TAMILNADU GENRATION AND DISTRIBUTION CORPORATION LIMITED.

2X660MW ENNORE SEZ COAL BASED STPP AT ASH DYKE OF NCTPS, CHENNAI

AMENDMENT NO – 01

FUEL OIL UNLOADING SYSTEM

SPECIFICATION NO.: PE-TS-412-166-A001

BHARAT HEAVY ELECTRICALS LTD

POWER SECTOR

PROJECT ENGINEERIING MANAGEMENT

NOIDA

AMENDMENT / ADDITION TO EXISTING CLAUSES OF FOHS TECHNICAL SPECIFICATION. BIDDER TO NOTE THAT EXISTING DISCRIPTION AS APPEARING IN THE SPECIFICATION STANDS DELETED / MODIFIED OR ADDED AND CLAUSES / DETAILS AS MENTIONED IN "AMMENDMENT (TO BE READ AS)" COLUMN SHALL BE APPLICABLE AND COMPLIED BY THE BIDDER.

S.NO.	CLAUSE	EXISTING DISCRIPTION	AMENDMENT (TO BE READ AS)
1.0	2.1.0 SECTION C, PAGE NO 20 OF 487.	NEW REQUIREMENT.	FOLLOWING IS INCLUDED IN BIDDER'S SCOPE: "CONTROL VALVES FOR FUEL OIL TEMPERATURE CONTROL I.E. AUX STEAM FOR FLOOR COIL HEATER (ON/OFF TYPE) CONTROL VALVE AND AUX STEAM FOR SUCTION HEATER (MODULATING) CONTROL VALVE."
2.0	1.0 (INSTRUMENTAION & CONTROL) SECTION C ANNEX I, PAGE NO 34 OF 487.	NEW REQUIREMENT.	ALL PRIMARY INSTRUMENTS, HARDWARE & JBS ETC USED FOR MEASUREMENT FOR HFO AND LDO SYSTEM SHALL BE FLAME PROOF (IEC-79.1, PART I).
3.0	SECTION C ANNEX II	NEW REQUIREMENT.	APPLICABLE STANDARD FOR MAJOR ITEMS HAVE BEEN MENTIONED AT ANNEXURE II, SECTION C OF TECHNICAL SPECIFICATION. CODES FOR DESIGN, INSPECTION AND SERVICE FOR C&I ITEMS SHALL BE AS PER ANNEXURE I TO THIS AMMENDMENT.
4.0	P&ID FOR HFO SYSTEM, # PE-DG-412-166-A101	NEW REQUIREMENTS	1. FOLLOWING INSTRUMENTS SHALL ALSO BE PROVIDED IF NOT SHOWN SPECIFICALLY IN PID: A) DUAL REDUNDANT PRESSURE TRANSMITTERS SHALL BE PROVIDED AT DISCHARGE HEADER OF HFO PUMPS REQUIRED FOR INTERLOCK & PROTECTION. B) DUAL REDUNDANT RADAR TYPE LEVEL TRANSMITTERS

			SHALL BE PROVIDED FOR EACH OIL TANK REQUIRED FOR INTERLOCK & PROTECTION. C) DUAL REDUNDANT TEMPERATURE ELEMENTS SHALL BE PROVIDED FOR EACH OIL TANK REQUIRED FOR OIL TEMPERATURE CONTROL IN TANK. D) LEVEL SWITCHES SHALL BE PROVIDED ON EACH FUEL TANK AS PER TECHNICAL SPECIFICATION SECTION C, ANNEX VIII, CL. NO.15.4.9.2 (B), PAGE NO. 94 OF 487. E) EACH PUMP PROVIDED IN OIL WATER SEPARATOR PIT AND SUMP SHALL BE PROVIDED WITH PRESSURE SWITCH AT DISCHARGE FOR INTERLOCK & ALARM. 2. REVISED PID IS ATTACHED.
5.0	P&ID FOR HSD SYSTEM, # PE-DG-412-166-A102.	NEW REQUIREMENTS.	1. FOLLOWING INSTRUMENTS SHALL ALSO BE PROVIDED IF NOT SHOWN SPECIFICALLY IN PID: A) DUAL REDUNDANT PRESSURE TRANSMITTERS SHALL BE PROVIDED AT DISCHARGE HEADER OF HFO PUMPS REQUIRED FOR INTERLOCK & PROTECTION. B) LEVEL SWITCHES SHALL BE PROVIDED ON EACH FUEL TANK AS PER TECHNICAL SPECIFICATION SECTION C, ANNEX VIII, CL. NO.15.4.9.2 (B), PAGE NO. 94 OF 487. 2. REVISED PID IS ATTACHED.
6.0	P&ID FOR STEAM AND CONDENSATE FOR HFO HEATING AND TRACING, #		REVISED PID IS ATTACHED.

	PE-DG-412-166-A103.		
7.0	ADDITION	NEW REQUIREMENT	CHAPTER FOR PERFORMANCE GUARANTEE TO BE ESTABLISHED BY SUCCESSFUL BIDDER IS ATTACHED AS ANNEXURE II TO THIS AMMENDMENT.
8.0	PG.NO. 42 OF 487, CL.NO.1.9, SR.NO. 2	SIZE: 50 NB X8 M LONG FOR CONDENSATE SERVICE.	SIZE: 25 NB X8 M LONG FOR CONDENSATE SERVICE.
9.0	ADDITION		SPECIFICATION FOR ELECTRIC HEAT TRACING IS ATTACHED AS ANNEXURE III TO THIS AMENDMENT.

NOTE:

1. REPLIES TO PRE-BID QUERIES ARE ATTACHED AS ANNEXURE IV TO THIS AMENDMENT AND SHALL BE BINDING ON BIDDER.

ANNEXURE - I
CODES AND STANDARD

System particulars are as follows:

Tropicalisation:

1. All equipment supplied against this specification shall be given tropical & fungicidal treatment in view of the severe climatic conditions prevailing at site as described under project data.

2. Tropical protection shall conform to IS:3202 entitled "Climate Proofing of Electrical Equipment" or BI:CP-1014:1963 entitled "Protection of Electrical Power Equipment Against Climatic condition".

Gases and fumes	Sulphur dioxide and/or trioxide fumes mildly present. Climate is tropical conductive to fungus growth.
Dust particles	Heavily dusty with abrasive dust and coal particles of size 5 to 100 microns present in the atmosphere in large quantity.

1.08.00 CODES AND STANDARDS

1.08.01 All equipments, system and service covered under this specification shall comply with the requirements of the latest statutes regulations and safety codes as applicable in the locality where the equipments/systems will be installed. The Bidder shall fully acquaint himself with these requirements and shall ensure compliance with them.

The equipments, systems and services furnished as per this specification shall conform to the codes and standards mentioned in Cl. no. 1.08.02 of this Section. However in the event of any conflict between the requirements of two standards or between the requirements of any standard and this specification, the more stringent requirements shall apply unless confirmed otherwise by the Owner in writing. The decision of the Owner shall be final and binding in all such cases.

The Bidder's scope of supply shall include some items such as thermowells, and other in-line devices for main steam, hot reheat, cold reheat, feed water system falling under the purview of Indian Boiler Regulation (IBR) Act. It shall be the responsibility of the Bidder to obtain the necessary approval of the concerned Inspecting Authority/Chief Inspector of Boilers for the design and design calculations and manufacturing and erection procedures as called for under the IBR act for all items requiring such certifications.

The requirements of statutory authorities (e.g. MOEF, Inspectors of factories, IBR, TAC, BEE, CPCB/TNPCB etc) with regards to various plants areas like Main plant, Fuel oil plant/system, Chlorination Plant, Fire Fighting system, Emission Measurement, Ambient Air Monitoring system etc. shall be complied, even if not actually spelt out.

1.08.02 Reference Codes and Standards

The design, manufacture, inspection, testing, site calibration and installation of all equipment and systems covered under this specification shall conform to the latest editions of codes and standards mentioned below and all other applicable ANSI,

ASME, IEEE, NEC, NEMA, ISA, DIN, VDE, NFPA, IEC, EIA, TIA and Indian Standards and their equivalents. Bidder to note that in no case, OEM/manufacturers own standards shall be accepted.

1.08.02.01 Temperature Measurement

1. Performance Test Code for temperature measurement ASME PTC 19.3 (1974 – R 1998)
2. Temperature measurement - Thermocouples ANSI-MC 96.1 – 1982, IEC 584
3. Temperature measurement by electrical resistance thermometers - IS-2806.
4. Thermometer-element-platinum resistance-IS-2848, IEC 751/DIN 43760
5. RTD Design Code – DIN EN 60751:1996, BS EN 60751 : 2008
6. Thermowell Design Code – ASME PTC 19.3 TW – 2010

1.08.02.02 Pressure Measurement

1. Performance Test Code for pressure measurement - ASME PTC 19.2 (2010)
2. Bourdon tube pressure and vacuum gauges - IS 3624, IS 3602, ASME B 40.1

1.08.02.03 Electronic measuring Instruments & Control hardware

1. Automatic null balancing electrical measuring instruments - ANSI C 39.4 (Rev. 1973), IS 9319
2. Safety requirements for electrical and electronic measuring and controlling instrumentation - ANSI C 39.5 - 1974.
3. Compatibility of analog signals for electronic industrial process instruments - ISA-S 50.1:ANSI MC 12.1 - 1975.
4. Dynamic response testing of process control instrumentation - ANSI MC 4.1 (1975): ISA-S26 (1968).
5. Surge withstand capability (SWC) tests - ANSI C 37.90A (1974) IEEE Std. 472 (1974). IEC – 255.4.
6. Printed circuit boards - IPC TM-650, IEC 326 C
7. General requirements and tests for printed wiring boards - IS 7405 (Part-I) - 1973
8. Edge socket connectors - IEC 130-11.
9. Requirements and methods of testing of wire wrap terminations DIN 41611 Part-2.
10. Dimensions of attachment plugs & receptacles ANSI C73-1973.
11. Direct acting Electrical Indicating Instruments: IS-1248-1968.

1.08.02.04 Instrument Switches and Contacts

1. Contact rating - AC services NEMA ICS Part-2 125, A600
2. Contact rating - DC services NEMA ICS Part-2-125, N600.

1.08.02.05 DDCMIS & other Control System

1. Application of Safety Instrumented System – ANSI/ISA 84.01 1996
2. Functional Safety - Safety Instrumented System for Process Sector – IEC – 61151

3. IEEE Application Guide for Distributed Digital Control Monitoring for Power Plant – IEEE 1046
4. Fossil Fuel Power Plant Steam Turbine Bypass System – ANSI/ISA – 77.13.01
5. Human System Interface Design Review Guide lines – NUREG – 700
6. Annunciation Sequence and Specification – ANSI/ISA 18.1
7. "IEEE 1050, IEEE guide for Instrumentation & control system grounding in generating station",
8. ANSI/ISA-77.44.01-2007 - Fossil Fuel Power Plant - Steam Temperature Controls
9. ANSI/ISA-RP77.60.05-2001 (R2007) - Fossil Fuel Power Plant Human-Machine Interface: Task Analysis
10. ANSI/ISA-77.42.01-1999 (R2006) - Fossil Fuel Power Plant Feedwater Control System – Drum-Type
11. ANSI/ISA-77.20-1993 (R2005) - Fossil Fuel Power Plant Simulators - Functional Requirements
12. ANSI/ISA-77.41.01-2005 - Fossil Fuel Power Plant Boiler Combustion Controls
13. ANSI/ISA-RP77.60.02-2000 (R2005) - Fossil Fuel Power Plant Human-Machine Interface: Alarms
14. ANSI/ISA-77.70-1994 (R2005) - Fossil Fuel Power Plant Instrument Piping Installation
15. ANSI/ISA-TR77.60.04-1996 (R2004) - Fossil Fuel Power Plant Human-Machine Interface-Electronic Screen Displays
16. ANSI/ISA-77.43.01-1994 (R2002) - Fossil Fuel Power Plant Unit/Plant Demand Development-Drum Type
17 ANSI/ISA-77.13.01-1999 - Fossil Fuel Power Plant Steam Turbine Bypass System

1.08.02.06 Electronic Cards, Subassemblies and Componets

a) Unpackaged

i)	Vibration	:	IEC-68.2.6
ii)	Shock	:	IEC-68.2.27
iii)	Drop & Topple	:	IEC-68.2.31

b) Packaged

Vibration, Drop & Static Compression - NSTA

C) Electromgnetic Compatibility

i)	Electrical Fast Transient	:	IEC-801.4
ii)	Surge Withstand	:	IEC-255.4
iii)	Radiated Electromagnetic Field	:	IEC-801.3
iv)	Electrostatic Discharge	:	IEC-801.2
v)	Electromagnetic Emission	:	VDE 0871, Class B

1.08.02.07 UPS System/DC control power supply system:

1. Practices and requirements for semi-conductor power rectifiers - ANSI C34.2-1973.

2. Relays and relay systems associated with electrical power apparatus - IEEE Std. 3.13, ANSI C 3790-1983.
3. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 - 1974
4. Recommended practice for sizing large lead storage batteries for generating stations & substations - IEEE-485.
5. Performance testing of UPS - IEC 146.
6. IEC 62040 – General & Safety requirement of UPS.
7. IEC 62040-2 - UPS – EMC Requirement.
8. IEC 62040-3 - UPS – Method of specifying the performance and test requirement.
9. IEC 60269-2 – Main Supply Fuse.
10. IEC 60947 – MCCB.
11. IEC/EN 60623 – BATTERIES. IEEE485/IEEE1115 IS : 10918, IS : 1069
12. IEC 60146 - For DC system.

1.08.02.08 Control Valves

1. Control Valve sizing - Incompressible fluids - ISA S39.2 - 1972.
2. Control valve sizing - Compressible fluids - ISA S39.3 - 1973, ISA S39.4 - 1974.
3. Face to face dimensions of control valves - ANSI B16.10

1) ISA Hand book of control valves - ISBN B1047-087664-234-2.
2) Valves - flanged, threaded and welding end : ANSI B 16.34(2009)
3) Casting : ASTM A 216 / A 351 (2008)
4) Welded end connection : As per ASME boiler and pressure vessel code / ANSI.B 16.34(2009), B16.25 (2009), B 16.11(2009).
5) Defect removal: ANSI B 16.34 2009.
6) Cleaning : ASTM A 380 2006.
7) CV test : As per ISA procedure S 75.02 (2008).
8) Control Valve seat leakage : ANSI/FCI 70.2

1.08.02.09 Enclosures

1. Types of enclosures - NEMA Std. ICS-6-110.15 through 110.22 (Type 4 to 13).
2. Racks, panels, and associated equipment - EIA: RS-310-B (ANSI C83.9 - 1972)
3. Protection Class for Enclosure, Cabinets, Control Panels and Desks - IS-13947-1962.

1.08.02.10 Apparatus, enclosures and installation practices in hazardous areas

1. Classification of hazardous area - NFPA Art. 500, Vol.70-1984.
2. Electrical Instruments in hazardous dust locations - ISA-RP 12.11
3. Intrinsically safe apparatus - NFPA Art.493 Vol.4.1978
4. Purged and pressurized enclosure for electrical equipment in hazardous location - NFPA Art. 496 1982.

1.08.02.11 Sampling System

1. Stainless steel material of tubing and valves for sampling system - ASTM A269-82 Gr TP316.
2. Submerged helical coil heat exchangers for sample coolers ASTM D 11-98.
3. Water and Steam in power cycle - ASME PTC 19.11(2008).
4. Standard methods of sampling system - ASTM D 1066-69.

1.08.02.12 Annunciators

1. Specifications and guides for the use of general purpose annunciators - ISA RP 18.1-1979.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE std. 472-1974

1.08.02.13 Interlocks, Protections

1. Relays and relay system associated with electric power apparatus - IEEE std.3.13.
2. Surge withstand capability tests - ANSI C.37.90a - 1974 and IEEE Std. 472 - 1974.
3. General requirements & tests for switching devices for control and auxiliary circuits including contactor relays - IS-6875 (Part-I) 1973.
4. Turbine water damage prevention - ASME - TDP-1980.
5. Boiler safety interlocks - NFPA Section 85B, 85D, 85E, 85F,85G.

1.08.02.14 Process Connection and Piping:

1. Codes for pressure piping power piping ANSI B31.1
2. Seamless carbon steel pipe ASTM A-106.
3. Forged and Rolled Alloy steel pipe flanges, forged fittings, valves and parts - ASTM A-182.
4. Material for socket welded fittings - ASTM A-105.
5. Seamless ferrite alloy steel pipe - ASTM A-335.
6. Pipe fittings of wrought carbon steel and alloy steel - ASTM A-234.
7. Composition bronze or metal castings - ASTM B-62.
8. Seamless copper tube, bright annealed ASTM B-168.
9. Seamless copper tube - ASTM B-75.
10. Dimensions of fittings - ANSI B-16.11
11. Valves flanged and butt welding ends - ANSI B16.34.
12. Nomenclature for Instrument tube fittings ISA-RP-42.1 - 1982.

1.08.02.15 Instrument Tubing

1. Seamless carbon steel pipe - ASTM - A106.
2. Material for socket weld fittings - ASTM - A105.
3. Dimensions of fittings - ANSI B16.11
4. Code for pressure piping, welding, hydrostatic testing - ANSI B31.1.

1.08.02.16 Cables

1. Thermocouple extension wires/cables - ANSI C 96.1 - 1982.
2. Colour coding of single or multi-pair cables – VDE 0815

3. Guide for design and installation of cable systems in power generating stations (insulation, jacket materials) - IEEE Std. 422 - 1977.
4. Requirements of vertical tray flame test - IEEE 383 - 1974.
5. Standard specification for tinned soft or annealed copper wire for electrical purpose - ASTM B-33 - 81.
6. Oxygen index and temperature index test - ASTM D-2863.
7. Smoke generation test - ASTMD-2843 and ASTME-662.
8. Acid gas generation test - IEC-754-1.
9. Swedish chimney test - SEN - 4241475 (F3)
10. Instrumentation cables and internal wiring IS-1554 (Part-I, 1976) and IS-5831(1984).
11. Standard for Control, Thermocouple Extension and Instrumentation cable - NEMA WC57-2004 ICEA S-73-532, Rev. 2, 2004)□
12. PVC insulated (heavy duty) Electric cables for working voltages upto and including 1100V - IS:1554 (Part-I)
13 Conductors for insulated electric cables and flexible cords. - IS:8130
14 PVC insulation and sheath of electric cables - IS:5831
15. Mild steel wires, strips and tapes top armoring cables - IS:3975
16. Water Immersion Test - VDE 0815
17 Drums for electric cables - IS : 1048

1.08.02.17 Cable Trays, Conduits

1. Guide for the design and installation of cable systems in power generating station (cable trays, support systems, conduits) - IEEE Std. 422, NEMA VE-1, NFPA-70-1984.
2. Guide for the design and installation of cable systems in power generating station (Cable trays, support systems, conduits) Test Standards, NEMA VE-1 - 1979.
3. Galvanising of Carbon steel cable trays - ASTM A-386-78.

1.08.02.18 Flow measurement

1. ASME Performance Test Code PTC-19.5 (2004), ISA RP3.2
2. BS 1042
3. ISO 5167

1.08.02.19 Surge Protection System

1. Surge withstand capability tests - ANSI C37.90a-1974. IEEE Std. 472 – 1974
2. IEC 61643-1:1998-02 and E DIN VDE 0675 part 6:1996-03/A2: 1996-10
3. IEC 61643-21:2000-09 and E VDE 0845 part 3-1:1999-07

1.08.02.20 Digital Video Recording & Management System (DVRMS)

1. ISO 9001 (2000)
2. ISO/IEC15504 Level3 or higher (SPICE 2.0 Software Process Improvement and Capability Determination)

3. SEICMM Level3 or higher (American Software Engineering Institute - Capability Maturity Model)

Where:

i) IEEE - Institute of Electrical and Electronics Engineers.
ii) ISA - Instrument, Systems and Automation Society
iii) NEMA - National Electrical Manufacturers Association
iv) ANSI - American National Standards Institute
v) NFPA - National Fire Protection Association
vi) ASME - American Society of Mechanical Engineers
vii) IS - Indian Standards
viii) IEC - International Electro-technical Commission
ix) ASTM - American Society for Testing Materials
x) EIA - Electronic Industries Association
xi) DIN - Deutsche Institute Normale
xii) TIA – Telecommunication Industries Association

ANNEXURE - II
PERFORMANCE GUARANTEE

PERFORMANCE GUARANTEE

1.0.0 GENERAL REQUIREMENTS

1.1.0 After satisfactory completion of the trial operation, the performance test shall be conducted at site by the Contractor. Any preparations required for this test shall be carried out by the Contractor for which Owner will provide required shutdown. The duration of the Performance Guarantee Test of the Plant at the rated capacity shall be mutually agreed. However, a stability period of 2 hours before commencement of test and 2 hours test period followed by another 2 hours stable period shall be maintained. The PG test procedure should be submitted to the owner well in advance and got approved before the commencement of PG test. Performance Guarantee Test shall be conducted within 30 days of intimation from the Contractor about his readiness for conducting Performance Guarantee Test. These tests shall be binding on both the Owner and the Contractor to determine performance of the equipment/system with the performance guarantee data.

1.2.0 The tests shall be conducted at the specified load conditions or as near the specified conditions as practicable. The Owner/Contractor will apply agreed factors to compensate for deviation from the designed parameters. The suitable correction curves mutually agreed by the Owner and the Contractor shall be used.

1.3.0 All test instrumentation as required for the Performance Guarantee Test shall be arranged by the Contractor free of cost. Precision instruments required for Performance Guarantee Test shall, however, be arranged by the contractor. Calibration before and after test and installation of the test instrumentation for the test shall be the Contractor's responsibility. All test instrumentation shall be in accordance with the applicable code. All test instruments and calibration procedures shall be duly approved by the Owner. Batch calibration shall not be accepted. The test shall be commenced only after clearance of owner on the above vital issues.

1.4.0 Any special equipment, tools and tackles required for the successful completion of the performance tests shall be provided by the Contractor free of cost.

1.5.0 The performance guarantee figures of the equipment shall be proved by the Contractor during the Performance Guarantee Test.

1.6.0 Should the results of these tests show any decrease from guaranteed values, the Contractor shall modify the equipment within 90 days from the date of intimation by the owner as required to bring it to meet the guarantees. In such cases, the performance tests shall be repeated within one month from the date on which the equipment is made ready again for tests subject to grid requirements at that time. All costs of modifications including labour, material and the cost of additional testing to prove that equipment meets the guarantee shall be borne by the Contractor.

1.7.0 The provisions outlined in the ASME performance test code or other International and Indian approved equivalents shall generally be used as a guide for all the above test procedures unless specified otherwise in the specification. The details of all measuring/recording meters, test instrumentation such as class of accuracy, make etc. shall be covered in the trial operation/ performance test reports. All the list of equipment,

accuracy class and test certificates to be submitted and got approved by the owner before the commencement of trail operation.

1.8.0 PG test to be witnessed by the consultant and the owner

2.0 PERFORMANCE GUARANTEES, PENALTIES & CAPABILITY TESTS:

2.1 The Contractor shall meet the Performance Guarantees as have been indicated in the Specifications.

2.2 The penalty for not meeting the performance guarantees during the Performance Guarantee Test shall be assessed and recovered from the Contractor. Such penalty shall be levied without limitations, in accordance with stipulations made in in this Annexure and shall be without prejudice to all the other conditions of the contract.

2.3 If the guarantees specified are not achieved by the Contractor within 90 days of notification by the Owner, he may at his discretion reject the equipment or accept it after levying and recovering suitable penalties.

2.4 In case there is shortfall in capability of equipment while demonstrating capability tests, the Contractor shall forth-with rectify his equipment within 90 days and re-perform the capability tests to Owner's satisfaction.

3.0 PERFORMANCE PERAMETERS AND PENALTY FOR POOR PERFORMANCE:

3.1 Category I Guarantees: Performance guarantees penalties.
Auxiliary power consumption - Summation of power consumption of working drives at their rated capacities for fuel oil handling system. Base auxiliary power consumption for FOHS and penalties shall be as per mentioned in this Annexure. Bidder to furnish its guaranteed auxiliary power consumption with its offer.

3.2 Category III Guarantees: Performance Guarantee under compulsory correction.
The contractor shall make every effort to practicable to correct the deficiencies. In case the Contractor fails to meet the guarantees, the equipment / system shall be replaced with the one that shall meet the guaranteed values without any time and cost implication to the Owner. The following items are under compulsory correction:

a) Capacity of each HFO & HSD unloading pump (m3/hr).
b) Head developed by each HFO & HSD unloading pump (MWC).
c) Parallel operation of pumps to be demonstrated at site.
d) Vibration level and noise level of all the pumps at the rated duty point shall be demonstrated at site.

Annexure II, AMMENDMENT 1

2 X 660 MW ENNORE SEZ TPS						
Guaranteed Power Consumption For Fuel Oil Handling System Shall be as per Following :						
S.No. (1)	**Description of Equipments (2)**	**Nos. of Equipments (3)**		**Total Guaranteed Power Consumption for Each Equipment at Motor Input Terminals & control Panel (4)**	**Duty Factor (5)**	**Total (KW) (6) = (3A)*(4)*(5)**
		Working	**Standby**			
		(3A)	**(3B)**			
1	HFO Unloading Pumps, 100 M3/hr at 45 MWC pressure	2	1		0.1	
2	HSD Unloading Pumps, 50 M3/hr at 40 MWC pressure	1	1		0.1	
					TOTAL	

Note :	
1	Estimated Power Consumption Figure for the compressed air system (For Working Drives Only) considered is **9.6 KW** (For station)
2	Bidders Guaranteed power consumption at motor input terminals (Not Shaft Power) including power for control panel as furnished in guranteed schedule shall be demonstrated by the successful bidder during performance testing at works/site.
3	The price quoted by the bidder shall be loaded @ (INR) 356607/- for every additional kW (or part thereoff) increase in consumption from the base figure indicated at Note no. 1.0 above.
4	In case the successful bidder fails to establish / prove the guaranteed values of power consumption (base figure of auxiliary power consumption) on actual performance testing at the manufacturing works / site, penalty @ (INR) 356607/- for every additional kW (or part thereoff) increase in consumption from the base figure shall be levied.

To be filled by bidder and to be submitted with price schedule.

ANNEXURE - III
SPECIFICATION FOR ELECTRIC HEAT TRACING

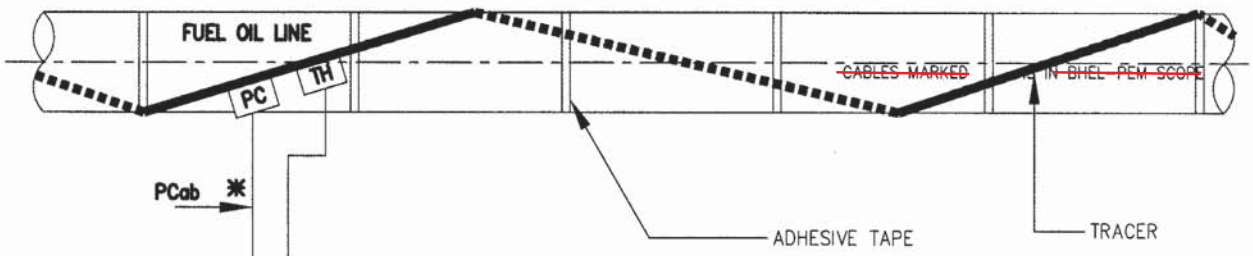
FIRST ANGLE PROJECTION (ALL DIMENSIONS IN MILLIMETRES)

DRAWING No 4-81-441-05249

CAUTION: THE INFORMATION ON THIS DOCUMENT IS THE PROPERTY OF BHARAT HEAVY ELECTRICALS LIMITED. IT MUST NOT BE USED DIRECTLY OR INDIRECTLY IN ANY WAY DETRIMENTAL TO THE INTEREST OF THE COMPANY

LEGEND : PC : POWER CONNECTOR
JB : JUNCTION BOX
PDP : POWER DISTRIBUTION PANEL
TH : THERMOSTAT

CIRCUIT – 1 (TYPICAL)



PCab ✱

J.B

PCab ✱ CC ✱

E.H.T POWER DISITRIBUTION PANELS–1 & 2

nos of panels to be decided by Bidder.

✱✱ MAIN INCOMING CABLE By BHEL

415V, 3ph, 50Hz, 3WIRE, 100 kVA (For each panel)

PCab : POWER CABLE
CC : CONTROL CABLE

these cables are in Bidder's scope

NOTES :

01) THIS DRAWING IS APPLICABLE FOR SELF LIMITING, SELF REGULATING TYPE ELECTRICAL TRACER.

02) A) ALL POWER/CONTROL CABLES MARKED ■ ARE BHEL-PC SCOPE (SUPPLIED BY EHT VENDOR)
CABLES MARKED ■■ ARE IN BHEL-PEM SCOPE
B) POWER/CONTROL CABLES FOR EHT IN F.O PUMP HOUSE ARE IN BHEL SCOPE (EHT VENDOR SCOPE)

03) FOR RECOMMENDED SIZE OF INTERCONNECTING POWER CABLE BETWEEN PDP AND PC/JB, CIRCUIT SCHEDULE TO BE REFERRED.

04) RECOMMENDED SIZE OF MAIN INCOMER CABLE

05) CABLE GLAND AT PC/JB END AND PDP END BY BHEL-PC (SUPPLIED BY EHT VENDOR)

06) CABLE GLAND AND LUGS FOR MAIN INCOMER BY BHEL-PEM.

07) **DRAWING INDICATED FOR ONE CIRCUIT. TYPICAL FOR OTHER CIRCUITS.**

08) POWER/CONTROL CABLES FOR TRACERS IN YARD PIPING ARE IN BHEL-PC SCOPE OF SUPPLY (SUPPLIED BY EHT VENDOR)

09) TWO Nos. EHT PDP SUPPLIED BY BHEL-PC. ONE WILL BE LOCATED IN F.O.PUMP HOUSE, AND OTHER WILL BE IN ESP CONTROL ROOM.

10) FOR BASIC SCOPE OF EHT FOR F.O.SYSTEM REFER DRG.No. 4-81-441-05248

11) REQUIREMENT OF JB TO BE DECIDED BY VENDORS

1. BHEL shall provide incoming power cable to ETH panel.
2. ETH power distribution panel, further power and control cables, JBs, power connectors, thermostats, tracer, tape, cable lugs and glands are in bidders scope.
3. Number of ETH power distribution panels shall be decided during detailed engineering.

REV	DATE	ALTERED / APPROVED	REV	DATE	ALTERED / APPROVED	REV	DATE	ALTERED / APPROVED
03			02			01		
ZONE			ZONE			ZONE		

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	NAME	SIGNATURE	DATE
DRN.	B.SUMITH		03.05.13
CHD.	B.SUMITH		03.05.13
APPD.	R.PRABHA		03.05.13

ALL DIMENSIONS IN MILLIMETRE
PROJECTION SCALE NTS

TITLE CABLING SCOPE FOR E.H.T SYSTEMS

DRG.No. 4-81-441-05249 REV. 00

TECHNICAL SPECIFICATION FOR ELECTRCAL HEAT TRACING SYSTEM

1.0 SCOPE

1.1 This standard specifies the requirement of Electrical Heat Tracing System in Utility/ Captive Power Plants.

1.2 This specification covers the general requirements for the design, selection and supply of "Electric Heat Tracing (EHT) System" for the pipelines (including valves and fitting), equipment (eg. pumps, strainers etc) and tanks/vessels to maintain the specified operating temperature of the process. Depending on system offered whether a total package, or tracers alone, etc. other specifications (referred elsewhere), shall also be deemed to constitute within the scope of this specification.

2.0 GENERAL

2.1 It is the responsibility of the vendor to supply all items that are incidental for completion of the installation whether specifically mentioned or not, so that the installation complies with the relevant standards and specifications, at no extra cost to the purchaser.

2.2 Responsibility of obtaining necessary approvals from statutory authorities rests entirely with the vendor. Vendor shall submit all necessary drawings, detail proforma etc. to the concerned authorities and get their approval.

3.0 CODES AND STANDARDS

The design, material, construction, manufacture, inspection, testing and performance of the EHT system shall essentially comply with Standards IEEE:515 – 1997, IEC 60079-30-1 & 2: 2007 regulations and safety codes as applicable to the locality where it is to be used. Nothing in this specification shall relieve the vendor of meeting the above responsibilities.

4.0 DATA SHEET

4.1 Enclosed Data Sheet, gives specific project information, requirement and the same constitutes a particular requirement in addition to general technical requirement specified in this specification.

5.0 GENERAL TECHNICAL REQUIREMENTS

5.1 For heat tracing requirements, low watt density heaters shall be used. (Rating shall be limited and optimised).

5.2 Heaters shall have self burn-out proof feature or design.

5.3 For easy installation and efficient heat transfer, the heater strip shall be flexible and with flat configuration. Semi-rigid, round configuration type of heaters is not acceptable. Also heaters requiring incorporation of resistors are not acceptable.

5.4 Heaters shall be of self-limiting and self-regulating type of parallel circuit flat cable, with positive temperature coefficient.Minimum Output Shall be 33 Watts per Meter.

NOTE: Constant wattage parallel and constant wattage series type of EHT are not acceptable.

5.4.1 The bidder shall include power supply distribution panel, all accessories for EHT installation like fixing tapes, end / power / special connections etc. in scope of supply to make the system complete, in all aspects. Supply of ordinary power and control cables are included in scope. The recommended cable sizes (power and control) shall be furnished.

5.4.2 It is to be noted that controls required for the EHT chosen shall also be housed in power supply distribution panel itself. Each circuit shall be provided with dedicated thermostat, to effect energy savings.

5.5 General Requirements

5.5.1 The design shall be based on continuous and reliable service, safety to personnel and equipment, ease of maintenance and interchange ability of equipment.

5.5.2 The system shall be complete in every detail with all equipment, accessories and material required to provide a total heating system to meet the requirements in this specification. Consideration shall be given, but not to be limited, to climatic conditions, pipe material, pipe size and length, fittings, type and thickness of insulation, fluid flow conditions, voltage levels and power supplies available. The design shall take into account heat losses at the pipe supports, tank foundations etc. Actual pipe layout drawings will be made available after purchase order during execution of the contract. The number of circuits, connectors and accessories shall be decided based on pipe length indicated vide data sheets. Number of feeders and rating of feeders at the time of bid shall be liberally selected/sized so that the same can be utilized during contracts execution based on actual pipe layout drawings (Refer clause No. 5.28.6)

5.5.3 Entire surface area has to be considered for tanks (if applicable), for computing the heat loss. A 10% design margin shall be considered on the rate of heat loss calculated this way.

5.5.4 Extra heater length shall be provided for valves, flanges, pipe supports etc.,(one support to be mounted at every 3 meters. Pipe to pipe connections are welded type). The electric heat tracing for these shall be done in such a way that the servicing and operation of the same shall be easily possible, without disconnecting the wiring.

5.5.5 Vendor shall supply all necessary accessories for fixing and installing the heater strip.

5.5.6 Glass adhesive tape shall be used for fixing the heat tracer on pipe lines and aluminium adhesive tape shall be used for fixing on the tanks. The tapes shall be offered and quantity to be indicated in BOM.

5.5.7 The rating of tracer selected shall be such that pitch factor is always <1. A pitch factor >1 shall be generally avoided.

5.6.1 Heat tracer inner and outer jacket material shall be high temperature fluoropolymer having minimum continuous temperature rating 210 Deg. C. vendor to confirm type of fluoropolymer of tracer meeting this requirement and provide published data from the manufacturer of fluoropolymer.

5.6.2 Heat tracer shall have a metallic braiding.

5.7 Heater strip shall be such as to permit easy and quick replacement of damaged portions, if accidentally damaged

5.8 Heater shall not be affected by water in the event of flood, rain and/or fire fighting operations.

5.9 Design, manufacture, guarantee shall cover an operating life of 20 years. Vendors shall furnish details on accelerated ageing tests carried out and the basis of their claim.

5.10 Heaters (EHT) shall operate on Purchaser's 240V, 1 phase, two wire. For this purpose, 415V, 3 phases, 3 wires, 50 Hz AC supply system, will be provided by the Purchaser. Necessary power distribution for distributing power to each segment of tracer from this power rating shall be properly engineered and supplied. 415V/415V Delta/Star transformer to be provided by vendor with primary and secondary isolation (MCCB) as part of panel to convert 3 wire incoming supply to 240V ac feeders.

5.11 Heaters shall be of weather proof, water proof and shock proof type and shall be suitable for outdoor installation.

5.12 The construction shall be such that the jacket over the element is thermally conductive, electrically insulative polymer material of the flexible type, with metallic braid plus over sheath.

5.13 Heat tracers offered shall not require the use of heat transfer cement.

5.14 The heater having self-regulating characteristics shall ensure auto-reduction in heat output in response to increase in process temperature or ambient temperature and this process shall also be reversible. Inrush current, of such self-limiting, self-regulating type of tracers, shall be clearly indicated in the offer.

5.15 Heat tracer shall have high self-regulating index (SRI) to meet requirements for rapid start-up and energy efficiency. SRI is a measure of tracer's ability to adjust its heat output in response to changes in pipe temperature and ambient temperature, SRI shall not be less than 0.25 watts at 0°C and value of the same to be guaranteed.

5.16 The heater shall have uniform heat output per unit length, and minimum cut length shall not be less than 100 metres and shall permit site cutting / fabrication.

5.17 Heaters shall not be affected by vibration and twisting.

5.18 Overlaying / criss-crossing of heater during installation shall not affect the performance, or life of the tracing system.

5.19 Design shall be such that failure of controls, under heater energised condition, shall not raise the temperature sufficient enough to cause heater failure.

5.20 Heater sheath shall not reach auto-ignition temperature of the surrounding atmosphere, if used in hazardous areas.

5.21 All EHT shall meet Factory Mutual to IEEE 515/2007, BASFEFA to BS 6351/83,SIRA to IEC 60079-30-1: 2007 from safety point of view and shall be certified by the Chief Controller of Explosives, India and CMRS, India. In this regard, the product actually supplied shall be either FM / BASEFFA/ SIRA approved. The manufacturing facility shall be licensed to issue FM / BASFEFA /SIRA/Country of origin certification. Documentary evidence for the above to be furnished.

5.22 Heater shall be selected based on the maximum temperature differential (Refer enclosed Data Sheet).

5.23 Heaters shall be selected after considering its heat output and taking into account the value of the temperature to be maintained for the fluid and the maximum temperature to be withstood by the heater. In this regard, power-on and power-off temperature requirements spelt vide data sheet shall be met. This should be supported by certification from statutory authority of the country of origin.

5.24 Heat tracers requiring incorporation of special transformers or resistors are not acceptable.

5.25 Heat Tracer shall have unconditional T3 rating. This should be supported by certification from statutory authority of the country of origin.

5.26 Design shall account for following variances also:

5.26.1	Voltage	:	± 10%
5.26.2	Frequency	:	± 5%
5.26.3	Combination of voltage & frequency	:	± 10%
5.26.4	Design margin	:	± 10%

5.27 Controls:
Each circuit shall be provided with surface mounted thermostat to effect energy savings (i.e. power off at temperature >90 Deg. C).

5.27.1 Suitable space shall be provided in power distribution panel and the controls shall be housed in the same.

5.27.2 Annunciation for following fault condition to be provided.

5.27.2.1	Heater failure	-	circuit wise
5.27.2.2	Power distribution transformer temp. very high	-	zone wise

Necessary sensors for the same to be provided.

5.27.3 2 no.(1 for supply and 1 for return at convenient location). Temperature indication should be made available in the panel.

5.27.4 Constant monitoring of the circuit by detecting the current drawn in the circuit shall be provided (Ammeter to be provided).

5.27.5 Powering of circuit zone-wise shall be as per enclosed powering scheme.

5.27.6 Circuit Selection:
Circuit selection shall be done based on product flow and temperature maintenance conditions as recommended by IEEE. However, use of artificial dead legs should not be resorted to. The circuit length shall be limited so as to limit the end to end heat tracer output drop. Variations allowed + 5%. Ease of monitoring and fault finding shall be kept in view while deciding the number of circuits wherever power connector / power splice connector, are employed. The number of circuits shall be such that number of feeders are kept minimum 20% spare feeders to be made available in the panel.

Circuit Selection for Trichy portion:
Heater shall be selected to maintain the temperature indicated in the attached data sheet under minimum ambient temperature and with negative heater out put and voltage tolerances under continuous power on condition and fluid at maximum temperature.
Failure of controls under heater energise conditions shall not raise the temperature sufficient enough to cause heater failure.

Vendor shall furnish calculation for heater sheath temperature for 1" sch40 pipe with 50mm mineral wool insulation, maximum ambient temperature and maximum fluid temperature.
Heater sheath temperature shall not reach auto ignition temperature of the surrounding atmosphere and shall be with in T3 limits.
Overlaying / criss-crossing of the heater during installation shall not affect the performance or life of the heater system.
Field cutting of the heater shall not affect heat out put at either ends.
For other details attached data sheet as well as relevant spec. Clause is to be complied.

5.27.7 All earth points shall be connected to an established earth terminal. Each zone shall have established earth points at an interval of 250m. Copper bus to effect the same (details of which to be furnished in offer) shall be included in the offer.

5.28 Power distribution panel shall generally comply with enclosed Specification **PC:TSP:PDP:SAGARDIGHI**.

5.28.1 Each outgoing circuit shall have DP MCB, Taut band ammeter, contactor, indicating lamps etc. There shall be two incomers for each panel & manual selection through switch shall be possible. The incomer shall contain:

5.28.1.1 MCCB
5.28.1.2 Power distribution transformer
5.28.1.3 Back up fuse
5.28.1.4 Taut band voltmeter
5.28.1.5 Taut band ammeter

5.28.2 One main incoming feeder will be standby and selection of the feeder through manual switch shall be available on the panel.

5.28.3 PDP shall be single front, sheet steel mounting, free standing, completely draw out, totally enclosed dust and vermin proof modular construction, fully compartmentalized. No hinges, rivets shall be apparent from outside.

5.29 Field junction boxes to terminate Thermostat shall be provided. Intermediate field JB shall be used wherever (i) the power connector (PC) cannot accept required power cable, (ii) access to PC is a problem. In such case, cable connecting JB and PC / PSC (Power Splice Connectors) shall also be supplied (5 Met/point).

5.29.1 All PC(Power Connectors), PSC(Power Splice Connectors), TC(Tee Connectors), EC(End Connectors) shall be complete with cable glands for incomer and outgoing feeders. The same shall be flame-proof type. Necessary certification to be provided.

5.30 Field sensors (Thermostat), shall be provided.(1 Per Circuit)

5.31 Each suitable power distribution transformer to cater to the total heat tracer burden shall be provided with suitable voltmeter / ammeter and protective elements. The entire load shall be properly distributed in each phase, with protection and indicators like ammeters, etc. The load shall be decided considering the start-up requirements. The transformer shall comply with relevant IS code. The % impedance shall be minimum 4% and shall be properly co-ordinated for total fault load reduction with reference to withstandability. Supporting calculations to be furnished. The transformer shall be dry type.

5.32 All accessories and erection consumables like fixing tape, end terminations, power connectors, splicer kits, cable trays, lugs, etc. as required for the system shall be offered. All terminators, connectors and seal kits, etc. shall be flame proof and weather proof to IP-65.

6 INSPECTION & TESTING

Shall be as per the following standard QP

QPG: 056 Standard Quality Assurance plan for EHT
QPG: 057 Standard Quality Assurance plan for FLP Thermostat for EHT system
QPG: 058 Standard Quality Assurance plan for JB for EHT system
QPG: 059 Standard Quality Assurance plan for Power Distributing Panel for EHT system

7 INSTALLATION REQUIREMENTS

(Important: Installation is not in scope).

7.1 All fittings and material required to install and supply power to EHT shall be supplied.

7.2 All installation connections, joints, etc. shall be weather proof, waterproof and flame proof.

7.3 Supervisory assistance during erection & commissioning of EHT (as a total package) to be quoted separately.

7.4 Heating cables shall be spiralled or shall be axially installed preferably more than 60° below the horizontal centre line of pipe to allow for the best heat transfer upward from the tracer and to utilise the pipe for mechanical protection of the tracer. Tracer selected shall be suitable for the same.

7.5 Self-illuminated signs shall be permanently fixed to the outside of the finished external thermal insulation which shall be visible from the ground level. The sign shall read "DANGER / ELECTRICALLY TRACED". The sign plate shall be of size 200x60mm and shall be spaced at an interval of 6M maximum. These labels/name plates shall be supplied in adequate quantity.

8.0 DOCUMENTS

8.1 The following documents in TRIPLICATE shall be furnished in ENGLISH along with the bid.

8.1.1 Detailed calculation sheets with basis of design, supplemented by catalogues, graphs, etc. for EHT. Detailed panel-sizing, transformer sizing calculations to be furnished.

8.1.2 Installation drawing of EHT showing orientation of heaters, thermostats, power connectors, etc. EHT superimposed on pipe isometrics to be given. (After placement of order).

8.1.3 Single line power distribution diagram.

8.1.4 Recommended interconnecting cable (power and control along with back-up selection calculation), clearly indicating terminal disposition and ferruling details.

8.1.5 Details of all accessories offered (along with BOM).

8.1.6 Quality control procedures & Quality assurance program.

8.1.7 Detailed BOM.

8.1.8 Details of Licence Number / Certificates for use from safety point of view.

8.1.9 All other documents called under other sub-specification.

8.1.10 "Tender Deviation" or "Point to Point" confirmation to our specification.

8.2 The following documents in ENGLISH shall be furnished in the event of an order.

8.2.1	Catalogues	5 sets
8.2.2	Operation, Maintenance, Erection and Commissioning Instruction	10 sets
8.2.3	Detailed BOM	5 sets
8.2.4	Panel G.A. drawing & Wiring Diagram, EHT superimposed piping isometrics, circuit schedule	10 sets + 1 reproducible
8.2.5	Recommended interconnection Cable Schedule	10 sets
8.2.6	Test Reports as called for in Q.C.P. and Specification	1 reproducible + 5 sets

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

9.0 PACKING & DELIVERY CONDITIONS

9.1 All packing will be to international standards, capable of withstanding transit risks. Number of despatch able unit (DU) clearly indicating the weight of each such unit shall be brought out in the offer itself. An unique material code for each item shall be furnished and marked on top of the packing/equipment for easy identification at site.

9.2 Minimum roll size of tracers shall be such that uncut length of tape shall be at least 100 metres, to minimise site joints.

10.0 Erection, Commissioning & Extended Warrantee Requirements

10.1 Alternatively supervisory assistance during erection and commissioning (E&C) of the system shall be quoted separately. Under such circumstances, special kits, if any, for E&C shall be quoted.

10.2 Extended guarantee for a period of 3 years over and above normal 2 years from the date of commissioning for the total EHT system to be provided. This shall cover, but not limited to, free replacement of defective component plus services.

NOTE (IMPORTANT)

(1) Actual requirement of tracer quantity, control system components, erection materials, etc. may vary at the time of execution at Site and the variation to the tune of +10% shall be accommodated without any commercial implication.

(2) It is not the intent to completely specify herein all aspects of design and construction of equipment. Nevertheless the equipment shall confirm in all respects to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the owner who will interpret the meaning of the specification for the purpose of which the owner reserves the right to alter the specification even during the contract execution stage for which commercial implications will not be entertained.

TECHNICAL SPECIFICATION FOR ELECTRCAL HEAT TRACING SYSTEM

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

1	**Ambient Conditions**		
1.1	Max. Dry Bulb Temp	(°C) :	35
1.2	Min. Dry Bulb Temp	(°C) :	5
1.3	Relative Humidity	:	100%
1.4	Design Ambient Min. Temp.	(°C) :	0
1.5	Design Temp. for Electrical Equipement / Device	(°C) :	45
2	**EHT SERVICE**	:	**LSHS – FUEL OIL LINES**
	For description of service, F.O pipe size, pipe length & insulation thickness, refer the Basic scope of EHT for fuel oil lines, Drg No: 4-81-441-05248.		
	Maintenance temperature	(°C) :	85
3	Maximum Process Temperature	(°C) :	140
4	**Exposure Temp.Rating**		
4.1	Continous power on temperature	(°C) :	140
4.2	Intermittent power ON temperature	(°C) :	210
4.3	Intermittent power OFF temperature	(°C) :	210
5	Maximum withstandable outside temperature (Insulation rating)	(°C) :	210
6	Power supply available at Site	:	415V 3 phase, 3 wire with 50 kA fault level. Bidder to specify kVA rating of total load.

TECHNICAL SPECIFICATION FOR ELECTRCAL HEAT TRACING SYSTEM

7	**Supply variations**		
7.1	Voltage	:	± 10%
7.2	Frequency	:	± 5%
7.3	Combined	:	Absolute 10%
8	**Insulation Data**		
8.1	Type	:	LBM
8.2	Density	:	100 kg/m³
8.3	Thermal Conductivity (W/m°C)	:	0.040 at 50°C mean 0.052 at 150°C mean
9	Design EHT Load	:	Each tracer circuit shall be Single phase load
10	Spare EHT	:	10% of each type

NOTES

1 **Only SLSR tracers are acceptable.**

2 FOS and FOR lines are a combination of yard piping in racks plus piping inside boiler area.

3 The total portion shall be apportioned into segments depending on tracer limitations. Each segment shall be provided with power supply module and controls. Loading and segregation shall ensure proper balancing of all 3 phases.

4 Pipe layout will be finalised during contract execution stage.

5 EHT shall be provided with dedicated thermostat for cutting off power to effect energy savings conditions.

FUEL FIRING/PE(B)
BHEL,TIRUCIRAPALLI

HEAT TRACER DATA SHEET 1306 285

PROJECT:	Thermostats/Temp Switch/RTD Provided
1 APPLICABLE STANDARDS	5 ELECTRICAL DATA :
BS 6351 : 1983	Operating Voltage : V.
2 OPERATING DATA	Inrush Current :
Fluid - HFO/LSHS	Circuit Breaker Data Attached Y/N
Ambient Temperature - 5 to 50 °C	Wiring Diagram: Power Attached Y/N
Pipe Maintenance Temperature - 85 °C	Wiring Diagram: Control Attached Y/N
Max Fluid Temperature - 140 ° C	6 TESTS :
Size of Pipes/Fittings - 1/2" to 8"	Type Tests :
Power Supply - 240 V 1Ph AC	Impact Test - Y/N
- 415 V 3Ph AC	Cold Bend - Y/N
Insulation : Material-Mineral Wool	High Temperature Exposure - Y/N
: Thickness-50 mm	Repeated Electrical Cycling - Y/N
: K-0.039 KCal/m-hr°C	Repeated Mechanical Flexing - Y/N
(Note: 1. K - Thermal Conductivity	Repeated Abrasion - Y/N
at a Mean Temp. of 50°C)	
3 TYPE OF HEATER :	Routine Tests :
SLSR/Constant Wattage	Dielectric Withstand Test - Y/N
Parallel Circuitry	Output Vs Temperature - Y/N
Cut to Length/Factory Terminated	Visual Examination - Y/N
Burnout Proof : Yes/No	
Weather Proof : Yes/No	7 APPROVALS
4 HEATER DATA :	Approvals for model chosen:
Watt Density - W/m at $T_{MAINTENANCE}$	
Heater Insulation :	(Note:Enclose Copies of Approval Doc)
Material -	
Max Withstand Temp - °C	8 DOCUMENTS
Heater Core :	Documents with Offer Attached Y/N
Material -	Documents after PO Y/N
Max Withstand Temp - °C	List of Similar Installations : Y/N
Max Sheath Temp (Clause 3.13)- °C	
Calculation Attached- Yes/No	
Heater T Rating -	
Unconditional - Yes/No	
If Conditional attach conditions	
Tolerance on Output - + % - %	
Max Circuit Length - m	
Min Radius of Bend - mm	
Overlapping: Permitted/Not Permitted	
Predicted Heater Life : Yrs	
Basis:Graph/Calculation Attached Y/N	
Aluminium Tape : Provided/Not Provided	

BHARAT HEAVY ELECTRICALS LIMITED
4-42-823-03192 REV 01.

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TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

1.0 GENERAL

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

2.0 SCOPE

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

3.0 DATA SHEET

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

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

4.0 CODES AND STANDARDS

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

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

4.3 Design Calculations

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

5.0 SCOPE OF WORK

5.1 The scope of work covers-

5.1.1 Design, fabrication and testing of the complete panel;
5.1.2 Procurement, mounting and wiring of all equipment, specified;
5.1.3 All internal wiring from equipment to terminal blocks and all interpanel wiring between panels;

5.2 Supply of all cable terminations and mounting accessories like trays, troughs, clamps, lugs, etc.;

5.3 Supply of all necessary drawings;

5.4 Testing of panels as specified and furnishing of test certificates;

5.5 Preparation and furnishing of instruction manual and catalogues giving the make, model and type of all the equipments used;

5.6 Packing and delivery of the equipment in acceptable condition at the place specified to the satisfaction of the purchaser;

5.7 Typical wiring diagram for a single segment is enclosed to this specification. Bidder to actually determine the rating of each component for each segment and in total and shall furnish a consolidated wiring diagram covering all sections.

6.0 CONSTRUCTIONAL FEATURES

6.1 The panel shall be completely metal enclosed, free standing floor mounting modular type. Shall be of dust moisture and vermin proof. Shall be made of vertical sections easily extendable on both sides by addition of vertical sections. The panel enclosures shall meet the degree of protection IP 55.

6.2 The metal used shall be of cold rolled sheet steel of thickness not less than 3 mm for the front and rear and 2.5 mm for the other sections & sides. The panel shall be free from flaws, dents and undulations. Shall be, if needed, reinforced to provide level surfaces as mentioned below.

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

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

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

6.4 All removable plates, doors and glass plates shall be properly gasketed all around with neoprene gaskets (single piece-6mm). Ventilating louvers, if provided, shall be provided with fine Brass or GI meshes. All door hinges shall be of concealed type.

6.5 The panel shall be provided with proper anti-vibration pads between the base channel and panel so as not to transmit the vibration, if any, to the panel and panel mounted equipments.

6.6 The dimensions and the general arrangement of the panel shall be furnished. The cable entry to the panel shall be bottom on a 3 mm removable cable gland plate.
Required number of proper cable glands shall be provided. The cable glands shall be of brass and double compression of screwed type suitable to receive PVC armoured cables.

6.7 The panel shall be provided with illumination lamp operated through a door switch. The panel shall be provided with necessary space heaters and accessories. The panel shall be provided with capped power sockets with switch and fuse.

6.8 The panel edges shall be properly smoothened or deburred so as not have any sharp or pointed surface, which may cause injury to the operating personnel. The doors provided in the panel shall have in-built locking facility.

6.9 Earth leakage protection shall be provided for all outgoing Heat tracing circuits with necessary relays.

6.10 All equipments / components shall be properly labelled for easy identification.

6.11 The switch gear section shall be divided into distinct vertical sections each comprising-

6.11.1 a completely metal enclosed bus bar compartment running horizontally;

6.11.2 individual feeder modules arranged in multi-tier formation. It is essential that modules are integral multiples of the basic unit size to provide for flexibility in changes, if any, at Site;

6.11.3 enclosed vertical bus bars serving all modules in the vertical section with proper safety isolation;

6.11.4 a vertical cable alley covering the entire height - the cable alley shall be minimum 500 mm wide for circuit breaker controlled modules;

6.11.5 a horizontal separate enclosure for all auxiliary power and control buses, as required, shall be located and tap off connection from these buses shall be arranged separately;

6.11.6 each vertical section shall have space heater located on vertical cable alley.

6.11.7 there is no back access available; vertical bus bar alleys have to be provided.

6.11.8 Four (4) Nos. lifting lugs shall be for each section, two (2) nos. on either end of the section.

7.0 PAINTING

7.1 All metal surfaces shall be thoroughly cleaned and degreased to remove scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The surface shall be made free from all imperfections before undertaking the finishing coat.

7.2 After preparation of the surface, the switchboard shall be powder coated with two coats of epoxy based electrostatic power painting of min 100 microns of final painting. The finished panels shall be dried in stowing ovens in dust free atmosphere. Panel finish shall be free from imperfections like pinholes, orange peels, run-off paint etc.

7.3 The pre-treatment of all steel work, including, de-greasing, rust / scale removal, phosphating and even drying shall be carried out as per IS 6005.

7.4 All unpainted steel parts shall be cadmium plated or suitably treated to prevent rust formation. If these parts are moving elements then they shall be greased. The mounting plate shall be zinc passivated. A small quantity of finishing paint shall be supplied for minor touching up at Site after installation.

8.0 MOUNTING

8.1 All equipments on front of panel shall be flush mounted or semi-flush. In case of semi-flush mounting only flange or bezel shall be visible from the front.

8.2 Equipments shall be mounted such that removal, replacement and maintenance can be accomplished easily without interruption of service to adjacent equipment. The terminal markings shall be clearly visible. All live parts shall be provided with at least phase to phase and phase to earth clearance in air of 25 mm.
For all other components, the clearance between two live parts, a live part and an earthed part, and isolating distance shall be at least 10mm throughout.

8.3 The centre lines of switches, push buttons and indicating instruments shall not be less than 450 mm from the bottom of the panel. Control switches, push buttons and indicating instruments shall be so located for ease of operation and reading.

8.4 No equipments shall be mounted on the doors unless otherwise there is specific mention.

8.5 Current transformers shall not be directly mounted on the buses. CT on circuit breaker controlled circuits shall be mounted on the fixed portion of the compartment.

9.0 LABELS AND FERRULES

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

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

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

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

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

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

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

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

10.0 WIRING

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

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

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

10.2.2 CT circuits : 2.5 mm^2 per core

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

10.4 No loose wires are allowed. All the wires shall be either terminated to the terminal block or to the equipment as required. If accidental short circuiting of wires is likely to result in closing or tripping of breaker or the system, then wires shall not be terminated on adjacent terminal blocks.

10.5 Only one wire per terminal shall be used on the outgoing side of these blocks. Any common connections required, shall be provided on the panel side of the block. Wires shall not be looped around the terminal screws or studs. No more than two wire shall be connected to one terminal

10.6 All wire terminations shall be made with solderless crimping type tinned copper lugs. The lugs must be of the compression, insulated sleeve ring tongue type so as to firmly grip the conductor and insulation. Open-ended lugs are not acceptable. Each wire shall be ferruled by plastic tube with indelible ink print at both end having terminal block no., terminal nos., destination no. as per approved drawing.

10.7 Wiring of circuits for power supply to transducers and amplifiers for signal transmission shall be suitably fused to limit short circuit currents. Means for detection of blown or open circuited fuses shall be provided.

10.8 The vertical wiring on the panels between the terminal blocks and the devices shall be enclosed in non-metallic race ways with removable covers. All exposed wiring shall be formed neatly with wires neatly grouped using plastic bands and binders and substantially supported, along with the panels. Wire stripping shall be done in such a manner that conductor will not be nicked or cut. Wire shall not be tapped or spliced between terminal blocks.

10.9 Power connection between main incomer power transformer to PDP shall be supplied through adequately rated bus bar connections with accessories (if required).

11 EARTHING

11.1 A continuous copper earth bus of minimum 50x6 sq.mm required size identified with green colour shall, run continuously throughout the length of the control panel. And it shall have the provision for termination to 50x6 mm G.S. flat station earth bus. Necessary terminal clamps and connectors for this, shall be supplied along with the panel.

11.2 All metallic covers of components, instruments and other panel mounted equipments shall be independently connected to the green earth bus by using 1100V grade 16 SWG copper conductor. Soldering of earthing wires is not permitted.

11.3 All hinged doors shall be earthed by flexible copper braid.

11.4 Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earthing connections between equipment to provide alternative paths to earth bus can be provided.

11.5 VT and CT secondary neutral or common lead shall be earthed at one place only at the terminal blocks. Such earthing shall be made through links so that earthing may be removed from one group without disturbing continuity of earthing system.

12.0 TERMINAL BLOCKS

12.1 Terminal blocks shall be 1100V grade box-type 10mm^2 minimum with marking strips. Separate TBs for power and control cables as per drawing, shall be provided and have to be segregated. The power TBs shall be shrouded properly.

12.2 Power TBs shall be of one piece moulded complete with insulated barriers, stud type terminals, washers, nuts, lock nuts and identification strips for the power circuit.

12.3 TBs shall be of self-extinguishing or resistant to flame propagations substantially non-hygroscopic and shall not carbonise when tested for tracking. The insulation between any terminal and framework or between adjacent terminals, shall stand a test of 2KV for one minute.

12.4 All wiring for external connections shall be brought out to the individual terminals on a readily accessible terminal block. All terminal blocks shall be shrouded or provided with transparent covers. Minimum 1 NO + 1 NC unused contacts shall be wired up to terminal block. All the terminals shall be numbered.

12.5 Unless otherwise specified, the TBs for the control circuit shall be suitable for connecting minimum two 2.5 mm.sq. copper conductors.

12.6 Cage Clamp type control terminal blocks shall be provided for outgoing control cables. Control terminal block of different voltages shall be separated by means of an insulating barrier.

12.7 TBs for CT & PT secondary leads shall have test links and isolating facilities. Also CT secondary leads shall be provided with short-circuiting and earthing facilities.

12.8 There shall be a minimum clearance of 250 mm between the gland plate and the terminal blocks. The minimum clearance between two rows of TBs shall be 150 mm.

12.9 At least 20% spare terminals shall be provided on each panel and there shall be uniformly distributed on all rows of terminal blocks.

12.10 Unless terminals for external connections shall be arranged for consecutive connections of different cores of a multicore cable.

12.11 All TBs shall be suitable for terminating recommended cables.

12.12 All terminal block and wires shall be tagged for identification in accordance with IS 5578 and IS 11353.

13.0 CABLE TERMINATION

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

COMPONENTS

14.0 TRANSFORMER

14.1 Control Transformer

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

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

14.2 Power Transformer

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

14.3 Bus bars:

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

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

14.3.2 Vertical busbars shall be designed for a minimum current rating of 200A.

14.3.3 Bus bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuits. Bus bar insulators shall be of track-resistant, high strength, non-hygroscopic, non-combustible type and suitable to withstand stresses due to over voltages and short circuit current. Insulators and barrier of inflammable material such as Hylam shall not be provided. Bus bar support design should ensure free thermal expansion.

14.3.4 Bus-bars for horizontal and vertical risers shall be of uniform cross section throughout the panel. Bus bar risers vertical bus-bars shall be rated to carry minimum 125% of the rated current of all feeders connected to the risers. The minimum cross section of neutral bus bars shall be equal to that of the bus bars for phase.

14.3.5 The bus bars shall have the short circuit rating of minimum 50 kA for 1 second. The bus bars shall have proper identification.

14.3.6 The joints made in the bus bars shall be treated suitably to avoid oxidation of contact surfaces and bimetallic corrosion.

14.3.7 The bus bar shall be properly supported by epoxy / SMC / DMC supports.

14.3.8 Bus bars shall run at the top as required all along the length of the switch gear in a separate enclosure.

14.3.9 Bus bars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom, or front to rear when viewed from the front of the assembly.

14.4 MCCBs / MCBs:

14.4.1 MCCBs (Incomer) / MCBs (Out going Feeders) shall be hand operated air break heavy duty, quick make and quick break type.

14.4.2 MCCBs shall be 4pole, single throw, confirming to as IS-60947 (Part-2). MCCB shall have current limiting design. MCCB shall be provided with 1NO & 1NC electrically separate auxiliary contacts.

14.4.3 The contacts of the switches shall be spring assisted and contact faces shall be of Silver/ Silver alloy. Springs shall not be used as current carrying paths. The minimum current rating of the contacts shall be 10A.

14.4.4 Instrument selector switches shall be of stay-put type.

14.4.5 The MCCBs shall have a short circuit capacity of 50 KA for 1 second and MCBs for 9 KA for 1 second. The MCCBs / MCBs shall have a dolly for 3 position indication viz. ON / OFF and TRIP. The MCB shall be switched off on a trip and then only switched on manually.

14.4.6 The contacts shall be of Silver alloy to have high arc resistance and long electrical life. The MCCBs / MCBs shall have min. 3 changeover contacts for the control purposes.

14.4.7 The MCCBs / MCBs shall have both adjustable thermal and magnetic tripping system.

14.4.8 MCCBs shall have door interlocks and padlocking facility.

14.5 Contactors:

14.5.1 Contactors shall be three pole, magnetic, air break type generally as per IS 60947 Part-4 suitable for Type 2 co-ordination.

14.5.2 Main contacts of the power contactors shall be of silver /silver alloy or silver plated copper. The contacts shall be of bounce free, double break non-gravity type.

14.5.3 All power contactors shall be provided with 2 Normally Open (NO) and 2 Normally Closed (NC) auxiliary contacts convertible from NO to NC and vice versa.

14.5.4 All power contactors shall be rated for minimum 125% of full load current. Minimum rating shall be not less than 16 Amps.
Coil voltage shall be as per scheme. Contactor coils shall operate satisfactorily and drop OFF at voltages as given in IS 60947 Part-4. All contactor coils shall be suitable for tropical climatic conditions specified elsewhere in this specification. Insulation Class for Coils - Class 'H'.

14.6 Relays:

14.6.1 Necessary auxiliary relays, time delay relays and voltage relays as required for control and protection shall be mounted inside the cabinet. Relays shall be equipped with positive action operation indicator. Voltage relays shall have sufficient thermal capacity for continuous energisation.

14.6.2 The relays shall be rated to operate satisfactorily between 80% and 110% of the rated voltage.

14.6.3 Unless otherwise specified, all these auxiliary relays shall be of electro-magnetic type and time delay relays shall be of either static or electro-magnetic type.

14.6.4 The contacts of these relays shall be rated for min.10A and adequate for breaking inductive loads at 220V DC, 5A and 240 V AC 10A.

14.6.5 In case of static relays, the electronic hardware shall conform to the requirements of applicable standards and suitable for environmental conditions at Site. The non-availability of air condition system shall not affect the performance of the relay.

14.6.6 Static relays shall be immune to self induced and externally induced noise. The printed circuit cards shall be of fibreglass with gold plated contact connectors and shall be designed for trouble free service throughout the life of the plant when subjected to normal operation, handling and maintenance.

14.7 Push Buttons:

14.7.1 The push buttons of momentary contact push to actuate type. The push button shall be rated, continuously to carry and break 10A at 240V AC and 1A inductive load at 220V DC.

14.7.2 The push buttons shall be provided with 2 NO + 2 NC self reset contacts, with rear terminals. The actuator shall be of oil tight and waterproof condition. The contact faces shall be of silver / silver alloy.

14.7.3 The push buttons shall be provided with integral inscription plates engraved with designation.

14.8 Indicating Lamps:

14.8.1 The indicating lamps shall be panel-mounted type with rear terminal connections. The lamps shall be LED type with InP Technology (Aluminium Indium Gallium Phosphide Technology). LED circuit shall be PCB mounted. Intensity shall be greater than 200mcd. The body shall be made of Poly carbonate unbreakable lens. LED shall be protected by inbuilt fuse & surge suppresser or leakage voltage glow protection. LED circuit shall be PCB mounted. The lamps shall have translucent lamp-covers to diffuse lights, coloured red, green and amber as specified.

14.8.2 LED Bulbs and lenses shall be interchangeable and easily replaceable from the front of the panel. Tools, if any, required in replacing the bulbs and lenses shall also be supplied along with the panel.

14.8.3 The colour of indicating lamps shall normally be the following
Red - Feeder 'ON'
Green - Feeder 'OFF'
Amber - Feeder 'TRIP'

14.9 Indicating Instruments:

14.9.1 Unless otherwise specified, all the indicating instruments shall be 96 mm^2 with 240° scale. They shall be suitable for semi-flush mounting with only flanges projecting on vertical panels.

14.9.2 The instrument dials shall be of white with black numerals and lettering. Dials shall be parallax free and shall be provided with knife-edge pointers. The instrument shall be provided with anti-dazzle glass.

14.9.3 Shall have zero adjustment provision in the front side. The instrument shall have an accuracy class of +/-2% full scale.

14.9.4 The enclosure protection shall be of IP 55. The meter shall satisfy the environmental test requirements when exposed to ambient temperatures within -10 to +55°C at all times and vibration test as said in IS 1248. The case of the meters shall be made of self extinguishing, flame retardant polycarbonate material.

14.9.5 The meter shall comply with IS 9249 (Part-I) safety requirement for indicating electrical instruments and their accessories.

14.9.6 Ammeter shall continuously withstand 120% of rated current.

14.10 Current Transformers:

14.10.1 The current transformers shall be of Cast resin type.

14.10.2 The max. VA Burden shall be 10 with accuracy Class of 1 and instrument safety factor of 5 and shall confirm to IS:2705, Part-V of 1981.

14.10.3 CTs shall have short time withstand rating equal to the short time withstand rating of the associated switch gear for one second.

14.10.4 All CTs shall be earthed through a separate earth link on the terminal block to permit easy measurement of the current transformers insulation resistance. Tests links shall be provided in the CT secondary leaks to carry out current measurement tests with CTs in service.

14.10.5 Accuracy class for metering 0.5, Class 5P20 for relaying.
All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.
CT secondary shall be rated for 1A for metering and either 5A or 1A for protection.

14.11 Annunciators:

14.11.1 Annunciators of the visual and audible type suitable for operation with the power supplies as mentioned in the scheme shall be provided. The annunciator panel shall be of flush or semi-flush mounting type.

14.11.2 The system shall be of solid state, which dispenses with the moving contacts. The system shall use industrial grade CMOS circuitry so as to have reliable operation and immune to electro-magnetic noise.

14.11.3 All printed plug boards, if used, shall be provided with Gold plated edge connectors so as to have positive contacts.

14.11.4 The unit shall be supplied with swing door display with front accessibility for the printed circuit modules.

14.11.5 The windows shall be provided with two lamps for reliability. The lamps shall be provided with series resistors or shall be biased with small current. The lamps shall be replaceable from the front. However, LED type lamps are preferable. The window shall be provided with easily changeable photo type film with black letters on white translucent background.

14.11.6 The first in alarm condition shall be displayed distinctly from subsequent alarms by different flash rates or by continued flash after accept. First in alarm conditions shall be interlocked with subsequent alarm ensuring accept and first in reset operator sequence. The system shall have dual tone system.

14.11.7 The system shall be suitable for operation with normally open fault contacts which close on a fault. The system shall have the facility to change the operation from "close on a fault" to "open on a fault". Each channel shall also have a potential free output contact of rating 50 VA min. for customers use. These contacts shall be brought out in terminal blocks on the rear of the panel.

14.11.8 Facilities for lamp testing, audio testing and flasher testing be provided.

14.11.9 The annunciator shall be designed for the following conditions.

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

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

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

15.0 MAKES

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

16.0 INSPECTION & TESTING:

Standard Quality Plan, **QA:CI:STD:QP:30/Rev.05 to be followed,** with the following tests as minimum.
1) Dimension check, 2) Component rating check, 3) Functional check, 4) IR test, 5) HV test, 6) Temperature raise, 7) Enclosure, 8) Paint thickness & finish, 9) Component layout (aesthetics, ease of access and maintenance)

17.0 QUALITY ASSURANCE PROGRAMME

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

17.1.1 Structure of the organisation for management and implementation of proposed QAP.

17.1.2 Documentation control system.

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

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

18.1 All equipment shall be protected for ocean shipment, inland transport and outdoor storages during transit and at the Site, strictly accordingly to the instructions given in this specification.

18.2 The vendor shall be responsible for any damage to the equipment during transit due to improper and inadequate packing.

18.3 Only packages constructed out of sound material and of dimensions proportional to the size and weight of the contents shall be used.

18.4 Fragile materials shall be securely braced within the containers or otherwise amply fastened and packed to prevent shifting or rattling. Soft non-hygroscopic packing materials shall be placed between the hard packing materials and the fragile equipment. The over- hanging or simply supported articles must be cushioned, braced, fastened or blocked to prevent damage to the article itself or destruction of the container.

18.5 Loose materials, e.g. anchor bolts, nuts, etc. be packed separately, sealed in polythene bags with proper tagging and shall be properly secured with the main panel.

18.6 Components containing glass shall be carefully covered with shock absorbing protection material such as expanded polystyrene (thermocole).

18.7 All openings in the equipment shall be tightly covered, plugged or capped to prevent foreign material from entering.

18.8 Wherever necessary, proper arrangements for attaching slings for lifting shall be provided.

18.9 All the inside walls of the packages shall be lined with waterproof paper to protect the equipment from damage due to dust and moisture. The protective wrapping shall last for a minimum period of three months.

18.10 Silicagel or approved equivalent moisture absorbing material in small bags shall be placed and tied on the equipment wherever necessary.

18.11 Dolegnate provision of stebes and pallets shall be made to tap the packages above the collecting drainage. Crates should have drain holes in the bottom to prevent collection of water within the packing.

18.12 Each crate or package shall contain a packing list in a waterproof envelope. All items of materials shall be clearly marked for easy identification against the packing list. All packages shall be clearly, legibly and durably marked with uniform block letters on at least three sides with-

18.12.1 Destination address as communicated;
18.12.2 Dimensions / weight of the equipment;
18.12.3 Name of the equipment.

ANNEXURE-A
CODES AND STANDARDS

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

1. IS:1248 Electrical indicating instruments.

2. IS:2705 : Current Transformers.

3. IS 3043 : Code of practice for earthing

4. IS:3156: Voltage Transformers.

5. IS 3231 : Electrical Relays for power System protection.

6. IS:5082: Aluminium alloys for electrical bus bars.

7. IS 5578 : Guide for marking of insulated conductors.

8. IS:6005 : Code of Practice for phosphating iron and steel.

9. IS:8623: Specification for factory built switch gear assemblies.

10. IS 10118: Code of practice for selection, Installation and Maintenance of switchgear and Control Gear.

11. IS 11353: Guide for uniform system marking and identification of conductors and apparatus terminals.

12. IS:12021: Control transformer for switch gear and control gear for voltage not exceeding 1000 V AC.

13. IS 13703: Low voltage fuses for voltages not exceeding 1000V AC and 1500V DC.

14. IS 60947 (part-1): Low voltage switchgear and control gear- General rules.

15. IS 60947 (part-2): Low voltage switchgear and control gear- Circuit breakers.

16. IS 60947 (part-3): Low voltage switchgear and control gear- Switches, Disconnectors, Switch disconnectors and fuse combinations unit.

17. IS 60947 (part-4): Low voltage switchgear and control gear Contactors and motor starters.

18. BS 60947 (part1-4): Specification for low voltage switchgear.

19. In the absence of specific Indian Standard Specifications, International Electro-technical Committee (IEC) Specification shall be followed.

ANNEXURE-B

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

ANNEXURE-C
DOCUMENTS

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

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

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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

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

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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

CHAPTER – 15

HV CABLES

1.00.00 CODES & STANDARDS

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS:7098 (Part -II)	Cross linked polyethylene insulated PVC sheathed cable for working voltage from 3.3 KV up to & including 33 KV.
IS : 3961	Recommended current ratings for cables
IS : 3975	Low Carbon Galvanized steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-754 (Part-I)	Test on gases evolved during combustion of electric cables.

IEEE-383	Standard for type test of Class IE Electric Cables.
IEC -332	Tests on Electric cables under fire conditions. Part-3 : Tests on bunched wires or cables (category -B)

2.00.00 GENERAL TECHNICAL REQUIREMENT

2.01.00 Power cable sizes shall be selected on the basis of current carrying capacity, short circuit rating, permissible voltage drop and standardization of cable sizes.

2.02.00 Power cables shall carry the full load current of the circuit continuously under site conditions considering the various derating factors like thermal resistivity of soil, ambient air/ground temperature, grouping, method of laying, etc. The design ambient air temperature and ground temperature shall be considered at 50 deg C and 30 deg C respectively.

2.03.00 The cables will be used for connection of power circuits of the system. All the power cabling shall be carried out by the contractor. Actual cable sizes will be selected by the Contractor. Number of different sizes selected will be kept to a minimum for optimization.

2.04.00 Cables shall be generally laid on ladder type cable trays or drawn, through rigid steel conduits. For inter plant connection cables shall be routed along overhead cable trestles/duct banks.

2.05.00 For continuous operation at specified rating, maximum conductor temperature shall be limited to the permissible value as per relevant standard and/or this specification.

2.06.00 The insulation and sheath materials shall be resistant to oil, acid and alkali and shall be tough enough to withstand mechanical stresses during handling.

2.07.00 Armouring shall be single round wire / strip of galvanized steel for multi core cables and aluminium for single core cable as per the relevant standards.

2.08.00 The inner and outer sheath shall have fire resistant low smoke (FRLS) characteristic and shall meet the requirements of additional tests specified for the purpose.

2.09.00 Core identification for multi core cable shall be provided by colour coding.

2.10.00 Cables shall be so designed and manufactured that no damage occurs during handling, transit, storage, installation under any operative conditions which they may be subjected to.

2.11.00 HV XLPE FRLS power cables shall be manufactured by triple extrusion dry cure (CCV) process using nitrogen.

2.12.00 Minimum value of volume resistivity for XLPE insulation shall be $1.0x10^{14}$ ohms-cm at 27 deg C and $1.0x10^{12}$ ohms-cm at 90 deg C.

2.13.00 Maximum continuous operating temperature shall be 90 deg C under normal operation and 250 deg C under short circuit condition.

2.14.00 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.

2.15.00 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath.

2.16.00 The gap between armour wires / formed wire shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface.

2.17.00 Cable Identification

2.17.01 Cable identification shall be provided by embossing on every meter on the outer sheath the following:

a) Owner's Name

b) Manufacturer’s name or trademark

c) Voltage grade

d) Year of manufacture

e) Type of insulation and sheath, e.g. XLPE / HRPVC FRLS as applicable.

f) No. of core and size of cables.

g) ISI Mark

h) Sequential length marking at an interval of 1m throughout the length of the cable.

2.17.02 Outer sheath shall be of PVC black in colour as per IS 5831. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties:

(a.) Oxygen index of min. 29 (to ASTMD 2863)

(b.) Acid gas emission of max. 20% (to IEC-60754-I).

(c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2.17.03 For reduced neutral conductors the core shall be black.

2.17.04 In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath:

(a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre. To be embossed / printed

The embossing / printing shall be progressive, automatic, in line and marking shall be legible and indelible.

2.18.00 All cables shall meet the fire resistance requirement as per IEEE - 383 with cable installations made in accordance with 'Flammability Test' and as per Category-B of IEC 60332 Part -3.

2.19.00 Allowable tolerances on the overall diameter of the cables shall be +/-2mm maximum over the declared value in the technical data sheets.

2.20.00 In plant, repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc. are not acceptable.

2.21.00 The cross-sectional area of the metallic screen strip/tape shall be considered in design calculations.

3.00.00 Cable selection & sizing

HV cables shall be sized based on the following considerations:

- Rated current of the equipment
- The voltage drop in the cable, during motor starting condition, shall be limited to 15% and during full load running condition, shall be limited to 5 % of the rated voltage.
- Short circuit withstand capability

  The cables for circuit breaker controlled circuits shall withstand the maximum calculated fault currents for the following fault clearing times.

  (a) Motor, service transformer (Protected by instantaneous over current protection) -0.16 seconds

  (b) Tie feeders (with no IDMT relays on Down-stream) -0.5 seconds

  (c) Others -1 second

In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.

4.00.00 Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

- Variation in ambient temperature for cables laid in air
- Grouping of cables
- Variation in ground temperature and soil resistivity for buried cables.

4.01.00 Cable lengths shall be considered in such a way that straight through cable joints is avoided.

4.02.00 All cables shall be armoured type.

5.00.00 CONSTRUCTIONAL FEATURES

5.01.00 33kV/11kV /3.3 kV Grade Power Cables

Cables shall conform to IS: 7098 Part - II. These cables shall have multi- stranded, compacted circular shaped, aluminium conductors. The conductor screen and insulation screen shall both be of extruded semi conducting compound and shall be applied along with the XLPE insulation in a single operation of triple extrusion process so as to obtain continuously smooth interfaces. Thickness of these screens shall not be less than 0.8mm. The metallic screen of each core shall consist of copper tape with minimum overlap of 20%. The metallic screen shall be capable of carrying the system earth fault current for the specified duration. The eccentricity of the core shall not exceed 10% and ovality not to exceed 2%. Method of curing for cables shall be "dry curing / gas curing / steam curing".

6.00.00 SPECIFIC REQUIREMENTS / CONSTRUCTIONAL REQUIREMENTS

6.01.00 33kV/11KV/3.3 kV (UE), 90 Deg.C rating, heavy duty power cables with stranded aluminium conductor, extruded XLPE insulation, conductor and insulation screen, extruded HRPVC, FR-LSH inner sheath, aluminium round wire armour for single core cables and galvanised steel strip armour for three (3) core cables, and extruded HRPVC, FR-LSH overall sheath manufactured by triple extrusion dry cure (CCV) process using nitrogen.

6.02.00 **Conductor**

Stranded, compacted circular aluminium conductor of H2 grade, conforming to class-2 of IS: 8130 (1984).

6.03.00 **Conductor Screening**

Cross linked semi-conducting compound extruded in the same operation as the insulation.

6.04.00 **Insulation**

Cross linked polyethylene (XLPE) of natural colour, extruded over screened conductor. This shall be conforming to IS: 7098 Part-2 (1985).

6.05.00 **Insulation Screening**

All cables shall be provided with insulation screening. The insulation screening shall consist of extruded cross linked semi-conducting compound in combination with a layer of lapped copper tape of thickness not less than 0.1 mm.

6.06.00 **Core Identification**

a. Three (3) core cables, core identification shall not be done with different colouring of XLPE insulation, but with natural colour with coloured strips applied on the cores or by numerals printing on the cores.

b. Laying up of cores:

Cores shall be laid up together as per IS 7098 Part – 2 (1985).

c. Inner Sheath

Three (3) core cables, after laying up of cores, shall be provided with extruded HRPVC, FR-LSH inner sheath conforming to type ST2 of IS: 5831/1984. Such inner sheath shall be provided by pressure extrusion process without filler.

However, if in the process, the centre filler is required, the same shall be provided and material of centre filler shall be the same as inner sheath material.
Extruded FR-LSH inner sheath shall also be provided for single core cables.

6.07.00 **Armour**

For three (3) core cables: - Single galvanized steel strip armour conforming to IS: 3975 / 1988.

For Single Core Cables: - Armour shall be of Non magnetic material consisting of single hard drawn aluminium round wires conforming to H4 grade of IS: 8130 / 1984.

6.08.00 **Overall Sheath**

A tough overall sheath of extruded HRPVC, FR-LSH compound conforming to type ST2 of IS: 5831 / 1984 shall be provided over armour.
The colour of outer sheath shall be black.

6.09.00 **Discharge free construction:**

Inner conductor shielding/screening, XLPE insulation and outer core shielding /screening shall be extruded in one operation by special process (i.e. triple extrusion dry cure process) to ensure that the insulation is free from contamination and voids and perfect bonding of inner and outer shielding with insulation is achieved. The contractors are requested to elaborate the manufacturing technique adopted by their manufacturers to achieve this motive.

7.00.00 PACKING

7.01.00 Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

7.02.00 Each drum shall carry manufacturer's name, Owner's name, address and contract number, Type of cable & voltage grade, Year of manufacture, Type of insulation / sheath e.g. XLPE /HRPVC FRLS as applicable, No. of core and size of cables, Cable code, Length of cable on drum, ISI Mark, Approx. gross mass stenciled on both side of the drum. A tag containing same information shall be attached to the leading end of the cable. An arrow and suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

8.00.00 TESTS

8.01.00 Routine tests shall be carried out on 100% drums.

Type and acceptance tests shall be carried out on 1 drum selected on random basis, out of every 10 or less number of drums of each type and size of cable of each lot. Size shall mean area of cross section in sq.mm read in conjunction with the number of cores. Type shall mean type of insulation, sheath, volt grade FRLS/FS etc.

All acceptance and routine tests as per the specification and relevant standards shall be carried out. Charges for these shall be deemed to be included in the equipment price

All tests shall be witnessed by owner's representative.

In addition to standard Type, Routine & acceptance tests as per IS or other relevant standards as indicated elsewhere, to prove the fire resistant characteristics, each type of cable shall also be subject to the following additional type/ acceptance tests at works. The sample for these tests shall be selected based on criteria specified in IS 7098-II, Appendix A:

8.02.00 Oxygen index test as per ASTM D 2863. Minimum value of oxygen index shall be 29. The minimum value of temperature Index shall be 21 at 250 Deg.C.

8.03.00 Flammability tests on finished cable as per the requirements of IEEE-383, IEC-60332-1 and Swedish standard SS 4241475 clause F3.

8.04.00 Smoke generation by sheath under fire shall be as per ASTM D 2843. The cables shall meet the requirements of light transmission of minimum 40% after the test. The test shall be carried out by extrapolation method beyond temperature at which the material of sheath may start deformation as per BICC handbook chapter-6 on cable in fire.

8.05.00 Acid gas generation by sheaths under fire as per IEC-60754-1 and the minimum acid gas generation shall be less than 20% by weight.

8.06.00 Each type of cable shall also be subject to the following additional type test at works:-

Test for Rodent and termite repulsion properties

Test shall be conducted to note the presence of rodent and termite repelling chemical in PVC compound. Normal procedure is that a few chippings of PVC compound are slowly ignited in a porcelain dish in a muffle furnace at about 600 deg. C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot indicates the presence of anti- termite & rodent compound.

9.00.00 TESTING PROCEDURE

9.01.00 Tests During Manufacture:-

During the manufacture of cables, manufacturer's standard tests shall be performed and record / test report shall be made available to purchaser's representative during inspection / testing.

9.02.00 Type Routine & Acceptance Tests:-

After completion of manufacture of cables, type, routine and acceptance tests shall be performed strictly as per relevant IS & other applicable standards amended up to date.

9.03.00 Type Tests:-

9.03.01 The type test as per applicable standards as given below shall be conducted on one drum selected on random basis out of every 10 drums or less of each type and size of cable (In presence of TANGEDCO representative). In case, facilities of any of the type tests are not available at the works of the supplier, then such type tests shall be carried out by the supplier at independent recognized Govt. approved laboratory at the cost of supplier.

1. Tensile test (for aluminium) as per IS:8130

2. Wrapping test (for aluminium) as per IS:8130

Note: - In the case of compacted circular & shaped conductors these tests shall be carried out before compacting/shaping for ensuring use of H2 grade aluminium.

3. Conductor Resistance test as per IS: 8130.

4. Test for armour wire/strip as per IS:3975

5. **Test for thickness of XLPE Insulation and HRPVC,FR-LSH sheath** :-

Requirements and methods of tests for the thickness of insulation, inner sheath and outer sheath shall be as per IS: 7098 (Part-2).

6. **Tensile strength and elongation test for insulation & sheath**:-

This test shall be carried out as per IS: 7098 Part-2 for XLPE cable.

7. **Ageing test for insulation and sheath**:-

The method of test shall be as per the relevant IS standard. The period of test shall be 168 hours (7 days). At the end of the ageing period, the tensile strength and elongation test shall be carried out as per Sr.No. (6) Above. The value obtained must not differ from the corresponding values obtained before ageing by more than + or - 25% in case of XLPE compound.

8. **Loss of mass test for HRPVC, FR-LSH sheath**:-

This test shall be carried out as per IS 583/1984 012 IEC 60540 & IEC 60502, on cables of all voltage grades. The maximum permissible loss of mass is 2 mg/sq.cm for PVC.

9. **Shrinkage test for XLPE insulation & HRPVC FR-LSH sheath**:-

This shall be carried out as per IS: 5831 – 1984 for sheathed and as per IS 7098 (Part 2) 1985 for XLPE insulation.

10. **Hot deformation test for HRPVC, FR-LSH sheath**:-

This shall be carried out as per IS: 5831 / 1984.

11. **Cold Impact test for HRPVC, FR-LSH sheath**:-

This shall be carried out as per IS: 5831.

12. **Heat shock test for HRPVC, FR-LSH sheath**:-

This test shall be carried out as per IS 5831 / 1984 and IEC 60540 and IEC 60502 & sheath shall pass the requirements of this test.

13. **Thermal stability test for HRPVC, FR-LSH sheath**:-

This test shall be carried out on cables as per IS 5831 / 1984 and IEC 60540 and cables shall pass the minimum requirements of 80 minutes for sheath.

14. **Hot set test for XLPE Insulation**:-

This test shall be carried out as per IS: 7098 Part-1 and Part-2 and cable shall pass the requirements given therein.

15. **Test for bleeding and blooming of Pigments for HRPVC, FR-LSH Sheath**

This shall be carried out as per IS: 5831 / 1984.

16. **Fire Resistance Test:-**

This test is compulsory and shall comply with the relevant clause of applicable IS.

17. **Partial Discharge Test for XLPE Cables**:-

The partial discharge test for XLPE insulation shall be carried out as per IS: 7098 (Part-II).

18. **Bending Test for XLPE Cables:**-

The test method and test requirement shall be as per IS: 7098 (Part-II). On completion of this test, the sample shall be subjected to partial discharge measurement and comply with the requirements given in above sub-clause 17.

19. **Insulation Resistance / Volume resistivity** -

As per IS 7098 Part-2 / 1985

20. **Dielectric Power Factor Test**

As per IS 7098 Part-2 / 1985.

21. **Heating cycle test for XLPE Cables**:-

This test shall be as per IS: 7098 (Part-II)

22. **High Voltage Test:-**

This test shall be performed as per the relevant Indian Standard 7098 Part 2 / 1985.

23. **Test for Rodent & Termite Repulsion Property of Sheath**:-

A few chipping of the PVC compound is slowly ignited on a porcelain dish or cubicle in a muffle furnace at about 60 degree C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). Place a drop of aqueous sodium sulphide solution on a thick filter paper and allow soaking. Touch the spot with a drop of above extract. A black spot indicates the presence of lead, the anti-termite and rodent compound.

24. **Impulse Withstand Test**

As per IS – 7098 (2) (amended upto date).

25. **Water Absorption Test**

As per IS 7098 Part-2 / 1985.

9.03.02 The normal sequence of the electrical tests shall be as per Clause 16.1.1 of IEC-60502/1978 and / or as per IS 7098 Part – 2 / 1985. All the tests listed herein shall be applied successively to the same sample.

9.03.03 The inner and outer sheath of the XLPE insulated cable shall be subjected to all the tests applicable for PVC sheath as per IS 5831 / 1984.

9.04.00 Special Tests On HRPVC 'FR-LSH' Material

All the sizes of 3.3 kV (UE)/11KV(E) XLPE power cables of the 'FRLS' HRPVC sheathed type shall pass following special test requirements. Inner sheath wherever applicable shall also be of the 'FR-LSH' type 'HRPVC' to meet these special tests.

i) **Oxygen/Temperature Index test on sheath material**:-This test shall be carried out as per American National Std. ASTM-D-2863/77.

The minimum oxygen index shall be 29 at room temperature.

For determination of the temp.index, the oxygen index test shall be carried out at different temperature upto 250°C. However, the test shall be carried out by extra-polation method beyond temperature at which the material of sheath may start deformation. The minimum temperature index (i.e. the temperature at which the oxygen index is minimum 21) shall be 250°C generally as per BICC Hand Book Chapter-6.

ii) **Acid gas emission test on sheath material**:-This test shall be carried out as per IEC 60754-1. The maximum acid gas emission shall be less than 20 by weight.

iii) **Smoke density test on sheath material**:-This test shall be carried out as per American National Standard ASTM-D-2843/1977 and also as per UITP method (3M cube test on finished cable sample). **The ASTM test method is compulsory.** For passing this test, the requirement of light transmission shall be minimum 40% after the test.

iv) **Flammability test on finished cable sample**: - This test shall be carried out as per the following method:

- **Swedish Std.SS:424-14-75 Class-F3**. This test known as Swedish Chimney test is compulsory.

- **IEEE 383-1974** – This test known as the vertical tray flame propagation test shall be conducted if insisted by purchaser.

- **IEC 60332-1. –** The cable should meet the requirement of all the above standards.

9.05.00 Routine Tests:

The following tests shall be carried out as Routine tests on each and every drum length of cable, as per IS 7098 (Part 2) / 1985.

a) High Voltage Test

b) Conductor Resistance Test

c) Partial discharge test (for screened cables) – on full drum length.

9.06.00 Acceptance Tests:

The following test shall be carried out as Acceptance Test in the presence of TANGEDCO Inspecting Engineer on samples taken from the delivery lot. One drum out of every 10 number of drums or less shall be selected at random sampling basis in each lot for the Acceptance Tests which shall be carried out at manufacturers/supplier's cost.

a) High Voltage Test

b) Conductor Resistance Test

c) Tensile / wrapping test.

d) Partial discharge test (In screened cables).

e) Insulation Resistance/Volume resistivity test

f) Measurement of thickness of insulation and sheath and other dimensions

g) Tensile strength & elongation at break for insulation & sheath.

h) Hot set test on XLPE insulation

i) Flammability test as per Swedish standard SS:424-15-75 Class-F-3 (Swedish Chimney test)

j) Acid gas generation test as per IEC-60754-1.

k) Smoke density test as per ASTM-D-2843/1977

l) Oxygen index test as per ASTM-D 2863/1977

m) Temp. index test as per ASTM-2863/77

10.00.00 COMMISSIONING

The contractor shall carry out the following commissioning tests and checks after installation at site. In addition the contractor shall carry out all other checks and tests as recommended by the manufacturers.

a) Check for physical damage

b) Check for insulation resistance before and after termination/jointing.

c) HV cables shall be pressure tested (test voltage as per IS: 7098) before commissioning.

d) Check of continuity of all cores of the cables.

e) Check for correctness of all connections as per relevant wiring diagrams. Any minor modification to the panel wiring like removing/inserting, shorting, change in terminal connections, etc., shall be carried out by the Contractor.

f) Check for correct polarity and phasing of cable connections.

g) Check for proper earth connections for cable glands, cable boxes, cable armour, screens, etc.

h) Check for provision of correct cable tags, core ferrules, and tightness of connections.

CHAPTER – 16

LV CABLES

1.00.00 CODES AND STANDARD

1.01.00 All standards, specifications and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions as on date of opening of bid. In case of conflict between this specification and those (IS: codes, standards, etc.) referred to herein, the former shall prevail. All the cables shall conform to the requirements of the following standards and codes:

IS : 3961	Recommended current ratings for cables
IS : 3975	Low carbon galvanised steel wires, formed wires and tapes for armouring of cables.
IS : 4905	Methods for random sampling.
IS : 5831	PVC insulation and sheath of electrical cables.
IS:7098 (Part -I)	Cross linked polyethylene insulated PVC sheathed cables for working voltages up to and including 1100V.
IS : 8130	Conductors for insulated electrical cables and flexible cords.
IS : 10418	Specification for drums for electric cables.
IS : 10810	Methods of tests for cables.
ASTM-D -2843	Standard test method for density of smoke from the burning or decomposition of plastics.
ASTM-D-2863	Standard method for measuring the minimum oxygen concentration to support candle like combustion of plastics.
IEC-60754 (Part-I)	Test on gases evolved during combustion of electric cables.
IEEE-383	Standard for type test of Class IE Electric Cables.
IEC -60332	Tests on Electric cables under fire conditions.

	Part-3 : Tests on bunched wires or cables (catagory -B)
SS-4241475 classF3	Swedish Chimney test
NES-715-1	Temperature index

2.00.00 TECHNICAL REQUIREMENTS

2.01.01 The cables shall be suitable for laying on racks, in ducts, trenches, conduits and under ground buried installation with chances of flooding by water.

2.01.02 Cables shall be flame retardant, low smoke (FRLS) type designed to withstand all mechanical, electrical and thermal stresses develop under steady state and transient operating conditions as specified elsewhere in this specification.

2.01.03 Aluminium conductor used in power cables shall have tensile strength of more than 100 N/ sq.mm. Conductors shall be multi stranded.

2.01.04 XLPE insulation shall be suitable for a continuous conductor temperature of 90 deg. C and short circuit conductor temperature of 250°C.

2.01.05 The cable cores shall be laid up with fillers between the cores wherever necessary. It shall not stick to insulation and inner sheath. All the cables, other than single core unarmoured cables, shall have distinct extruded PVC inner sheath of black colour as per IS: 5831.

2.01.06 For single core armoured cables, armouring shall be of aluminium wires/ formed wires. For multicore armoured cables armouring shall be of galvanised steel as follows : -

Calculated nominal dia of cable under armour	**Size and Type of armour**
i) Up to 13 mm	1.4mm dia GS wire
ii) Above 13 & upto 25mm	0.8 mm thick GS formed wire / 1.6 mm dia GS wire
iii) Above 25 & upto 40 mm	0.8mm thick GS formed wire / 2.0mm dia GS wire
iv) Above 40 & upto 55mm	1.4 mm thick GS formed wire /2.5mm dia GS wire
v) Above 55 & upto 70 mm	1.4mm thick GS formed wire / 3.15mm dia GS wire
vi) Above 70mm	1.4 mm thick GS formed wire / 4.0 mm dia GS wire

2.01.07 The aluminium used for armouring shall be of H4 grade as per IS:8130 with maximum resistivity of 0.028264 ohm mm^2 per meter at 20 deg C. Aluminium armouring shall be same as indicated above for galvanized steel.

2.01.08 The gap between armour wires / formed wires shall not exceed one armour wire / formed wire space and there shall be no cross over / over-riding of armour wire / formed wire. The minimum area of coverage of armouring shall be 90%. The breaking load of armour joint shall not be less than 95% of that of armour wire / formed wire. Zinc rich paint shall be applied on armour joint surface of G.S.wire/ formed wire

2.01.09 Cable Identification

1. Outer sheath shall be of PVC (of suitable grade) & black in colour. In addition to meeting all the requirements of Indian standards referred to, outer sheath of all the cables shall have the following FRLS properties.

   (a.) Oxygen index of min. 21 (As per NES-715-1)

   (b.) Acid gas emission of max. 20% (As per IEC-60754-I).

   (c.) Smoke density rating shall not be more than 60% during Smoke Density Test as per ASTMD-2843.

2. Cores of the cables shall be identified by colouring of insulation. Following colour scheme shall be adopted:

   1 core - Red, Black, Yellow or Blue

   2 core - Red & Black

   3 core - Red, Yellow & Blue

   4 core - Red, Yellow, Blue and Black

3. For reduced neutral conductors the core shall be black.

4. In addition to manufacturer's identification on cables as per IS, following marking shall also be provided over outer sheath.

   (a.) Cable size and voltage grade - To be embossed

(b.) Word 'FRLS' at every 5 metre - To be embossed

(c.) Sequential marking of length of the cable in metres at every one metre- To be embossed / printed

The embossing shall be progressive, automatic, in line and marking shall be legible and indelible.

5. Cores of the cables of upto 5 cores shall be identified by colouring of insulation. Following colour scheme shall be adopted.

1 core	-	Red, Black, Yellow, Blue
2 core	-	Red & Black
3 core	-	Red, Yellow & Blue

2.01.10 All cables shall meet the fire resistance requirement of IEEE - 383 with cable installations made in accordance with clause “Flammability test” and as per Category-B of IEC 60332 Part -3.

2.01.11 Allowable tolerances on the overall diameter of the cables shall be +\-2 mm maximum over the declared value in the technical data sheets.

2.01.12 In plant repairs to the cables shall not be accepted. Pimples, fish eye, blow holes etc, are not acceptable.

3.00.00 Cable selection & sizing

3.01.00 Cables shall be sized based on the following considerations:

i. Rated current of equipment.

ii. Maximum voltage drop limits under steady state and during starting for motor being fed from 415V switchgear restricted to 5% and 15% respectively.

Maximum voltage drop limits under steady state and during starting for motor being fed from 415V MCC restricted to 3% and 15% respectively.

Maximum voltage drop limits under steady state for feeder (i.e. Outgoing feeders being fed from 415V switchgear) restricted to 3%.

iii. For cables to motors and feeders protected by MCCBs the cross section will be chosen according to the tripping time of MCCBs.

3.02.00 Derating Factors

Derating factors for various conditions of installations including the following shall be considered while selecting the cable sizes:

i. Variation in ambient temperature for cables laid in air
ii. Grouping of cables
iii. Variation In ground temperature and soil resistivity for buried cables.

3.03.00 Cable lengths shall be considered in such ways that straight through cable joints are avoided.

3.04.00 Cables shall be armoured type if laid in switchyard area, coal handling area or directly buried.

3.05.00 All LV power cables except trailing cables shall be XLPE insulated FRLS.

3.06.00 All control cables shall be 2.5 Sq mm copper cable.

3.07.00 Multicore control cables will generally have spare conductor (s) in accordance with the following chart and cores of a single cable will not be split for different auxiliary/equipment:

Conductors	required Cables
1 or 2	1-3/C
3 or 4	1-5/C
5 or 6	1-7/C
7 or 8	1-10/C
9 or 10	1-12/C
11 or 12	1-16/C
13 or 14	1-18/C
Above 14 core	Two or more of above cables

4.00.00 CONSTRUCTIONAL FEATURES

04.01.00 1.1 KV Grade Power Cables

(d.) 1.1 KV grade XLPE power cables shall have compacted aluminium conductor for cables including 10 sq. mm and above and copper conductor for cables below 10 sq.mm, XLPE insulated, PVC inner-sheathed (as applicable), armoured, FRLS PVC outer-sheathed conforming to IS: 7098. (Part-I).

(e.) 1.1 KV grade Trailing cables shall have tinned copper (class 5) conductor, insulated with heat resistant elastomeric compound based on Ethylene Propylene Rubber (EPR) suitable for withstanding 90°C continuous conductor temperature and 250 deg C during short circuit, inner-sheathed with heat resistant elastomeric compound, nylon cord reinforced, outer-sheathed with heat resistant, oil resistant and flame retardant heavy duty elastomeric compound conforming to IS 9968

4.02.00 1.1 kV Grade Copper Conductor Fire Survival Power Cables

4.02.01 1100 volt grade, 90 Deg.C rating, Power cables with stranded Copper conductor, heat resistance elastomeric insulation generally conforming to Type IE-2 of IS: 6380-1984, extruded Halogen free or very low Halogen elastomeric inner sheath, generally conforming to Type SE-3 of IS-6380-1984, round wire/strip armour and extruded outer sheath of elastomeric material generally conforming to Type SE-3 of IS: 6380-1984.

4.02.02 The cables shall be generally manufactured in conformity to IS-9968 Part-1/1988.

4.02.03 The cables shall be rated for 3 hours fire rating.

4.02.04 Conductor shall be of stranded construction, consisting of high conductivity annealed plain copper wires conforming to Class-II of IS 8130.
A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

4.02.05 The insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

4.02.06 The suitable fire retardant material fillers shall be used for filling in the interstices. Two layers of plain glass fiber binder tape shall be applied over the laid up cores.

4.02.07 Fire Survival Power & Control cables shall be provided for the following services:

(a.) DC emergency lube oil pump.
(b.) Turbine lube oil pump/barring gear.
(c.) Jacking oil pump.
(d.) Scanner air fan.
(e.) Incoming & outgoing cables for DC lighting distribution board.
(f.) Fire /smoke detection system.
(g.) DC seal oil pump.
(h.) DC emergency lighting cables for Main Plant Building.
(i.) Batteries to charger and DC distribution board.
(j.) Emergency turbine trip by push button in control room.
(k.) Boiler turbine: Generator inter-trip which includes the interconnecting cables between

1. Boiler master fuel trip and turbine trip relays
2. Generator trip relays and turbine trip relays
3. Generator trip relays and 400 kV circuit breaker
4. Generator trip relays and generator field breaker.
5. Generator trip relays and UAT breaker.

4.03.00 1.1 KV Grade Control Cable

Control cable shall be multi core, minimum 2.5 sq.mm cross section, stranded copper conductor, PVC insulated, inner PVC sheathed / galvanized steel wire armored and outer sheath made of FRLS PVC compound. In situation where accuracy of measurement or voltage drop in control circuit, warrant, higher cross sections as required shall be used. 4 sq.mm copper conductors shall be used for CT circuits, all other specification remaining same. In 4 sq.mm conductor impose unacceptable high burden on CTs, higher cross section of conductor shall be used.

Voltage Transformer leads shall be checked for voltage drop, which shall be limited to within 1 % for all cases other than tariff metering, for which the voltage drop shall be limited to 0.2 %. In case the voltage drop with 4 sq.mm Cu conductors exceeds this value, higher conductor sizes shall be used.

4.04.00 1.1 kV Copper Conductor Fire Survival Control Cables

4.04.01 Conductor shall be of stranded construction, consisting of high conductivity annealed tinned copper conductors conforming to IS 8130/1984 amended up to date.

4.04.02 A suitable heat barrier tape, preferably glass mica tape shall be provided over the conductor.

4.04.03 The conductor insulation shall consist of heat resisting elastomeric material EPR (Ethylene Propylene rubber) and shall conform to Type IE-2 of IS:6380/1984 amended up to date.

4.04.04 An inner sheath of extruded special low smoke and very low halogen content (acid gas generation shall be less than 2% by weight) elastomeric (HOFR) compound of black colour or any other natural colour with prior approval from Owner conforming to Type SE-3 of IS-6380/1984, amended up to date, shall be provided over the laid up cores.

4.04.05 The armouring over inner sheath shall consist of single layer of wire/round galvanized steel wire as per IS 3975 amended up to date.

4.04.06 The outer sheath shall be of special low smoke and very low Halogen content (Acid gas generation shall be less than 2% by weight) elastomeric HOFR compound comprising of synthetic rubber and shall generally conform to the type SE-3 of IS: 6380 latest revision.

4.04.07 The colour of outer sheath shall be black or any other natural colour agreed mutually between Owner and Contractor.

4.04.08 The minimum sizes of L.T. cable to be chosen are as below:
AL-16 mm^2 (3 core) & Cu – 2.5 mm^2 (3 core)

In power cables maximum conductor size to be used will be 300 sq. mm & 630 sq.mm for multi core and single core cables. In case of multi core cables not more than 3 runs to be used or otherwise single core cable to be used.

4.05.00 Cable Drums

Cables shall be supplied in non returnable wooden or steel drums of heavy construction. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Wood preservative anti-termite treatment shall be applied to the entire drum. Wooden drums shall comply with IS: 10418.

5.00.00 TESTS

5.01.00 Type Tests:

5.01.01 The reports for the following type tests shall be submitted on one size each of LV Power cables :

S.No.	Type Tests	Remarks
a)	**For Conductor**	
1.	Annealing test	For copper conductor only.
2.	Tensile test	For aluminium conductor only.
3.	Wrapping test	For aluminium conductor only.
4.	Resistance test	
b)	**For Armour Wires/ Formed Wires**	
1.	Measurement of Dimensions	
2.	Tensile Test	
3.	Elongation test	
4.	Torsion test	For round wires only
5.	Winding test	For Formed wires only
6.	Resistance test	
7(a)	Zinc Coating test	For G.S. Formed wires /wires only.

7(b)	Wrapping test	For Al. Formed wires /wires
c)	**For XLPE insulation & PVC Sheath**	
1.	Test for thickness	
2.	Tensile strength & elongation tests before ageing and after ageing	
3.	Ageing in air oven	
4.	Loss of mass test	For PVC sheath only
5.	Hot deformation test	For PVC sheath only
6.	Heat shock test	For PVC sheath only
7.	Shrinkage test	
8.	Thermal stability test	For PVC sheath only
9.	Hot set test	For XLPE insulation only
10.	Water absorption test	For XLPE insulation only
11.	Oxygen index test	For outer sheath only
12.	Smoke density test	For outer sheath only
13.	Acid gas generation test	For outer sheath only
d)	For completed cables	
1.	Insulation resistance test (Volume resistivity method)	
2.	High voltage test	
3.	Flammability test as per clause “Flammability test”	
4.	Flammability test as per IEC - 332 Part-3 (Category -B)	

5.01.02 Flammability Test

(f.) This test shall generally be carried out as per IEEE 383. The cable installation to be tested shall consist of as many cables as are necessary to give atleast 10 kg of organic material per metre run.

(g.) The following cable installation shall be tested :

(1.) Installation with single / multi core cables in touching formation.

(h.) Size of cables, number of cables, number of layers and laying arrangements for each installation shall be subject to Owner's approval.

(i.) The size of the cables selected (measured by total cross sectional area of the conductor) shall have maximum organic material per sq. mm of total cross sectional area of all the conductors.

5.01.03 Acceptance Tests

Acceptance tests shall be carried out on each type and size of the cables on the cable drums selected at random as per following sampling plan:

S. No.	No. of drums in the lot	No. of drums to be taken as sample
1.	Upto 100	10% (Subject to minimum of 1 drum)
2.	101 to 300	13
3.	301 to 500	20
4.	Above 500	32

The following shall constitute acceptance tests :

1. Item No. 1 to 14, 16, 19, 20, 22, 23, 24, 25 of list of type tests specified in 9.03.01 of chapter 15.
2. Fire resistance test as per SS 4241475 (F3 category)
3. One length per size / lot for surface finish and length measurement
4. Lay length / sequence of cores, armour coverage, Gap between two consecutive armour wires / formed wires, Band marking.

5.01.04 Routine Tests

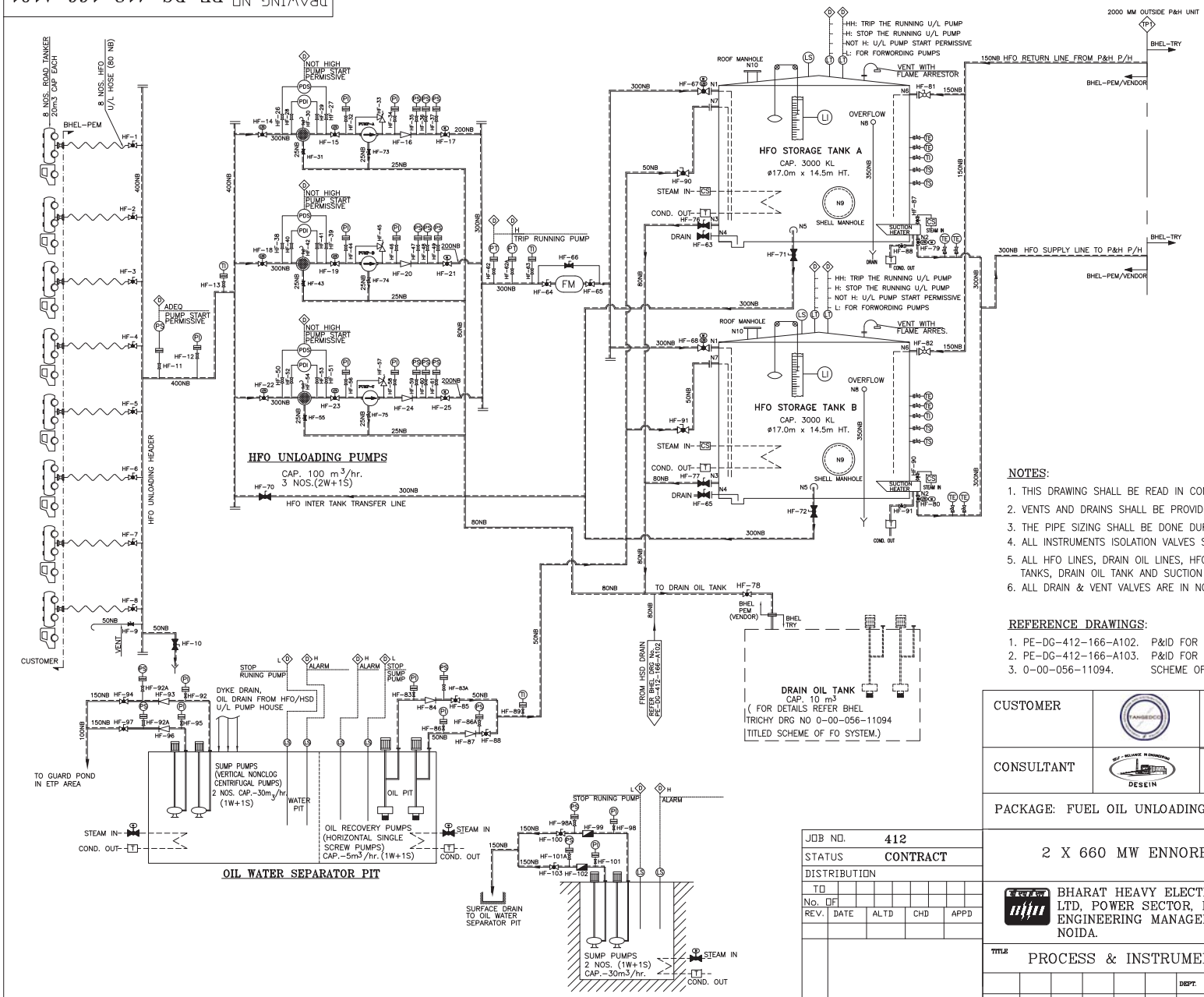
Routine tests shall be carried out as per relevant standard for each drum of cables of all types and sizes.

PIDs

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-412-166-A101

FILE NAME : PE-DG-412-166-A101-R01



LEGEND	
SYMBOL	DESCRIPTION
	HOSE
	HFO PIPE WITH INSULATED & ELECTRIC TRACED
	COIL HEATER
	PUMP
	LOCAL DRAIN
M	MOTOR
LMS	LIMIT SWITCH
PI	PRESSURE INDICATOR
PS	PRESSURE SWITCH
PT	PRESSURE TRANSMITTER
PDI	PRESSURE DIFFERENTIAL INDICATOR
PDS	PRESSURE DIFFERENTIAL SWITCH
LS	LEVEL SWITCH
LT	LEVEL TRANSMITTER(RADAR TYPE)
LI	LEVEL INDICATOR
TI	TEMPERATURE INDICATOR
TS	TEMPERATURE SWITCH
TE	TEMPERATURE ELEMENT
	SIGNAL TO DCS
T	STEAM TRAP
	SIMPLEX STRAINER
PS	PRESSURE SWITCH.
CS	STEAM CONTROL VALVE
	GLOBE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	PLUG VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	BALL VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	GATE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	NON RETURN VALVE
	RELIEF VALVE

NOTES:

1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DESIGN MEMORANDUM.
2. VENTS AND DRAINS SHALL BE PROVIDED AT THE HIGHEST AND LOWEST POINTS RESPECTIVELY.
3. THE PIPE SIZING SHALL BE DONE DURING DETAIL ENGINEERING BASED ON PIPE SIZING CRITERIA.
4. ALL INSTRUMENTS ISOLATION VALVES SHALL BE GLOBE VALVE.
5. ALL HFO LINES, DRAIN OIL LINES, HFO PUMPS & STRAINER ARE ELECTRIC TRACED. HFO TANKS, DRAIN OIL TANK AND SUCTION HEATER ARE STEAM TRACED.
6. ALL DRAIN & VENT VALVES ARE IN NORMALLY CLOSE CONDITION.

REFERENCE DRAWINGS:

1. PE-DG-412-166-A102. P&ID FOR HSD SYSTEM
2. PE-DG-412-166-A103. P&ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING.
3. 0-00-056-11094. SCHEME OF FUEL OIL SYSTEM (BHEL TRICHY DRG.)

CUSTOMER	TANGEDCO	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)
CONSULTANT	DESEIN	M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI

PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM.

2 X 660 MW ENNORE SEZ COAL BASED STPP

JOB NO.	412
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

REV.	DATE	ALTD	CHD	APPD

BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA.

DEPT CODE		NAME	SIGN	DATE
M	DRN	SC	Sd/-	21.01.2015
	DESN	KY	Sd/-	21.01.2015
	CHD	HK	Sd/-	21.01.2015
	APPD	PK	Sd/-	21.01.2015

TITLE: PROCESS & INSTRUMENTAION DIAGRAM FOR HFO SYSTEM

DEPT. SIGN DATE SCALE

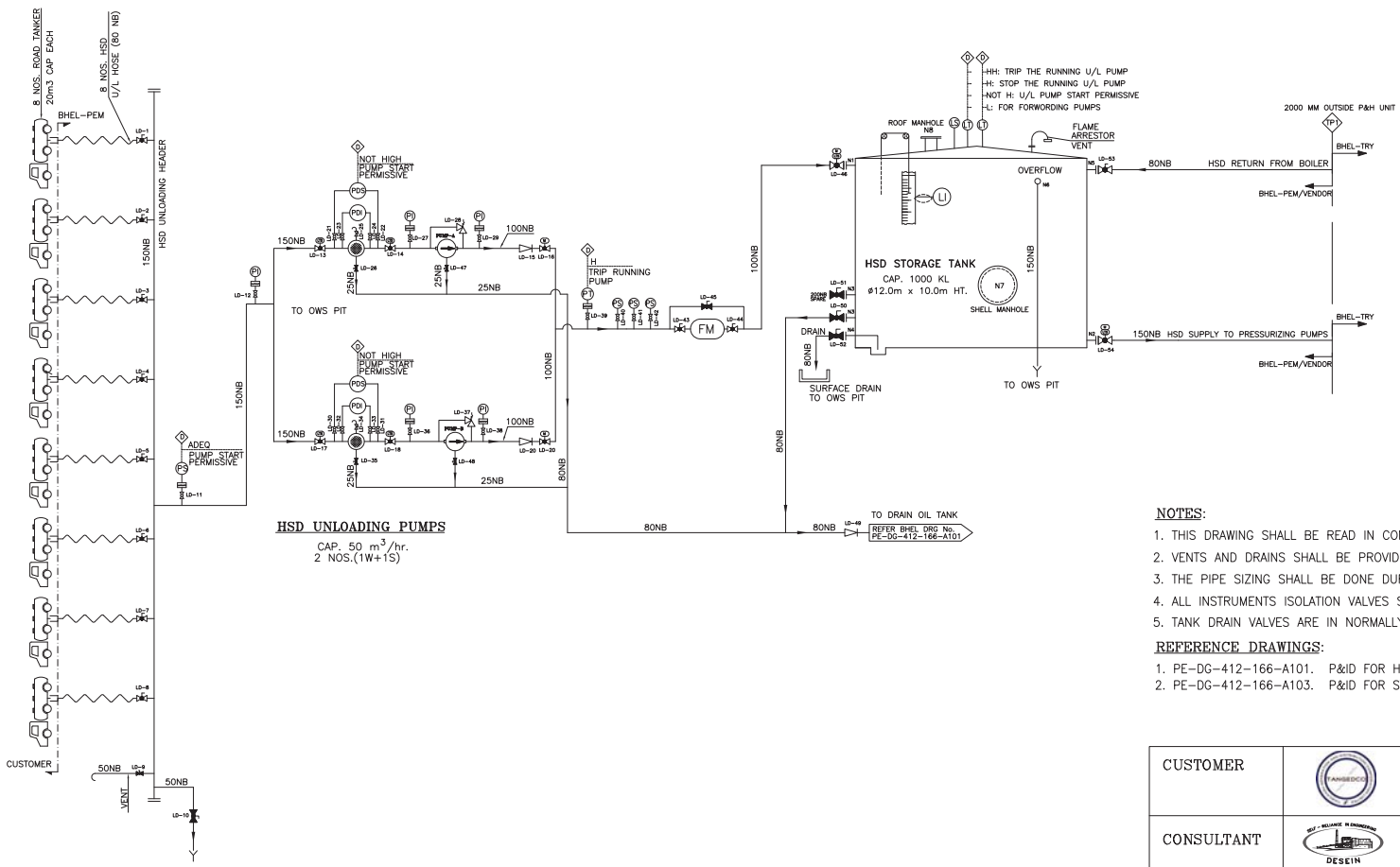
DRAWING No. PE-DG-412-166-A101

SHEET 01 OF 01 REV 01

FORMAT SIZE A3

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-412-166-A102



HSD UNLOADING PUMPS
CAP. 50 m^3/hr.
2 NOS.(1W+1S)

LEGEND	
SYMBOL	DESCRIPTION
~~	HOSE
——	HSD PIPE
	PUMP
PLC	PROGRAMMABLE LOGIC CONTROLLER
DCS	DISTRIBUTED CONTROL SYSTEM
	LOCAL DRAIN
M	MOTOR
LMS	LIMIT SWITCH
PI	PRESSURE INDICATOR
PS	PRESSURE SWITCH
PT	PRESSURE TRANSMITTER
PD	PRESSURE DIFFERENTIAL INDICATOR
PDS	PRESSURE DIFFERENTIAL SWITCH
LS	LEVEL SWITCH
LT	LEVEL TRANSMITTER(RADAR TYPE)
LI	LEVEL INDICATOR
TI	TEMPERATURE INDICATOR
TS	TEMPERATURE SWITCH
TE	TEMPERATURE ELEMENT
	SIGNAL TO DCS
T	STEAM TRAP
	SIMPLEX STRAINER
PS	PRESSURE SWITCH.
CS	STEAM CONTROL VALVE
	GLOBE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	PLUG VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	BALL VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	GATE VALVE (NORMALLY OPEN/ NORMALLY CLOSED)
	NON RETURN VALVE
	RELIEF VALVE

NOTES:
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH DESIGN MEMORANDUM.
2. VENTS AND DRAINS SHALL BE PROVIDED AT THE HIGHEST AND LOWEST POINTS RESPECTIVELY.
3. THE PIPE SIZING SHALL BE DONE DURING DETAIL ENGINEERING.
4. ALL INSTRUMENTS ISOLATION VALVES SHALL BE GLOBE VALVE.
5. TANK DRAIN VALVES ARE IN NORMALLY CLOSE CONDITION.

REFERENCE DRAWINGS:
1. PE-DG-412-166-A101. P&ID FOR HFO SYSTEM
2. PE-DG-412-166-A103. P&ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING.

CUSTOMER	TANGEDCO	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)
CONSULTANT	DESEIN	M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI

PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM

2 X 660 MW ENNORE SEZ COAL BASED STPP

JOB NO.	412
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No. OF									
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	CHD	HK	Sd/-	21.01.2015
	APPD	PK	Sd/-	21.01.2015

TITLE: PROCESS & INSTRUMENATION DIAGRAM FOR HSD SYSTEM

DEPT. | SCALE | SIGN | DATE

DRAWING No. PE-DG-412-166-A102

SHEET 01 OF 01 REV 01

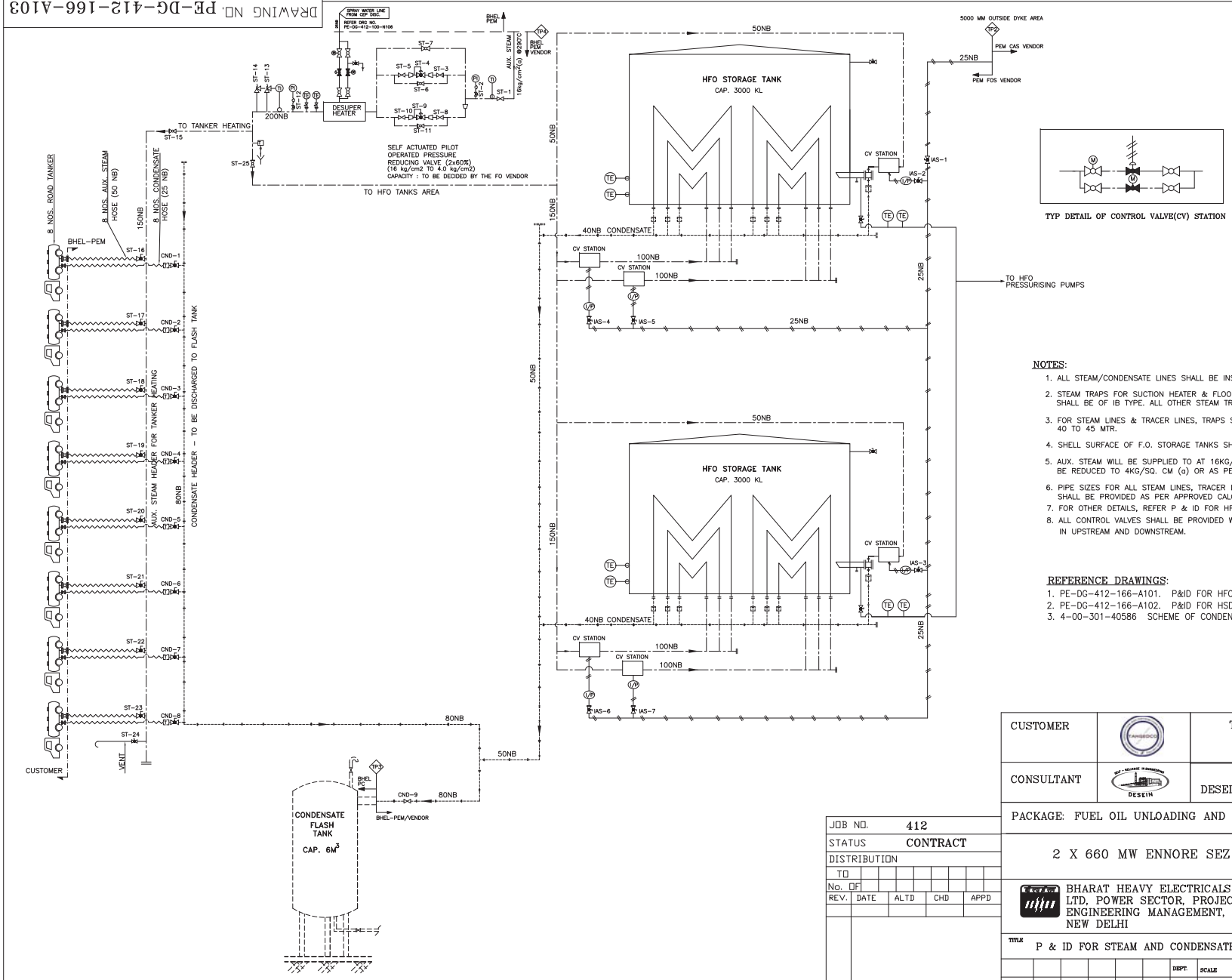
FILE NAME :PE-DG-412-166-A102-R01

FORMAT SIZE A3

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-412-166-A103

FILE NAME :PE-DG-412-166-A103-R01



TYP DETAIL OF CONTROL VALVE(CV) STATION

LEGEND	
SYMBOL	DESCRIPTION
TC	TEMPERATURE CONTROLLER
TE	TEMPERATURE ELEMENT
T	STEAM TRAP
	PLUG / BALL VALVE
	GATE VALVE
	PNEUMATICALLY OPERATED CONTROL VALVE
M	MOTOR
	HOSE
	COIL HEATER
	LOCAL DRAIN
	ELECTRICAL SIGNAL
	CONDENSATE LINE
	INSTRUMENT AIR LINE
	AUX. STEAM LINE
I/P	I/P CONVERTER
	INCHING TYPE MOTORISED VALVE.

NOTES:

1. ALL STEAM/CONDENSATE LINES SHALL BE INSULATED.
2. STEAM TRAPS FOR SUCTION HEATER & FLOOR COIL HEATER OF STORAGE TANKS SHALL BE OF IB TYPE. ALL OTHER STEAM TRAPS SHALL BE OF TD TYPE.
3. FOR STEAM LINES & TRACER LINES, TRAPS SHALL BE PROVIDED AT EVERY 40 TO 45 MTR.
4. SHELL SURFACE OF F.O. STORAGE TANKS SHALL BE INSULATED.
5. AUX. STEAM WILL BE SUPPLIED TO AT 16KG/SQ. CM (a) & 290 °C. FURTHER IT SHALL BE REDUCED TO 4KG/SQ. CM (a) OR AS PER SYSTEM REQUIREMENT.
6. PIPE SIZES FOR ALL STEAM LINES, TRACER LINES, CONTROL STATIONS, CONDENSATE LINES ETC. SHALL BE PROVIDED AS PER APPROVED CALCULATION.
7. FOR OTHER DETAILS, REFER P & ID FOR HFO SYSTEM, PE-DG-412-166-A101.
8. ALL CONTROL VALVES SHALL BE PROVIDED WITH ISOLATION VALVES AND WITH A DRAIN VALVE IN UPSTREAM AND DOWNSTREAM.

REFERENCE DRAWINGS:

1. PE-DG-412-166-A101. P&ID FOR HFO SYSTEM
2. PE-DG-412-166-A102. P&ID FOR HSD SYSTEM
3. 4-00-301-40586 SCHEME OF CONDENSATE FLASH TANK.(BHEL PC)

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CUSTOMER	TENGEDCO	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)
CONSULTANT	DESEIN	M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI

PACKAGE: FUEL OIL UNLOADING AND STORAGE SYSTEM.

2 X 660 MW ENNORE SEZ COAL BASED STPP

BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NEW DELHI

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DRN	SC	Sd/-	21.01.2015
DESN	KY	Sd/-	21.01.2015
CHD	HK	Sd/-	21.01.2015
APPD	PK	Sd/-	21.01.2015

TITLE: P & ID FOR STEAM AND CONDENSATE FOR HFO HEATING & TRACING

DEPT. / SIGN / DATE / SCALE

DRAWING No. PE-DG-412-166-A103

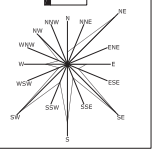
SHEET 01 OF 01 REV 01

FORMAT SIZE A3

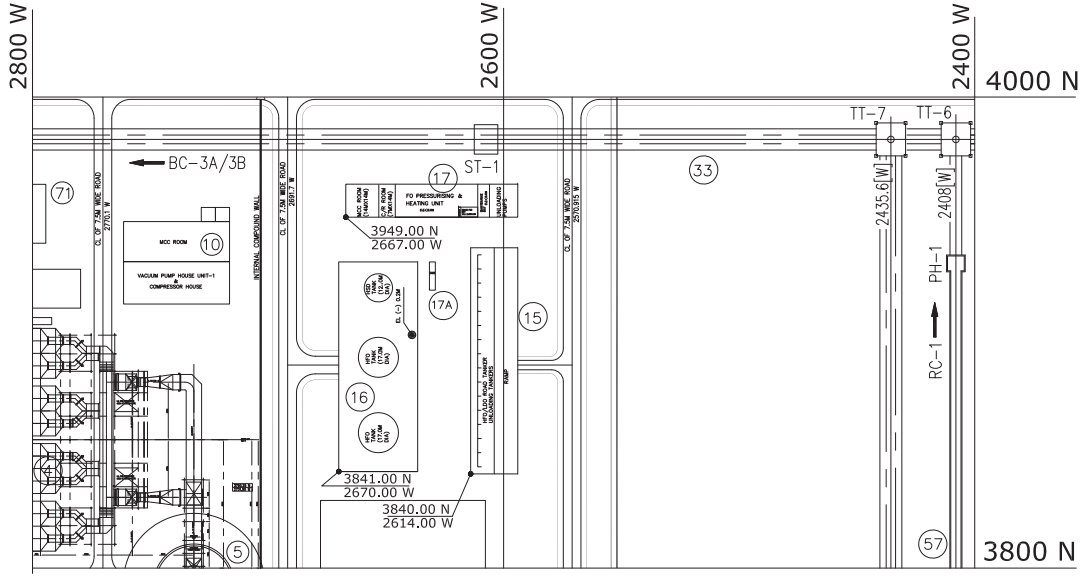
FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-412-166-A104

NORTH



LEGEND:	
S. No.	DESCRIPTION
16	HFO & HSD STORAGE TANK DYKE AREA.
17	HFO & HSD UNLOADING & FORWARDING PUMP HOUSE
15	HFO & HSD UNLOADING AREA (ROAD)
17A	OIL WATER SEPARATOR
21	FOAM PUMP HOUSE
5	CHIMNEY



KEY PAN

DIMENSIONS OF VARIOUS FACILITIES ARE AS UNDER.

1) HFO TANK :2 NOS., 17.0M DIA, 14.5 M Ht
2) HSD TANK :1 NO., 12.0M DIA, 10.0 M Ht
2) DYKE AREA 89M X 33.5M, Ht: 1.7M
3) DISTANCE BETWEEN SHELL TO SHELL OF ADJACENT TANKS = 15M
4) FUEL OIL UNLOADING PUMP HOUSE=AS SHOWN
5) FUEL OIL FORWARDING PUMP HOUSE=AS SHOWN
6) OIL WATER SEPARATOR=12M X 2.5M (APPROX.)
7) UNLOADING HEADERS AND STEAM HEADERS WILL BE PEDESTAL ROUTED.
8) FGL OF HFO & HSD UNLOADING AREA IS APPROX. 1.0M ABOVE FGL OF UNLOADING PUMP HOUSE

NOTE :

1) BASED ON ABOVE LAYOUT DETAIL ENGINEERING WILL BE DONE.
2) COORDINATES SHALL BE AS PER PLOT PLAN.
3) FENCING WILL BE DONE OVER THE DYKE WALL
4) PLANT FINISHED GRADED LEVEL (FGL) SHALL BE RL (+)9.50M. FUEL OIL PUMP HOUSE FINISHED GROUND FLOOR LEVEL IS EL(+)0.00M, WHICH CORR. TO RL(+)10.0M.

CUSTOMER	TANGEDCO	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)
CONSULTANT	DESEIN	M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI
PACKAGE:	FUEL OIL UNLOADING AND STORAGE SYSTEM.	

JOB NO.	412
STATUS	CONTRACT
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TO	
No. OF	

REV.	DATE	ALTD	CHD	APPD

2 X 660 MW ENNORE SEZ COAL BASED STPP

BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA.

DEPT CODE		NAME	SIGN	DATE
M	DRN	SC	Sd/-	15.05.2015
	DESN	KY	Sd/-	15.05.2015
	CHD	HK	Sd/-	15.05.2015
	APPD	PK	Sd/-	15.05.2015

TITLE: FUEL OIL HANDLING SYSTEM LAYOUT

DEPT. SIGN DATE SCALE:

DRAWING No. PE-DG-412-166-A1004

SHEET 01 OF 02 REV 00

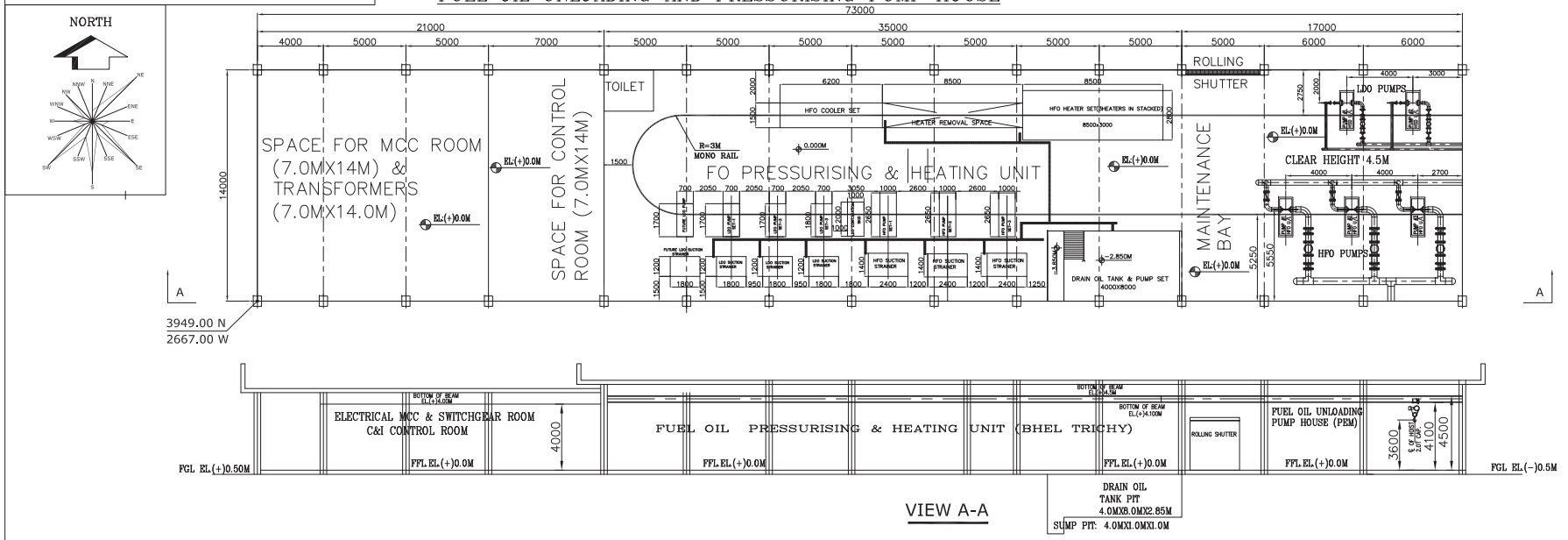
FORMAT SIZE A3

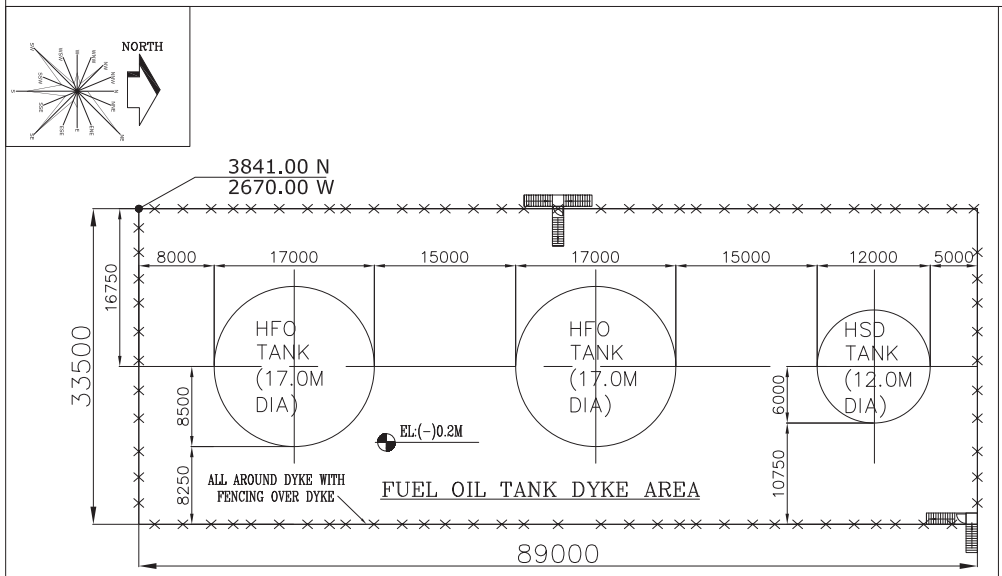
FILE NAME: PE-DG-412-166-A104-R0

FIRST ANGLE PROJECTION ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-412-166-A104

FUEL OIL UNLOADING AND PRESSURISING PUMP HOUSE





NOTES:

1) MONORAIL BEAM FOR CHAIN PULLEY BLOCK (2.0 T) ALONG THE PUMP HOUSE LENGTH WILL BE PROVIDED BY BHEL–CIVIL
2) BIDDER TO CONFIRM SIZES OF THE UNLOADING PUMP HOUSE AND DYKE AREA INDICATED IN THE DRAWING.

CUSTOMER	TANGEDCO	TAMILNADU GENERATION AND DISTRIBUTION CORPORATION (TENGEDCO)
CONSULTANT	DESEIN	M/s DESEIN PVT LTD. DESEIN HOUSE, GK – II, NEW DELHI

PACKAGE: – FUEL OIL UNLOADING AND STORAGE SYSTEM.

PROJECT: – 2 X 660 MW ENNORE SEZ COAL BASED STPP

JOB NO.	412
STATUS	CONTRACT
DISTRIBUTION	
TO	
No. OF	

REV.	DATE	ALTD	CHD	APPD

BHARAT HEAVY ELECTRICALS LTD, POWER SECTOR, PROJECT ENGINEERING MANAGEMENT, NOIDA.

DEPT CODE		NAME	SIGN	DATE
M	DRN	SC	Sd/–	19.05.2015
	DESN	KY	Sd/–	19.05.2015
	CHD	HK	Sd/–	19.05.2015
	APPD	SKB	Sd/–	19.05.2015

TITLE: – FUEL OIL HANDLING SYSTEM LAYOUT

DEPT. SCALE SIGN DATE

DRAWING No. PE-DG-412-166-A1004

SHEET 02 OF 02 REV 00

FORMAT SIZE A3

FILE NAME:PE-DG-412-166-A104-R0

REPLIES TO PRE-BID CLARIFICATIONS

PRE-BID CLARIFICATION - TECHNICAL

S.No.	Section/Clause/ Page No.	Statement of the referred clause	Clarification required	BHEL Reply
1	P & ID No.PE-DG-412-166-A101	Simplex strainer shall be provided at pump suction.	As presume that, as per the P&ID we shall provide one strainer for each pump with flow capacity equal to pump at full load/capacity. Kindly Confirm.	Confirmed
2	P & ID No.PE-DG-412-166-A103	Control valve shall be used to maintain temperature in HFO tanks.	As per system requirement we shall provide 1. On/off type control valve for floor heater 2. Modulating type for suction heater. Kindly advice.	Bidder to follow the revised PID and requirement of control valve station.
3	SCOPE OF SUPPLY, Page 20 of 487, Clause 2.1.8	One (1) no. Pressure Reducing and de-superheating station to reduce aux. steam from 16 kg/cm2 (a) and 290°C to 4.0 kg/cm2 (a) and 150°C or as required by FO System vendor during detail engineering. PRDS shall be located near Tank Dyke Area.	**It is not mentioned whether the PRDS shall be 2 X 60 % or 1 X 100%.** **Kindly provide** **Kindly Clarify.**	**Pressure reducing station shall be 2X60 % . For desuperheater and its control valve station bidder to follow revised PID #** PE-DG-412-166-A103**.**
4	VOLUME II-B,(Clause No.1.2.1), Page 32 of 487	The unloading header shall be electric traced. Steam/ electric tracing have been envisaged in the system please refer P&IDs for scope.	As per specification, All HFO lines/Headers, Unloading pumps and Strainers Shall be electric traced and steam shall only be used to heat to heat	Confirmed. HFO tanks and Suction heater shall be steam heated.

			unloading tankers, HFO storage Tank. Kindly confirm.	
5	VOLUME II-B,(Clause No.6.0.0), Point No I, Page 25 of 487	However, inside the pump house no pedestals / insert plate shall be provided for fixing. Bidder shall support the pipes using pipe supports and anchor fasteners inside the pump house.	Kindly provide the GA & elevation for Pump house to estimate the pipe support requirement for fixing arrangement.	Bidder to follow layout drawing, PE-DG-412-166-A104.
6	VOLUME II-B,(Clause No.6.0.0), Point No K, Page 25 of 487	Oily water collected in storage tank area, oil unloading area will normally be collected in OWS pit by gravity either through trench (limited to a depth of 0.5 m) or through buried pipe (limited to a depth of 1.0 m) . However, in case depth of pipe between the pit and OWS pit exceeds 1 m or gravity flow is not possible due to layout constraints (which can be reviewed during detail engineering), the oily water waste shall be collected by pumping to OWS pit. Necessary pumps, valves, pipe supports, and instruments etc. for the same shall be included by bidder in their scope.	Please provide the FGL at Tank farm area, oil unloading area & pump house area to determine the requirement of the pump. Also specify the capacity of these pumps (if required).	Capacity of pumps shall be decided during detail engineering. It shall normally be in the range 10-30 m3/hr. FGL is shown in LAYOUT DRAWNG. PE-DG-412-166-A104.
7	General	Preparation of drawings/ document/P&IDs in 3D modelling software & providing soft copy of same to BHEL	In general practice, we use AutoCAD software to develop piping layouts & PIDs. Kindly confirm	Confirmed.
8	Volume-II B (Cl.1.2.2), Page 32 of 487	The road tankers shall have steam heating coil arrangement dully	Kindly confirm the initial Temp and heating time for unloading	Initial temp is minimum ambient temp.

		installed for heating HFO up to min. 50C	Tankers.	Heating time shall be 2 hours.
9	Clause 15.2 System description, Point (a), Page 88 of 487	Fuel oil decanting pump house is also included in scope of bidder.	As fuel oil decanting pump house is comes under civil scope of work. Therefore, it is excluded from the bidder scope. Kindly confirm.	Civil work of fuel oil decanting pump house is not in Bidder's scope.
10	Oil Unloading Pump sets, 15.3.1, Page 89 of 487	a) Three (3) - 100 cum per hour capacity (2W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type heavy fuel oil unloading pump sets complete with AC electric motor drives and all other accessories as necessary. The pumps shall be electrically traced. b) Two (2) – 50 cum per hour capacity (1W+1S), 4 kg/cm2(g) discharge pressure, direct AC driven horizontal twin screw type HSD unloading pump sets complete with drive motor with accessories for unloading road tankers.	As per our understanding 4 kg/cm2 is the minimum discharge pressure to be considered for mentioned pumps. Kindly confirm.	Bidder understanding is correct.
11	Clause 1.2.2, Page 32 of 487	The road tankers shall have steam heating coil arrangement dully installed for heating HFO up to min. 50C. Steam supply to the road tankers from Aux steam header (laid by the side of Fuel Oil unloading header) shall be through metallic flexible hoses and the condensate shall be collected in a condensate header laid by the side of Fuel Oil unloading header.	As per the P&ID and control write-up, it's stated that, the road tanker shall be heated with steam to reduce the viscosity of the fuel. However, in the customer description it is stated that to be heated by electric heater. Kindly clarify.	Road tanker shall be heated with steam.
	Clause 15.2 System	The fuel oil will be transported to		

	description, Point (a), Page 88 of 487	the plant site by road tankers; and unloading pumps shall be used for unloading of oil and storing it in tanks. Before unloading the heavy fuel oil, it shall be heated by electric heaters in the road tankers as considered necessary to make it flowable. Fuel oil decanting pump house is also included in scope of bidder.		
12	Clause No 1.4, Page 39 of 487	Suction Heater Sr. No 1, Type of Heater U-tube, shell & tube type (Oil in shell, steam in tube).	As per the heating medium specified in the scope, the suction heaters shall be operated through steam only.	Suction heater shall be heated by steam.
	Clause 15.4.4, Page 93 of 487, Point ii	Heating media : Electric		
13	Clause 3.03.01.01, Page 347 of 487	Transmitters & other HART based instruments shall be supplied along with 3 Nos. of universal type hand held/portable pressure calibrators. Temperature transmitters shall be supplied along with 3 Nos. of hand held / portable mV source generators.	Kindly clarify the requirement of Hand Held Calibrator for transmitter	Hand Held Calibrator is not in bidder scope of supply. However, please note that the smart positioner (for control valves, if supplied) shall be compatible with Universal Hand Held Calibrator.
14	SCOPE OF C&I, Point No 19, Page 321 of 487	415 V AC/230 V AC supply shall be provided by BHEL at a single point, further distribution to various Instruments/Equipment of the system shall be in bidder scope. Bidder to include necessary power Distribution board in his scope. Any power supply other than the above, if required by any instrument/ equipment has to be derived by the bidder from the above supply & all necessary hardware for the same shall be in	We understand that 415V AC power supply and 24V DC supply for instruments shall be supplied by BHEL, kindly confirm.	For 415 V AC/230 V AC supply specification shall be followed. For Instruments, 24V DC shall be provided by BHEL.

		bidder scope. Bidder to submit the power requirement along with the bid.		
15	GENERAL	Electrical Heat Tracing	Kindly specify the Electrical Heat Tracing system specification with maximum allowable circuit length. Further, also clarify the Electrical Heat tracing for Strainer and pumps.	Electric heat tracing specification is attached. Bidder to follow the same.
16	Volume- V: Instrumentation & Control Works, Clause No. 6.00.02 LOCAL CONTROL PANEL, Page 324 of 487	The local control panel for control and monitoring……..	We have considered 2 nos. level transmitters in each tank as per said clause, kindly confirm.	For level transmitters on each tank, bidder to refer revised PID.
17	Pg.No. 20 of 487, Cl.No. 2.1.2	Two (2) nos, (1W+1S), HSD twin screw unloading pump motor set each of capacity 50 m3/hr with **twin simplex** type strainers at their suction.	Referred clause calls for Twin Simplex strainer whereas in "Process & Instrumentation Diagram for HSD System" indicates one simplex strainer at each pump suction. Please clarify which one has to be considered.	**One Simplex strainer at each pump suction is to be considered.** **Further Bidder to refer revised PIDs.**
18	Pg.No. 42 of 487, Cl.No.1.9, Sr.No. 2	Size: 50 NB x8 m long for condensate service.	Referred clause calls for 50NB Condensate hose whereas in "P&ID for Steam and Condensate for HFO heating and Tracing" indicates 25NB condensate hose. Please clarify which one has to be considered.	Bidder to refer Amendment.

19	Pg.No. 44 of 487, Cl.No.1.11, Sr.No. 5	i) Ball valves shall be used for isolation purpose in oil lines. These shall have 'port' position indicators with CLOSE/OPEN indications marked on valve body. ii) Ball valves shall be of class 150 full-bore type with face to face dimension as per ANSI B 16.10. Body material for plug/Ball Valves shall be ASTM A216 Gr. WCB. The ball shall be of SS AISI 316 quality. iii) Ball valves shall be of safe patter for internal (line) & external leakage. Ball valves in general shall confirm to BS: 5351/ and to BS6755 Part-2/API 607/ Equivalent for fire safe test. iv) Plug valves shall be of fire safe pattern for external leakage only. Plug valves in general shall confirm to API 6D/ Equivalent for design &manufacturing standard and to BS6755 Part-2/ API607/ Equivalent for fire safe test.	Please clarify upto what size Ball valves to be considered and Plug valves from what size to be considered.	Following shall be considered for valve selection: Ball valve: 200NB and Below. Plug valve: 250 to 350NB Gate valve: 400 and above.
20	Pg.No. 45 of 487, Cl.No.1.12, Sr.No. d	BURIED PIPE, IF ANY / PIPE CARRYING BILGE WATER (WATER WITH TRACES OF OIL)	We understood this piping specification to be considered for sum pump and recovered water pumps discharge piping. Plesae confirm.	Confirmed

21	Pg.No. 46 of 487, Cl.No.1.13	VELOCITIES FOR SELECTING PIPING	Velocities for sump pump discharge piping, recovered water pump discharge piping, condensate piping and super heated steam(aux. steam) piping is not given. Please provide the same.	Bidder to consider following velocities: Sump pump discharge :2m/s Recovered water pump discharge line :2.5 m/s Condensate piping and super-heated steam : Bidder to refer page 181of 487 of technical specification.
22	Pg.No. 89 of 487, Cl.No. 15.2, h	Heavy fuel oil road tankers shall be fitted with electric heating coils so that oilmay be heated to reduce its viscosity. When the oil temperature in tankerrises to about 50°C, oil shall be drained to the oil-unloading header. Whenthe oil unloading header and the piping at the unloading pump suction isfilled up with oil and steady oil supply is ensured, the unloading pumps shallbe started.	Both referred clauses contraducting about type of heating of road tankers. We are considering road tankers heating by steam. Please confirm.	Road tanker shall be heated through steam only.
	Pg.No. 32 of 487, Cl.No. 1.2.2	The road tankers shall have steam heating coil arrangement dully installed for heating HFO up to min. 500C. Steam supply to the road tankers from Aux steam header (laid by the side of Fuel Oil unloading header) shall be through metallic flexible hoses and the condensate shall be collected in a condensate header laid by the side of Fuel Oil unloading header.		

23	Pg.No. 92 of 487, Cl.No. 15.4.3.1	Each heavy fuel oil tank shall be provided with floor coil heater in one or more tiers at the bottom of the heavy fuel oil storage tanks to maintain oil within the tank at specified temperature with electricity as the heating medium. The tubes shall be seamless steel to A106 Gr. B supporting the coil within the tank bottom.	Both referred clauses contradicting about type of heating of HFO storage tanks. We are considering HFO storage tanks heating by steam. Please confirm.	HFO tanks shall be steam heated.
	Pg.No. 32 of 487, Cl.No. 1.2.5	Two (2) nos. HFO storage tanks, each of net capacity 3000 m3 are envisaged. The HFO tank shall be provided with steam floor coil heaters at the bottom of the tank to raise the temperature of oil to handling / tank maintenance temp. of 600C in 72 hrs. time and maintaining the temperature inside the tank at 600 C. The floor coil heater for the Fuel oil storage tanks shall have adequate nos. of sections and shall be regulated through one pneumatically operated modulating type control valve on the steam supply line. This shall be actuated from tank temperature.		
24	Pg.No. 92 of 487, Cl.No. 15.4.4	Fuel Oil Suction Heater	Both referred clauses contraducting about type of heating medium and temperature rise for suction heaters. We are considering steam as a heating medium and 10 deg. C temperature rise.	Suction heater shall be steam heated.
	Pg.No. 32 of 487, Cl.No. 1.2.8	Each HFO storage tank shall also be provided with a suction heater at tank outlet to heat the outgoing HFO by 10 deg C over maintenance temp of 600C inside		

		the tanks. Steam shall be the heating medium for the HFO tank suction heaters.	Please confirm.	
25	Pg.No. 93 of 487, Cl.No. 15.4.8	The oil storage tanks shall be provided with flame proof float type level indicators &switches. The float type level indicators shall comprise of stainless steel enclosedfloat filled with approved lightweight materials.	Referred clause calls for level switches on storage tanks. Whereas in Process & Instrumentation diagrams only Level transmitters are shown. We understood that as Level Transmitters are provided, level switches are not required. Please confirm.	**Bidder to follow revised PIDs.**
26	Pg.No. 44 of 487, Cl.No. 1.12	PIPES, FITTINGS & FLANGES	Minimum thickness/Sch to be considered for Fuel oil piping, steam piping, condensate piping, air piping, etc. is not given. Please provide.	Bidder to refer chapter on "power cycle piping and LP piping" (page No 181-261) of technical specification.
27	Pg.No. 239 of 487, Cl.No. 13.3.6, 13	FUEL OIL PUMP DISCHARGE LINES - ASTM A 106 GR B	Both referred clauses contradicting about MOC of fuel oil discharge piping. We are considering API 5L GR.B (ERW). Please confirm.	Both MOC for fuel oil discharge pipe is acceptable.
	Pg.No. 44 of 487, Cl.No. 1.12, 1.	Fuel Oil Pump Discharge Piping/Other Fuel Oil/ Piping - API 5L GR.B (ERW)		
28	Process and Instrumentation Diagram of HFO System, Pg.No. 476 of 487		Please confirm the number of pumps working for sizing inter tank transfer line in HFO system.	For sizing inter-tank transfer lines, bidder to consider two working HFO pumps.

29	P&ID for Steam and Condensate for HFO heating and tracing, Pg.No. 478 of 487		Two steam control valves shown for floor coil heater of each tank. In general 50% of coils connected to steam control valve and remaining coils connected to manual valves. Both valves will be used during heating and only control valve used during maintenance. Please check and confirm.	**Bidder to follow revised PID #** PE-DG-412-166-A103**.**
30	Pg.No. 23 of 487, Cl.No. 4.0.0	TERMINAL POINT	Spray water terminal point, pressure, temperature and properties of water are not provided for PRDS. Please provide the same.	Terminal point of spray water for desuperheater shall be same as steam terminal point. Properties of spray water shall be: 1/ Pressure: 30 Kg/cm2. 2/ Temperature: 46 ^{o}C. 3/ Properties: DM water.
31	Page 20 of 487, Cl. 2.1.10	Complete steam tracing / electric tracing, insulation and cladding of heavy fuel oil piping, drain oil piping, steam and condensate piping & accessories.	We understand that system required Electrical heat tracing. We have not find any specifications for Electrical heat tracing system. Please provide.	Electric heat tracing specification is attached with Amendment I. Bidder to follow the same.
32	Page 20 of 487, Cl. 2.1.14	LT transformers and LT switch gears for FO Unloading system shall be as per contract specification, Vol-IV (Electrical specification).	Both referred clauses are contradicting each other about scope Electricals. Please clarify and provide the clear scope.	Page 275 of 487, Annexure I, scope between vendor & BHEL shall prevail.
33	Page 275 of 487, Annexure - I, Scope between vendor & BHEL	SL. NO. 1: 415V MCC		
34	Page 22 of 487	Exclusion as indicated in Electrical & C&I portion of technical specification	We have not find any exclusions in Electrical & C&I scope. Please provide clear scope & exlcusions.	Bidder to follow specification.

35	ANNEXURE-I (SYSTEM WRTIE-UP) Page 34 of 487	Operation and Control of Fuel Oil unloading and storage system will be from main plant DCS **(under customer scope).**	Both referred clauses are contradicting each other. We understood that we have to provide one Local Control Panel (LCP) to terminate/connect all the instrumentation cables/ signal cable through junction box to this LCP. Interfacing with DCS from this LCP including DCS is on BHEL scope.	Specification is quite clear, operation of FO unloading and storage system shall be from BHEL supplied RPU (remote processing unit) of main plant DCS. RPU shall be located at control room of FOHS.
36	SCOPE OF C&I FOR FUEL OIL UNLOADING & STORAGE SYSTEM Page 320 of 487	FUEL OIL UNLOADING & STORAGE SYSTEM shall be operated from DCS (BHEL's scope).		
37	General		Please provide/ clarify the following: 1. Scope of electrical is not clear. Please confirm whether we have to consider as per scope matrix given in the tender? Or else please provide the clear scope. 2. Specifications for Local control panel & Electrical Heat Tracing panels. 3. Specifications for Power, control & Instrumentation cables. 4. Please provide other required specifications if any as per scope of Electrical & C&I.	Specification is quite clear, bidder to follow the specification and its amendment.