to earth for one minute.
 - 7.1.4 Insulation resistance of the complete wiring with all equipment mounted on the panels.
 - 7.1.5 Routine tests according to the standards followed by the manufacturer on the instruments, relays & other devices.
 - 7.1.6 DC tests
- 7.2 Certified copies of all routine test certificates shall be submitted to the purchaser before despatch for review by the Purchaser

8.0 Drawing and Data

- 8.1 Supplier shall furnish all the data / drawings / documents specified in the specifications for review by the Purchaser.
- 8.2 Supplier shall submit for Purchaser's approval the general arrangement drawings showing front, rear and side views, PT / CT connection drawings, AC / DC power diagrams, detailed bill of materials, interconnection and wiring diagrams, terminal arrangement drawings as well as other drawings which may be deemed necessary by the Purchaser. Approval of the GA drawing is required before the fabrication of panel starts. Approval of wiring and interconnection drawings is required before the manufacturer proceeds with the panel wiring. Programming listings for numeric type relays and relay setting format for all relays shall also be submitted for approval.
- 8.3 Final as-built drawings, catalogues of all relays / meters, O&M manuals and Instructions shall be furnished.

ANNEXURE – VII

SPECIFICATION FOR BUSBARS, INSULATORS AND ACCESSORIES

1.0 Standards

IS:398	-	Aluminium conductors for overhead transmission purposes.
IS:731	-	Porcelain insulators for overhead power lines with a nominal voltage greater than 1000 V.
IS:2121	-	Conductors and earth wire accessories for overhead power lines
IS:2544	-	Porcelain post-insulators for systems with nominal voltage greater than 1000 V
IS:2633	-	Methods for testing uniformity of coating of zinc coated articles
IS:4826	-	Hot-dipped galvanised coatings on round steel wires
IS:5082	-	Wrought aluminium and aluminium alloy bars, rods, tubes and sections for electrical purposes

2.0 General Requirement

- 2.1 Busbars and electrical connections in the outdoor area shall be of aluminium.
- 2.2 Busbars shall be in continuous lengths between supports and provision shall be made for expansion and contraction with variation in conductor temperature including sliding supports where necessary. Materials used for busbars and connections shall be stressed not more than forty (40) per cent of their elastic limits. **All joints shall be made only at equipment connection points. Straight joints should be avoided totally.**
- 2.3 The busbars, insulators and connectors shall be mechanically dimensioned to safely withstand the effect of temperature, wind load, tensile forces and movement of connections as well as short circuit forces.
- 2.4 Connections between two (2) dissimilar metals shall be of bimetallic type.
- 2.5 Unless otherwise approved, busbars and connections shall be so arranged and supported that under all circumstances, including short circuit conditions, the clearances specified shall be maintained.
- 2.6 The temperature rise of conductors and connections shall not exceed 35 deg.C over 50 deg.C design ambient.
- 2.7 All connectors for busbars, equipment etc. shall be of suitable design to permit easy dismantling for maintenance purposes.

3.0 Tubular Bus

- 3.1 The tubular buses shall be of aluminium alloy for electrical purposes. The tubes shall be hard drawn extruded from pure electrolytic aluminium rods and shall conform to IS:5082. The alloy shall be of 63401 grade in WP temper having high aluminium purity and maximum fifty five (55%) percent IACS conductivity.
- 3.2 The surface shall be clean, smooth and uniform.
- 3.3 The tube size shall be offered as per standard international pipe sizes (IPS), schedule 40.
- 3.4 For the inside diameter (ID) of the tube there shall be no plus tolerance and for the outside diameter (OD) there shall be no minus tolerance.
- 3.5 End plugs shall be provided wherever the tube extends beyond the clamps.

4.0 Stranded Conductor

- 4.1 The stranded conductors shall be ACSR, and shall be drawn from ninety nine and half (99.5) percent pure electrolytic aluminium rods with 60% IACS conductivity and shall conform to IS:398.
- 4.2 The surface shall be clean, dry and free from grease and burns.
- 4.3 Steel wires used in ACSR conductors shall be hot dip galvanized. Zinc coating shall be uniform and even.
- 4.4 Grease used shall be chemically neutral with respect to aluminium, zinc and steel.

5.0 Insulators and Hardware

- 5.1 The porcelain used for string and post insulators shall be sound, free from defects, thoroughly vitrified and smoothly glazed. Insulators shall have a good lustre and of uniform brown colour. The glaze shall be unaffected by sudden changes in temperature and by atmospheric pollution. Insulators shall have creepage distance to suit heavily polluted atmosphere.
- 5.2 Insulators shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surface. Design feature shall be such as to reduce radio interference level.
- 5.3 The string and post insulators shall have the best electrical and mechanical characteristics.
- 5.4 Strain strings shall comprise the conventional ball and socket type disc insulators. Individual insulators as well as strings of the same type shall be interchangeable with one another. The locking clips shall be made of phosphur bronze and shall provide positive locking of the coupling.
- 5.5 All metal parts shall be made of good commercial grade malleable iron or open hearth or electric furnace steel, hot dip galvanized conforming to IS:2633. Castings shall be free from blowholes, cracks and other similar defects.
- 5.6 The ultimate breaking strength of the insulator shall be decided considering a factor of safety of 2.5 (minimum) under short circuit conditions.

6.0 Clamps, Connectors, Fittings and Accessories

- 6.1 The connectors and clamps shall be made of aluminium alloy casting conforming to A6 of IS:617. All bolts, nuts and washers shall be of mild steel and hot dip galvanized. No part of a clamp or connector shall be less than 10 mm thick.
- 6.2 All castings shall be free from blowholes, surface blisters, cracks and cavities. All sharp edges and corners shall be blurred and rounded off.
- 6.3 The current bearing capacity of each connector shall be equal to or greater than that of the conductor size for which the connector is designed. The bore of each connector shall be of the correct diameter to fit the conductor size specified. Bores intended for a range of conductor sizes will not be permitted.
- 6.4 The size and shape of each connector in any assembly or location shall be free from visual and audible corona.
- 6.5 The hardware used in the connectors, clamps etc. shall have protective coating of approved type to eliminate galvanic action with the main body, wherever required.
- 6.6 The connections shall be such that the contact surfaces are more or less sealed from atmosphere and are not subjected to weathering.
- 6.7 The connectors, clamps and accessories shall be such that the contact pressure is uniformly distributed over the whole contact surface and no stress concentration develops anywhere. In order to achieve this a torque wrench shall be used for tightening all bolts in accordance with manufacturer's recommended torque. Bolts shall be used as clamping devices and not as current carrying parts.
- 6.8 Tension clamps shall be designed to avoid any possibility of damage or deformation of the stranded conductor and separating the individual strands. Wherever possible compression type fittings shall be used on stranded conductors.
- 6.9 All current carrying parts shall have minimum contact resistance.

ANNEXURE VIII

SPECIFICATION FOR ISOLATORS

1.0 Standards

- | | | |
|---------|---|--|
| IS:2544 | - | Porcelain post insulators for systems with nominal voltage greater than 1000 V. |
| IS:9921 | - | Alternating current disconnectors (isolators) and earthing switches for voltages above 1000 V. |
| IEC:129 | - | Alternating current disconnectors (isolators) and earthing switches |

2.0 General Requirements

- 2.1 The isolators shall be three pole, gang operated, horizontally mounted, centre pole rotating, operated manually. The isolator shall be complete with bases, insulators, contacts, terminals, blades, operating mechanisms and mounting poles. All switch bases, operating mechanisms, rods, and other steel parts shall be hot dip galvanized.
- 2.2 Isolator and earth switch shall be equipped with all necessary linkages, clamps, couplings, operating pipes and handle supporting brackets, guide blades, auxiliary switches, earth braids and other miscellaneous items required to make complete installation. All operating rods and levers shall be cut to length and all machining operations and threading shall be completed in the factory.
- 2.3 The isolator and the earth switch shall be mechanically designed to safely withstand the effects of temperature, windload, tensile forces and movement of connections, as well as short circuit forces.
- 2.4 The isolator blades and all conducting parts shall be of high conductivity copper or aluminium alloy. Bolts, screws and pins shall be provided with lock washers, keys or equivalent locking facilities. All bearings shall be such that no lubrication or maintenance is required.
- 2.5 During the course of normal operation, it is likely that the isolator may be left in the open / close position for long periods of time. They shall be designed to operate satisfactorily even after being kept in one position for long period.
- 2.6 The isolator shall be capable of breaking the magnetising current of associated power transformer.
- 2.7 The temperature rise of any part of the isolator and associated equipment shall not exceed the maximum permissible temperature rise values.

3.0 Contacts

- 3.1 The main blades of all switches shall have adequate strength and current carrying capacity conforming to the maximum rating. The switch blade shall be so assembled that no part of the blade can move relative to other. The current path shall not be through

any springs or movable pin connection. The contact shall be designed to be adjustable, self-aligning high pressure providing self-cleaning action. All contact surfaces shall be silver faced copper. All contacts shall be replaceable at site.

4.0 Earth Switch

- 4.1 Earth switch shall be provided wherever necessary and shall form an integral part of each pole of the isolator. The earth switches shall be three pole, manually group operated. Each earth switch shall be mechanically interlocked with its own blades when the main blades are closed and vice versa. A flexible tinned copper earthing braid of 185 sq.mm shall be provided from each earthing blade and shall be suitably attached to the earthing connector for common wire connection.

5.0 Insulators

- 5.1 The insulators shall be porcelain post type. Porcelain used for the manufacture of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown colour, free from blisters, burns and other defects.
- 5.2 The insulators shall have creepage distance to suit heavily polluted atmosphere. The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differences between the metal and the porcelain parts throughout the range of temperature variation shall not loosen the parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be of high grade cast steel or malleable steel casting and they shall be machine faced smoothly and galvanised.

6.0 Operating System

- 6.1 Isolator shall be of manual closing type. The switch operating mechanism shall be so designed that it will not cause excessive deflection to the member to which it is attached.
- All switches shall be self-locking in the open and closed positions independent of the control shaft restraint. Each mechanism shall be provided with an indicator showing direction of rotation for opening / closing.
- 6.2 The operating mechanism shall provide a quick, simple and effective operation. One man shall be able to operate the isolator / earthing switch without undue effort.
- 6.3 The ganging mechanism shall be provided with sufficient adjustment to allow for final alignment of the isolator blades for simultaneous operation.
- 6.4 The manual operating handles shall be mounted on the base of supporting structure. Guide bearings shall be provided if necessary at a height of 750 mm above grade level. All bearings shall be weather protected by means of covers and grease retainers. Bearing pressure shall be kept low to ensure long life and ease of operating.
- 6.5 The operating mechanism to be with turn and twist arrangement.

7.0 Interlock

- 7.1 A mechanised key interlock shall be incorporated for interlocking with associated circuit breaker. The key shall be released only when the isolator is fully closed or fully opened.

8.0 Accessories

8.1 Position Indicator

- 8.1.1 A mechanical position indicating device shall be provided for each isolator / earthing switch.

5.8.2 Terminal Pads

- 8.2.1 Each isolator shall be provided with suitable terminal pads of high conductivity aluminium alloy. The terminal pads shall be designed to withstand loads due to dead weight of the aluminium tube / ACSR conductor connected to it and alignment of the isolator main blade shall not be disturbed due to the above.

8.3 Earthing Pads

- 8.3.1 Each pole of the isolator shall be provided with two earthing pads of non corrodible materials at opposite ends, brazed to the base. Flexible tinned copper braid of 185 sq.mm shall be provided for connecting operating handles of isolators and earthing switches to the earthing system.

8.4 Auxiliary Switches

- 8.4.1 Each isolator switch shall be provided with a mechanically driven auxiliary switch with all necessary contacts for control, indication and interlocking purposes and with four normally open and four normally closed spare contacts. All contacts shall be rated for 10 amps. continuous rating at specified DC voltage.

8.5 Name Plate

- 8.5.1 A weather proof and corrosion proof name plate shall be provided on isolator, marked with information as per IS.

9.0 Spares

- 9.1 The Supplier shall furnish detailed list of spares as per his recommendations.

10.0 Tests

10.1 Factory Tests

- 10.1.1 Complete tests shall be made at the manufacturers plant to determine the performance and operating characteristics of the assembled isolators, earth switches and their respective accessories to determine whether or not the guarantees have been met.

- 10.1.2 Unless otherwise specified all tests shall be carried out in accordance with IS:9921. All routine and acceptance tests shall be witnessed by the Purchaser's engineer.

ANNEXURE – IX

SPECIFICATION FOR EARTHING AND LIGHTNING PROTECTION

1.0 Introduction

- 1.1 This specification covers the minimum requirements of the Earthing and Lightning protection for the 110 / 11 kV Substation.

2.0 Standards

- | | | |
|--------------|---|---|
| IS:2309 | - | Practice for the protection of buildings and allied structures against lightning - code of practice |
| IS:3043 | - | Code of practice for earthing |
| ANSI/IEEE:80 | - | Guide for safety in alternative current substation grounding Indian Electricity Rules |

3.0 General Requirements

- 3.1 The power plant and the substation shall be provided with a complete earthing system, comprising earth electrodes in conduction with buried earth grid. The Vendor shall submit the design calculations.
- 3.2 Fault level to be considered for sizing earth mat:
- 3.2.1 As given in the specification for basis of design .
- 3.2.2 However, the Vendor shall also get exact fault levels projected over 20 years from the Electricity Board.
- 3.2.3 The effective earthing resistance shall not exceed 1 Ohm. After the award of the contract, the Vendor shall measure the resistivity at his cost and based on this, earthing system shall be designed. The soil treatment with salt charcoal etc. shall be done, if necessary, to bring down the soil resistivity to less than 60 Ohm-m.
- 3.3 All buried conductors shall be of GI with earthing electrodes of cast iron pipe / plate.
- 3.4 Design Basis for Earthing
- 3.4.1 Time duration for conductor sizing : 3 Sec.
- 3.4.2 Time duration for calculation of step and touch potential : 1 sec.
- 3.4.3 Maximum allowable temperature for joints : As per IEEE-80

4.0 Earthing Layout

- 4.1 Earthing Conductors in outdoor areas shall be buried atleast 600 mm below finished grade level unless stated otherwise.
- 4.2 Minimum spacing between rod electrodes shall be provided unless stipulated otherwise.
- 4.3 Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, etc., it shall be laid minimum 300 mm below and shall be rerouted in case it fouls with equipment / structure foundations.

- 4.4 Tap-connections from the earthing grid to the equipment / structure to be earthed shall be terminated on the earthing terminals of the equipment and structures, if the equipment is available at the time of laying the cover of 'earth riser' with temporary wooden equipment foundation / pedestal for future connections to the equipment earthing terminals.
- 4.5 Earthing conductors along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable welding / cleating at intervals of 750 mm. Earthing conductors along cable trenches shall be on the wall nearer to the equipment. Cable trays and supports shall be connected to the earth mat at every 10 metres interval. Wherever it passes through walls, floors, etc. galvanised iron sleeves shall be provided for the passage of the conductor.
- 4.6 Earthing conductor around the building shall be buried in earth at a minimum distance of 150 mm from the outer boundary of the building. In case high temperature is encountered at some location, the earthing conductor shall be laid minimum 1500 mm away from such location.

5.0 Equipment and Structures Earthing

- 5.1 Earthing pads shall be provided by the Supplier of the apparatus / equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by short and direct earthing lead free from kinks and splices. In case earthing pads are not provided on the item to be earthed, same shall be provided in consultation with Purchaser.
- 5.2 Whether specifically shown in drawings or not, steel / RCC columns metallic stairs etc. shall be connected to the nearby earthing grid conductors by two earthing lead. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.
- 5.3 Metallic pipes, conduits, and cable tray sections for cables installations shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.
- 5.4 Metallic conduits shall not be used as earth continuity conductor.
- 5.5 Wherever earthing conductor crosses or runs along metallic structures such as water, conduits, pipe, etc. and steel reinforcement in concrete it shall be bonded to the same.
- 5.6 Light poles, junction boxes on the poles, cable and boxes / glands lockout switches etc. shall be connected to the earthing conductor running along with the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points, whether specifically shown or not.
- 5.7 Metallic sheaths and armour of all multi core power cables shall be earthed at both equipment and switchgear end.
- 5.8 Substation gates shall be connected to the gate rod by 65 sq.mm 600 mm long copper flexible braid and the gate post in turn shall be connected to the main mat. Alternative fence post shall be connected to main earthing conductor by separate earth conductor.

6.0 Specific Requirement for Earthing Systems

- 6.1 Each earthing lead from the neutral of the transformers shall be directly connected to two electrodes treated earth pit which, in-turn, shall be connected to station earthing grid. All electrodes shall have cement concrete pit with a cast iron cover hinged to a cast iron frame to have an access to the joints.
- 6.2 Earthing terminal of each lightning arrestor, power transformer and lightning down conductors shall be directly connected to earth electrode which, in-turn, shall be connected to station earthing grid.

7.0 Jointing

- 7.1 Earthing connections with equipment earthing pads shall be bolted type. Contact surface shall be free from scale, paint, enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Equipment bolted connections, after being checked and tested shall be painted with anti-corrosive paint / compound.
- 7.2 Connections between equipment earthing lead and main earthing conductors and between main earthing conductors shall be welded / brazed type. The welds should be treated with red lead and afterwards thickly coated with bitumen compound to prevent corrosion.
- 7.3 Steel to copper connections shall be brazed type and shall be treated to prevent moisture ingress.
- 7.4 Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.
- 7.5 All ground connections shall be made by electric arc welding. All welded joints shall be allowed to cool down gradually to atmospheric temperature before putting any lead on it. Artificial cooling shall not be allowed.

8.0 Control Room Earthing

- 8.1 An extension of earthing conductor from the station earthing shall be supplied and installed by the **SUPPLIER**. The **SUPPLIER** shall also supply and install all required earthing for control and relay panel, switchgears, local PBs, distributions boards, etc. The metallic cases of all instruments, relays control switches mounted on the cubicle and panels shall be connected to the cubicle for panel earth busbar.

9.0 Lightning Protection System

- 9.1 7/9 SWG GS Shield wire with necessary tension and PG clamps, crimping type lugs shall be used, as per statutory regulations. The shield wires / spikes shall protect busbars and substation equipment with angle of shield as per statutory regulations.
- 9.2 The Conductors of the lightning protection system shall not be connected with conductors of the safety earthing system above ground level.
- 9.3 Down conductors shall be supported by suitable clamps on the structures at 750 mm interval.
- 9.4 Connection between each down conductor and pipe electrodes shall be made via test joint located approximately 1500 mm above ground level.
- 9.5 Lightning conductors shall not pass through or run inside GI conduits.
- 9.6 All metallic structures within a vicinity of 2000 mm in air and 5000 mm below ground shall be bonded to the conductors of lightning protection system.

ANNEXURE – X

SPECIFICATION FOR ERECTION OF ELECTRICAL EQUIPMENT

1.0 Scope

- 1.1 The specification covers the installation requirements of all electrical equipment and accessories required for the switchyard and associated accessories for efficient and trouble free operation.

2.0 Standards

- 2.1 The electrical installation work covered by this specification shall unless otherwise stated comply with the requirements of the latest edition of relevant Indian Standard, statutory regulations and codes of practices.

Indian Electricity Rules

Tariff advisory committee

IS:2274	-	Code of practice for electrical wiring installation
IS:2309	-	Code of practice for protection of building and allied structures against lightning
IS:3043	-	Code for practice for earthing
IS:6600	-	Guide for loading of oil immersed transformers
IS:6665	-	Code of practice for industrial lighting
IS:10118	-	Code of practice for selection, installation & maintenance of switchgear and control gear

3.0 General Requirements

- 3.1 The installation shall be carried out by an electrical contractor holding a valid license as required by the State Government. The Vendor shall provide particulars of the license held by him or his sub-contractor to the Purchaser. The installation shall require approval of the Central Electricity Authority and the Vendor shall prepare all necessary drawings / documents. He shall also fully assist the Purchaser in obtaining approval from any other statutory authorities for the successful commissioning of the equipment covered under the scope of the Supplier.
- 3.2 Any modification in the equipment or installation that may be demanded by the inspector shall be carried out at no additional cost to the Purchaser.
- 3.3 In accordance with the specific installation instructions or as directed by the Purchaser, the Supplier shall unload, erect, assemble, install, wire, test and commission

all electrical equipment included in this contract. Equipment shall be installed in a neat workman like manner with highest regard for safety.

- 3.4 Providing storage and safe custody of the equipment etc. at site till such time these are erected, tested and commissioned and handed over to the Purchaser. Any damage to the equipment etc. during this period shall be made good by the Supplier at his own cost.
- 3.5 Erection materials, tools, testing instruments or any other machinery of any nature shall not be supplied by the Purchaser. The Supplier shall arrange for the same in a timely manner and he shall not be allowed to claim for any delay or extra cost of any nature.
- 3.6 Consumable materials of any nature required for the erection job shall also be arranged by the Supplier.
- 3.7 Clearing the site after completion of erection as well as regular clearance of unwanted materials from site, returning all packing material and excess material shall also be covered under the scope of work.
- 3.8 All equipment and instruments of indoor and outdoor, shall be inscribed with number, nomenclature, danger boards and other instructions.
- 3.9 The Supplier shall touch up the surface for all equipment, which are scratched and / or damaged during transportation and erection. The paint used shall match exactly the surface being touched up.
- 3.10 The Supplier shall employ skilled and semi-skilled labourers for erection, installation & testing as required. All electricians, cable jointers, wiremen, welders and others employed shall be suitably qualified possessing valid certificates / licenses recognised by the competent authorities.
- 3.11 The Supplier shall also furnish a list of Engineers / Supervisors and staff employed by him for erection and installation jobs, giving in brief, qualification and experience of such staff and indicating whether they hold such competency certificates / licenses to supervise the electrical installation jobs as required under Indian Electricity Rules & State Electrical Inspectorate Rules.
- 3.12 The Supplier shall set up his own workshop and other facilities at site to undertake fabrication jobs, pipe bending, threading etc.
- 3.13 The Supplier shall carry out all tests at site for outdoor and indoor Electrical equipment and commission the installation in the presence of Purchaser's representative. The Supplier shall be responsible for final adjustment of relays, instruments, meters breakers etc. and also for submission of relay settings and calculations.

4.0 Equipment Erection

- 4.1 All support insulators, Circuit breakers, Isolators, Transformers, Instrument Transformers, etc. shall be properly handled and erected as per the relevant codes of practice and manufacturer's drawings and instruction manuals.
- 4.2 For power / distribution transformers, drying out and oil filling as required, after

checking and testing the dielectric strength shall be carried out by the **SUPPLIER**. If required oil filtration shall be carried out and the **SUPPLIER** shall arrange for the necessary equipment.

- 4.3 Handling equipment, sling ropes etc. should be tested before erection and periodically for strength.
- 4.4 Necessary Junction boxes for CTs and PTs shall be supplied and installed.

5.0 Cables

- 5.1 Supplier's scope of work shall include unloading, laying, fixing, jointing, bending and terminating of cables. Supplier shall also supply all the necessary hardwares for jointing and terminating of cables. Cable shall be laid directly buried in earth, on cable racks in built up trenches, on cable trays and supports in conduits and ducts or bare on walls, ceiling etc. Where specific cable layouts are not shown in the drawing Supplier shall route these cables as directed by the Purchaser.
- 5.2 Markers shall be installed at all road crossing and joint positions. Their provision and installation shall be included in the areas.
- 5.3 Sharp bending and kinking of cables shall be avoided. The bending radius for various types of cables shall not be less than those specified by manufacturer.
- 5.4 Power and control cables shall be laid in separate cable trays. The order of laying of various cable in trenches shall be as specified below:
 - 5.4.1 11 kV cables on top most tier from top.
 - 5.4.2 415V cables on middle tier.
 - 5.4.3 Control cables in bottom most cable tier.
- 5.5 Some extra length shall be kept in each cable run at a suitable point to enable one or two straight through joints to be made at a later date, if any fault occurs.
- 5.6 Cable jointing shall be in accordance with relevant Indian Standard Codes of practice and Manufacturer's special instructions. Materials and tools required for cable jointing work shall be supplied by Supplier. Cable shall be firmly clamped on either sides of a straight through joint at not more than 300 mm away from the joints. Identification tags shall be provided at each joint and at all cable terminations.
- 5.7 Metal sheath and armour of the cable shall be bonded to the earthing system of the station.
- 5.8 Each cable shall be identified with its designation number as indicated in the drawings. The cable tags with these numbers engraved shall be tied to the cable all along its length at reasonable intervals.
- 5.9 Cable clamps shall be of 3 mm thick galvanised MS spaced at every 1.5 M interval.
- 5.10 Conductors for sizes upto 6 Sq.mm shall be with copper conductor. For all the sizes, the conductors shall be of 'multi-stranded' type.
- 5.11 Control cables shall be of cross section not less than 2.5 Sq.mm for general applications.

- 5.12 Closing and tripping signals of the circuit breakers shall not be taken in the same cables.
- 5.13 In cases, power and control applications shall not be grouped in a multicore cable. Also, AC & DC powers shall not be taken through same cable.
- 5.14 The cables shall be derated for the selected laying arrangement as per manufacturer's recommendations.
- 5.15 In no cases, different size cables shall be used in parallel.
- 5.16 From all field equipment, such as Cts, Pts, isolators, circuit breakers etc., shall be connected to respective control & relay panel through individual multicore control cable.
- 5.17 Spare cables shall be considered for multicore cables as follows:

1 Spare	-	upto 9 core
2 Spares	-	from 10 core to 14 core
10 % Spares	-	above 14 core.

6.0 Cable Trays, Accessories and Tray Supports

- 6.1 Cable trays shall either be run in concrete trenches or overhead supports from building steel, floor slab, etc.
- 6.2 All cable trays and fitting will be ladder type / perforated type and fabricated from MS Sheet / Structures. They shall be hot dip galvanized, with minimum 65 microns thickness. The sheet steel thickness shall be not less than 2 mm and the rungs shall be at intervals not more than 300 mm. Runner collar height shall be minimum 75 mm x 15 mm. Rungs shall be of minimum 30 mm x 15 mm, with slotted holes. The trays shall be connected through couplers only and they shall not be welded.

7.0 Structural works

- 7.1 The Bidder shall examine the site conditions and necessary transportation clearances before sending his bid.
- 7.2 All steel work shall be efficiently and sufficiently protected against damage in transit to site from any cause whatsoever. Distorted steel received during the transport from stores to the fabrication yard shall not be used in fabrication unless the distortions are minor which in the opinion of Engineer-in-Charge can be removed by acceptable methods.
- 7.3 The Supplier should arrange his own erection bolts and nuts, drifts, compressed air required for erection and also cranes, trailers, tractors, with necessary tools and tackles for loading. Unloading, handling and transport of fabricated or raw steel to the erection site and erection thereof.
- 7.4 If the dismantling, modification, rectification, addition, re-erection etc. is necessitated due to any discrepancy in the fabrication drawing prepared by the Supplier or in fabrication the Supplier shall be held responsible for the same despite the fact that such drawing might have been approved by the Engineer-in-Charge. In such cases the Supplier shall not be paid anything towards carrying out such modification, rectification, addition, re-erection, dismantling and transportation.

ANNEXURE – XI

LIST OF DOCUMENTS / DRAWINGS TO BE SUBMITTED

1.0 Drawings / Documents required along with the Bid

- 1.1 The Bidder shall submit in his Technical Bid the drawings, diagrams and all such information which are necessary to fully understand the offer both technically and commercially.
- 1.2 As a minimum requirement the following information shall be supplied with the technical bid in sufficient detail to fully describe the scope of work and the services offered:
 - 1.2.1 Duly filled-in data sheets and the schedules.
 - 1.2.2 Terminal point details.
 - 1.2.3 Time schedule for the design, manufacture, delivery, erection, testing, commissioning and trial operation indicating important milestone activities.
 - 1.2.4 Dimensioned General Arrangement Drawings of each equipment.
 - 1.2.5 Bill of quantities with type references for Relay, metering & control panels
 - 1.2.6 Bill of quantities for control cabling, earthing & structural items.
 - 1.2.7 Switchyard layout with plan & sections.
 - 1.2.8 Quality Assurance Plan.
 - 1.2.9 Catalogues of all equipment.
 - 1.2.10 List of sub-suppliers.
 - 1.2.11 Design calculations for the following:
 - 1.2.12 CT, PT burden calculation.
 - 1.2.13 Earthing mat design & calculations
 - 1.2.14 Lighting calculations for switchyard illumination.
 - 1.2.15 Busbar sizing calculation.
 - 1.2.16 Switchyard lightning protection calculation.
 - 1.2.17 Typical drawings for switchyard equipment structures.

2.0 Drawings and information required from Supplier During Contract Stage

- 2.1 The drawings and documents to be furnished by the supplier after the award of the contract shall include but not limited to the following.
 - 2.1.1 Detailed time schedule in the form of network or bar chart for the design, manufacture, delivery, erection, testing and commissioning period with critical milestone activities and other important intermediate dates for uninterrupted progress of the project.
 - 2.1.2 Duly filled-in revised technical data sheets.
 - 2.1.3 Quality Assurance Plan.
 - 2.1.4 List of manufacturers and specifications of all standard equipment.

- 2.1.5 Dimensioned General Arrangement Drawings, wiring diagrams, name plate details, terminal details, cable box / bushing details and drawings, for all equipment.
- 2.1.6 Detailed single line diagrams & schematic drawings.
- 2.1.7 Switchyard layout with plan & sections.
- 2.1.8 Electrical equipment layout of power house & other cogeneration equipment, including control room.
- 2.1.9 Any other drawings / documents, as required by CEA, for getting approval of complete 11 kV & 110 kV systems.
- 2.1.10 Catalogues of all equipment.
- 2.1.11 Design calculations for the following:
 - Equipment supports & structures.
 - CT, PT burden calculation.
 - Relay setting calculations & co-ordination charts.
 - Earthing calculations.
 - Lighting calculation, for switchyard illumination.
 - Busbar sizing calculation.
 - Bus support insulator cantilever strength calculation.
 - Switchyard lightning protection calculations.
- 2.1.12 Construction drawings as listed below:
 - Equipment supports / load data.
 - Switchyard foundation arrangements.
 - Transformer foundation arrangement drawings.
 - Cable trench & tray drawings.
 - Oil soak pit drawings
 - Oil drain arrangement drawings
 - Details of equipment earthing
 - Arrangement of foundations for equipment structures & transformers.
 - Complete structure drawings
- 2.1.13 Cable schedules.
- 2.1.14 Cable interconnection diagram.
- 2.1.15 Junction box and ACDB GA and wiring drawings.
- 2.1.16 Test certificates & inspection reports of all equipment.
- 2.1.17 Other drawings & documents as indicated in various sections of this document.
- 2.1.18 Erection manuals & installation procedures for all equipment.
- 2.1.19 Operation & maintenance manuals for all equipment & systems