

- (q) Wherever required valves shall be provided with chain operator, extension spindles and floor stands or any other arrangement approved by employer so that they can be operated with ease from the nearest operating floor. Wherever necessary for safety purpose locking device shall be provided. Further, necessary small platforms for facilitating easy valve operation shall be provided by the contractor wherever necessary in consultation with project manager within the bid price at no extra cost to employer.
- (r) All valves except those with rising stems shall be provided with continuous mechanical position indicator; rising stem valves shall have only visual indication through plastic/metallic stem cover for sizes above 50 mm nominal bore.
- (s) For CI gate, globe and check valves wherever thickness of body/bonnet is not mentioned in the valves standards, thickness mentioned in IS-1538 for fitting shall be applicable.

13.14.2 VALVE BODY MATERIAL

Valve body material for various services shall be as follows:

Valve body material for water application like DM Cooling Water (Passivated DM Water) (DMCW), RO Stage I Permeate, AHP Seal Water, APH/ ESP Wash, Service Water, Potable Water, HVAC Make UP shall be cast iron for sizes 65 NB and above; gun-metal/ Forged Carbon Steel for sizes 50 NB and below.

Valve body material for sea water application like Circulating Water. Auxiliary Cooling water, Blowdown, CT make up, sea water Intake, Guard pond inlet & Discharge, Ash Water using sea water, RO Stage II reject, RO Stage I reject, Reject Sump discharge and all other sea water applications shall be SS 316 L for all sizes.

For compressed air application, valve body material shall be cast carbon steel or forged carbon steel for sizes 65 mm NB & above and Gun metal for sizes 50 NB and below.

DM water: SS body and disc alongwith SS internals.

Condensate: Cast Carbon Steel/Forged Carbon Steel.

- 13.14.2.1 The design, material, construction, manufacture, inspection, testing and performance of valves shall comply with all currently applicable statutes, regulations and safety codes in the locality where the valves will be installed. The valves shall conform to the latest editions of applicable codes and standards as mentioned elsewhere. Nothing in this specification shall be construed to relieve the Bidder of his responsibility. Valves in general shall conform to the requirements of the following standards.

Standards and Codes

AWWA-C-504	Rubber seated butterfly valves
BS-5155/EN-593	Cast iron and steel body butterfly valves for general purpose.
IS-778	Gun-metal gate, globe and check valves for general purpose.

BS-5154	Copper alloy globe/globe stop and check and gate valves for general purpose.
IS-780	Sluice valves for water works purpose (50-300 mm size)
IS-2906	Sluice valves for water works purpose (350-1200 mm size)
IS-5150	Cast iron wedge and double disc gate for general purpose.
BS-5152	Specification for cast iron globe valves
BS-5153	Cast iron check valves for general purpose.
IS-5312	Swing check type reflux (non-return) valves
ANSI B 16.34	Standard for valves
API-594	Standard for Dual-check valves
API-600	Steel gate valves
ANSI-B-16.10	Valves face to face and other relevant dimension
API-598	Valves inspection test

13.14.2.2 End Connections

The end connections, shall comply with the following:

Socket welding (SW) – ANSI B 16.11

Butt Welding (BW) – ANSI B 16.25

Threaded (SC) – ANSI B 2.1

Flanged (FL) – ANSI B 16.5 & AWWA-C-207 (steel flanges), ANSI B 16.1 (Cast Iron flanges)

- 13.14.2.3 All cast iron body valves (gate, globe and non-return) shall have flanged end connections; (screwed ends for Ductile D.2NI body valves are not acceptable).
- 13.14.2.4 All steel and stainless steel body valves of sizes 65 mm and above shall have flanged or butt welding ends. Valves of sizes below 65mm shall have flanged or socket welded ends. Compatibility of welding between valve body material and connecting pipe material is a pre-requisite in case of butt-welded joints.
- 13.14.2.5 All gun metal body valves shall have screwed ends.
- 13.14.2.6 All flanged end valves/specialties shall be furnished alongwith matching counter flanges, fasteners, gaskets etc. as required to complete the joints

13.15.00 Check Valves

13.15.1 Check valves shall comply with the following characteristics:

- (a) For bore greater than 2" the valves must be swing check type or dual plate check type suitable for installation in all positions (vertical and horizontal);
- (b) For bore smaller than or equal to 2" the valves must be of the piston type to be installed, in horizontal position.
- (c) In the case of swing check valves, the body seat shall be inclined at such an angle from the vertical as will facilitate closing and prevent chatter.

13.15.2 Drilling on flanges of flanged valves must correspond to the drilling on flanges of the piping system on which the valves are to be installed.

13.15.3 All flanged valves intended for installation in steel piping systems shall have their flanges drilled to ANSI B 16.5 (or equivalent) and according to the pressure class.

13.15.4 Counter flanges to be installed on air pipes shall be screwed-on type irrespective of size.

13.16.00 Globe Valves

13.16.1 The globe valves shall have the following characteristics;

Straight conveyed flow

Right angle

Preferably, the valves shall be of the vertical stem type.

13.16.2 Globe valves shall preferably have radiused or spherical seating and discs shall be free to revolve on the spindle.

13.16.3 The pressure shall preferably be under the disc of the valve. However, globe valves, with pressure over the disc shall also be accepted provided (i) no possibility exists that flow from above the disc can remove either the disc from stem or component from disc (ii) manual globe valves can easily be operated by hand. If the fluid load on the top of the disc is higher than 40-60 KN, bypass valve shall be provided which permits the downstream system to be pressurized before the globe valve is opened.

13.16.4 For the regulating valves, valves with regulating plug & parabolic outline disc type is preferred.

13.16.5 All motorized globe valves with regulating plug for which indication of percentage (%) opening are required in the control room shall be provided with necessary position transmitter.

13.17.00 Gate valves

All gate valves shall be of the full-way type, and when in the full open position the bore of the valve shall not be constricted by any part of the gate.

Gate valves shall be of the solid/elastic or articulated wedge disc and rising stem type.

13.18.00 Air Release Valve

- (a) The air release valves shall be of automatic double air valve with two orifices and two floats. The float shall not close the valve at higher air velocities. The orifice contact joint with the float shall be leak tight joint.
- (b) The valve shall efficiently discharge the displaced air automatically from ducts/pipes while filling them and admit air automatically into the ducts/pipes while they are being emptied. The valve shall also automatically release trapped air from ducts/pipes during operation at the normal working pressure.
- (c) Body material of automatic air release valves shall comply generally with BS 1452 Gr. 14/IS:210 Gr. FG 260 and spindle shall conform to high tensile brass.
- (d) Air release valves shall not have any integral isolation device within them. Each Air release valve shall be mounted, preceded by a separate isolation gate/butterfly valve.

13.19.00 Butterfly Valves

13.19.1 Design/Construction

- (a) The valves shall be designed for the design pressure/temperature of the system on which it is installed and in accordance with AWWA-C-504, EN-593 or any other approved equivalent standard latest edition. Fabricated steel (IS: 2062 GR. B) butterfly valves instead of cast iron body valves are also acceptable for size above 300 mm nb diameter. In such a case, however, the bidder will have to necessarily submit thickness calculations, in order to establish the integrity of the fabricated valve body under the system operating pressure condition.
 - (1) The valves shall be suitable for installation in any position (horizontal/vertical etc.) and shall be generally of double-flanged construction. However for sizes 600 NB and below the valves of Wafer construction are also acceptable.
 - (2) The seals, both on the body (sleeve) and on the disc shall be of the material specified. Necessary shaft seal shall be provided and adequately designed to ensure no leakage across the seal. This seal shall be designed so that they will allow replacement without removal of the valve shaft. The sealing ring on the disk shall be continuous type and easily replaceable.
 - (3) For all types of valves, the design with shaft eccentric to the disc is preferred. The shaft shall be solid type and shall pivot on bushings. Bushings/sleeve type bearings shall be contained in the hub of valve body. The bearing shall be self-lubricated type with low coefficient of friction and should not have any harmful effect on water and on valve components.
 - (4) The design of the shaft shall be such that it will safely sustain maximum differential pressure across the closed valve. The shaft

and any key (taper pin etc.) for transmitting the torque between shaft and disc shall be capable of withstanding the maximum torque required to operate the valve. However, the shaft diameter shall not be less than the minimum shaft diameter specified in relevant code. Necessary Torque Calculation and the torque class selected on the basis of the same shall be furnished to the Employer for information.

- (5) The disc shall rotate from the full open to the tight shut position. The disc shall be contoured to ensure the least possible resistance to flow and shall be suitable for throttling operation. While the disc is in the throttled position, valve shall not create any noise or vibration.

- (6) The operating mechanism shall be mounted directly on or supported from the valve body.

- (7) All valves shall be complete with:

Position indicator (located in a visible place)

Arrow indicating the flow direction;

Adjustable mechanical stop limiting devices to prevent over

Travel of valve disc in open/close position.

All valves shall be "tight shut off"

- (8) Hand operated valves shall have the following

Local hand controls

The hand controls shall close the valve with clockwise rotation.

The hand controls shall be dimensioned to guarantee an easy maneuver under most severe conditions.

The hand controls shall be provided with locking systems suitable to avoid the disc assuming a non-desirable position during the operation.

Hand wheel shall be made of malleable iron with arms and rims of adequate strength. The hand wheel of diameters 300 mm or less shall be provided with handles for ease of operation. The pulling force required on the hand wheel rim shall not exceed 25 Kgf when operating the valve under full flow and operating pressure.

Valves-350 Nb and above shall have pressure equalizing bypass valves, wherever system parameters warrant the same.

Valves-350 Nb and above shall also be provided with gear operator arrangement suitable for manual operation. Manual operation of valve shall be through worm and gear arrangement having totally enclosed gearing with hand wheel diameter and gear ratio designed to meet the required operating torque. It shall be designed to hold the valve disc in intermediate position between full open and full closed position without creeping or fluttering.

Adjustable stops shall be provided to prevent over travel in either direction.

Limit and torque switches (if applicable) shall be enclosed in water tight enclosures alongwith suitable space heaters for motor actuated valves, which may be either for On-Off operation or inching operation with position transmitter.

13.19.2 Material of Construction (Butterfly Valves)

Materials and other design details shall be as indicated below:

(a) Cast Iron Butterfly valves

Body & Disc	ASTM A48, Gr. 40 with 2% Ni/ IS: 210. Gr. FG-260, with 2% Ni and epoxy coated
Shaft	BS 970 431 S: 291/EN 57, or AISI-410 or AWWA-permitted shaft material equivalent to EN-57/AISI-410 or better.
Seat ring	18-8 Stainless steel
Seal	Nitrile Rubber
Companion Flanges	IS 2062
External hardware	SS 316
Internal hardware	SS 316

(b) Duplex Stainless Steel Butterfly valves (All Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water (Sea water) etc.)

Body & Disc	SS 316 L
Shaft	SS 316 L.
Seat ring	SS 316 L
Seal	Nitrile Rubber
Companion Flanges	SS 316 L
External hardware	SS 316 L
Internal hardware	SS 316 L

(c) Stainless Steel Butterfly Valves

Body & Disc	ASTM A 351, Gr. CF8M/ASTM-A-182-Gr. 304
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Shaft	ASTM A 182, Gr. 316/ASTM-A-479 Gr. 316/Equivalent
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Disc & Seat Rings	EPT/BUNA-N/Neoprene
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Companion Flanges	SS 304
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External hardware	SS 316
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Internal hardware	SS 316
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(d) Carbon Steel Butterfly Valves

Body & Disc	ASTM A 216, Gr. WCB
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Shaft	ASTM A 182, Gr. 304/ASTM-A-479 Gr. 304/Equivalent
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Disc & Seat Rings	EPT/BUNA-N/Neoprene
-------------------	---------------------

Companion Flanges	IS 2062
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External hardware	SS 316
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Internal hardware	SS 316
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13.19.3 Proof of Design Test (Type Test) for Butterfly Valves

Proof of Design (POD) test certificates shall be furnished by the bidder for all applicable size-ranges and classes of Butterfly valves supplied by him, in the absence of which actual POD test shall be conducted by the bidder in the presence of Employer's representative.

All valves that are designed and manufactured as per AWWA-C-504 shall be governed by the relevant clauses of POD test in AWWA-C-504. For Butterfly valves designed and manufactured to EN-593 or equivalent, the POD test methods and procedures shall generally follow the guidelines of AWWA-C-504 in all respect except that Body & seat hydro test and disc-strength test shall be conducted at the pressures specified in EN-593 or the applicable code. Actuators shall also meet requirements of POD test of AWWA-C-504.

13.20.00 MATERIAL OF CONSTRUCTION (GATE/GLOBE/CHECK VALVE)

(a) The materials shall generally comply with the following:

(1) Cast Steel Valves

Body & bonnet	ASTM A 216 Gr. WCB/ ASTM A 105
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Disc for non-return Valves	ASTM A 216 Gr. WCB/ ASTM A 105
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Trim.	ASTM A 182 Gr. F6 or Equivalent
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Companion Flanges	IS 2062
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External hardware	SS 316
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	Internal hardware	SS 316
(2)	Stainless Steel Valves	
	Body & Bonnet	ASTM A 351 Gr. CF 8M/ ASTM A 182 Gr. 304
	Disc	-do-
	Trim.	ASTM 182 Gr. F. 316 /ASTM-A-479 Gr. 316 or Integral with body
	Companion Flanges	SS 304
	External hardware	SS 316
	Internal hardware	SS 316
(3)	Cast Iron Valves	
	Body & bonnet 260	BS 1452 Gr. 14/IS-210 Gr. FG
	Seating surfaces and rings	13% chromium steel/13% Chrome overlay
	Disc for non-return valves	BS 1452 Gr. 14/IS-210 Gr FG 260
	Hinge pin for non-return valves	AISI 316
	Stem for gate globe valves	13% chromium steel or Equivalent
	Back Seat	13% chromium steel / 13% Chrome overlay
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
(4)	Gun Metal Valves	
	Body and bonnet	IS 318 Gr. 2/Equivalent Standard
	Trim	-do-
	Companion Flanges	IS 2062
	External hardware	SS 316
	Internal hardware	SS 316
(5)	Duplex Stainless Steel (All Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)	

Body & bonnet	SS 316 L
Disc for non-return	SS 316 L
Stem	SS 316L
Trim.	SS 316 L
Companion Flanges	SS 316 L
External hardware	SS 316 L
Internal hardware	SS 316 L

- (b) Cast iron body valves shall have high alloy steel stem and seat.
- (c) Material for counter flanges shall be the same as for the piping except for sea water application.

13.21.00 Float Operated Valves

- (a) Valve shall automatically control the rate of filling and will shut off when a predetermined level is reached and close to prevent over flow on pre-set maximum water level. Valve shall also open and close in direct proportion to rise or fall of water level.

(b) DESIGN AND CONSTRUCTION FEATURES

The following design and construction feature of the valve shall be the minimum acceptable.

- (c) Valves shall be right-angled or globe pattern.
- (d) Valves shall be balance piston type with float ball.
- (e) Leather liner shall not be provided.
- (f) The body and cover material shall be cast iron conforming to ASTM-A 126 Grade 'B' or Is: 210 Grade 200 or equivalent, and float shall be of copper with epoxy painting of two (2) coats. For all sea water applications the complete valve shall be SS 316 L construction.
- (g) Valves shall be suitable for flow velocities of 2 to 2.5m/sec.
- (h) The valves shall have flanged connections.

13.22.00 PAINTING OF VALVES:

Two (2) coats of primer followed by three (3) coats of epoxy of approved color code/shade (usually same as that of connected piping) shall be applied to all exposed surfaces except stainless steel surface, Galvanized steel surface and gun metal surface at shop as required to prevent corrosion, before dispatch. The use of grease/oil other than light grade mineral oil, for corrosion protection is prohibited. The total DFT of painting shall be 150 micron (minimum). If during transport, unloading/unpacking or erection at site any part of the painted surface gets

damaged, the same shall be made good by the contractor by repainting with compatible painting primer and enamel to the satisfaction of the project manager.

13.23.00 RUBBER EXPANSION JOINTS

- 13.23.1 All parts of expansion joints shall be suitably designed for all stresses that may occur during continuous operation and for any additional stresses that may occur during installation and also during transient condition.
- 13.23.2 The expansion joints shall be single bellow rubber expansion joints. The arches of the expansion joints shall be filled with soft rubber.
- 13.23.3 The tube (i.e. inner cover) and the cover (outer) shall be made of natural or synthetic rubber of adequate hardness. The shore hardness shall not be less than 60 deg. A for outer and 50 deg. A for inner cover.
- 13.23.4 The carcass between the tube and the cover shall be made of high quality cotton duck, preferably, square woven to provide equal strength in both directions of the weave. The fabric plies shall be impregnated with age resistant rubber or synthetic compound and laminated into a unit.
- 13.23.5 Reinforcement, consisting of solid metal rings embedded in carcass shall be provided.
- 13.23.6 Expansion joints shall be complete with stretcher bolt assembly. The expansion joints shall be suitable to absorb piping movements and accommodate mismatch between pipelines.
- 13.23.7 The expansion joints shall be of heavy duty construction made of high grade abrasion-resistant natural or synthetic rubber compound. The basic fabric for the 'duck' shall be either a superior quality braided cotton or synthetic fibre having maximum flexibility and non-set characteristic.
- 13.23.8 The expansion joints shall be adequately reinforced, with solid steel rings, to meet the service conditions under which they are to operate.
- 13.23.9 All expansion joints shall be provided with stainless steel retaining rings for DM water application and IS 2062 Gr. B galvanized steel retaining rings for ordinary water for use on the inner face of the rubber flanges, to prevent any possibility of damage to the rubber when the bolts are tightened. These rings shall be split and beveled type for easy installation and replacement and shall be drilled to match the drilling on the end rubber flanges and shall be in two or more pieces.
- 13.23.10 The expansion joints shall have integral fabric reinforced full-face rubber flanges. The bolt on one flange shall have no eccentricity in relation to the corresponding bolt hole on the flange on the other face. The end rubber flanges shall be drilled to suit the companion pipe flanges.
- 13.23.11 All exposed surfaces of the expansion joint shall be given a 3 mm thick coating of neoprene. This surface shall be reasonably uniform and free from any blisters, porosity and other surface defects.
- 13.23.12 Each control unit shall consist of two (2) numbers of triangular stretcher bolt plates, a stretcher bolt with washers, nuts, and lock nuts. Each plate shall be drilled with three holes, two for fixing the plate on to the companion steel flange and the third for fixing the stretcher bolt.

13.23.13 Each joint shall have a permanently attached brass or stainless steel metal tag indicating the tag numbers and other salient design features.

13.23.14 Bidder to note that any metallic part which comes in contact with DM / Corrosive water shall be of stainless steel material.

13.23.15 For all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc the bolts & nuts, stretcher plates and companion flanges shall be SS 316 L.

13.24.00 STRAINERS

13.24.1 Simplex type

The strainers shall be basket type and of simplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe lines. The strainer element shall be 20 mesh. Pressure drop across the strainers in new condition fitted with a removable plug. The material of construction of various parts shall be as follows:

- | | | |
|-----|------------------|--|
| (a) | Body | IS: 318, Gr. 2 up to 50 mm Nb, and IS: 210 Gr.
FG 260 above 50 mm Nb. (For DM water/ -Body: AISI 316 or equivalent)
SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc) |
| (b) | Strainer Element | Stainless steel (AISI 316)

SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc) |
| (c) | End connection | Screwed upto 50 mm Nb, and flanged above 50 mm Nb |

13.24.2 Duplex type

- (a) The strainers shall be basket type and of duplex construction. The strainer shall be provided with plugged drain/blow off and vent connections. The free area of the strainer element shall be at least four (4) times the internal area of the connecting pipe. The mesh of strainer element shall be commensurate with the actual service required. Pressure drop across the strainer in new condition shall not exceed 4.0 MWC at full flow.
- (b) Wire mesh (if applicable) of the strainers shall be suitably reinforced. The material of construction of various parts shall be as follows.

- | | |
|------|---|
| Body | IS: 318, Gr. 2
Up to 50 mm Nb, and IS:210,
Gr. FG 260 of ASTM-A-515 Gr. 75/IS-2062
Gr. B and internally epoxy-painted above 50 NB. |
|------|---|

SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)

Strainer element Stainless steel (AISI 316)/ SS 316 L (all Sea Water applications including guard pond, reject sump, CW, ACW, CT make Up, Sea Water Intake, RO Stage I Reject, RO Stage II Reject, Ash water etc)

End connection Screwed up to 50 mm NB, and Flanged above 50 NB. Gasket shall be of full face type

- (c) The strainer will have a permanent stainless steel tag fixed on the strainer body indicating the strainer tag number and service and other salient data.
- (d) The size of the strainer and the flow direction will be indicated on the strainer body casting.
- (e) Thickness of the strainer element should be designed to withstand the pressure developed within the strainer due to 100% clogged condition exerting shut-off pressure on the element.

13.24.3

Three shop coats of paint preceded by two coats of primer shall be applied to all exposed surfaces as required to prevent corrosion. All parts shall be adequately protected for rust prevention. The use of grease or oil other than light grade mineral oils for corrosion protection is prohibited.

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 conducive 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.



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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 - ASTM D-2843 and ASTM E-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 (IECA 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



PERFORMANCE GUARANTEE



FUEL OIL HANDLING SYSTEM

2X 660MW ENNORE SEZ STPP

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

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,



FUEL OIL HANDLING SYSTEM

2X 660MW ENNORE SEZ STPP

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

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

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 (3A)	Standby (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 fuel oil handling 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 guaranteed 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 thereof) 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 thereof) increase in consumption from the base figure shall be levied.					

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

SPECIFICATION FOR ELECTRIC HEAT TRACING

FIRST ANGLE PROJECTION (ALL DIMENSIONS IN MILLIMETRES)

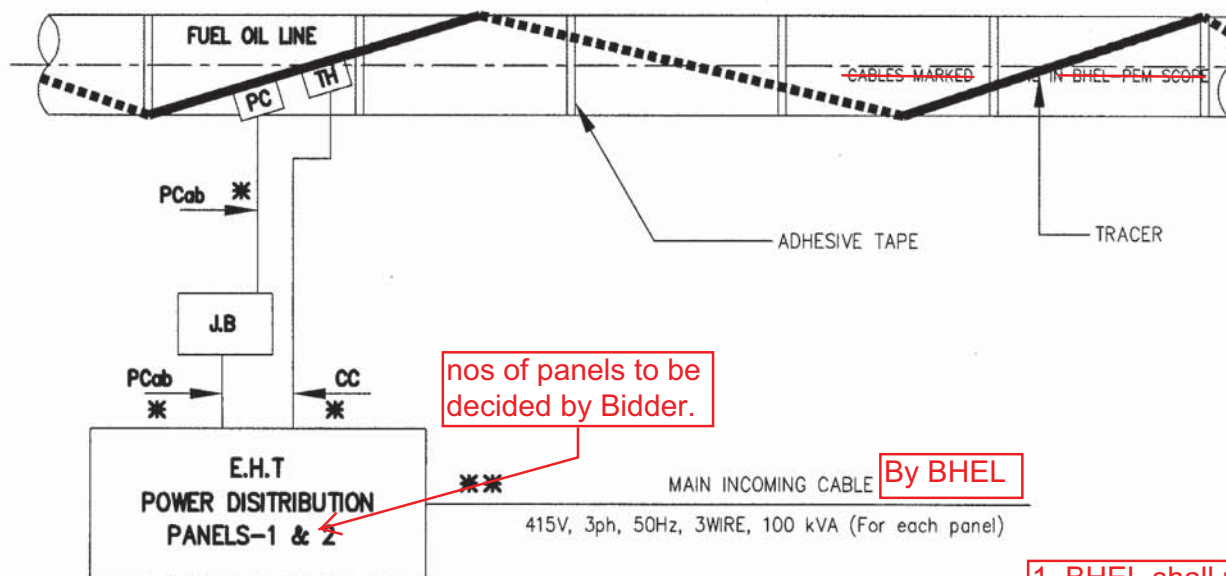
4-81-441-05249
DRAWING No.

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

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 CLAND 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

CIRCUIT - 1 (TYPICAL)



nos of panels to be decided by Bidder.

PCab : POWER CABLE
CC : CONTROL CABLE

these cables are in Bidder's scope

1. BHEL shall provide incoming power cable to ETH panel.
2. ETH power distribution panel, further power and control cables, JB's, 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			

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.

NAME	SIGNATURE	DATE	TITLE
DRN. B.SUMITH		03.05.13	CABLING SCOPE FOR E.H.T SYSTEMS
CHD. B.SUMITH		03.05.13	
APPD. R.PRABHA		03.05.13	
ALL DIMENSIONS IN MILLIMETRE			ORG.No. 4-81-441-05249
PROJECTION	SCALE	NTS	REV. 00

TECHNICAL SPECIFICATION FOR ELECTRICAL 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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

- 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 on 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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

- 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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

- 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 output 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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

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 within 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 output 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)

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

- 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.

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

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

TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM

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

9.0 PACKING & DELIVERY CONDITIONS

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

10.0 Erection, Commissioning & Extended Warranty Requirements

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

NOTE (IMPORTANT)

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

TECHNICAL SPECIFICATION FOR ELECTRICAL 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 Equipment / 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 Continuous 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.

<u>TECHNICAL SPECIFICATION FOR ELECTRICAL HEAT TRACING SYSTEM</u>
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7 Supply variations

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

8 Insulation Data

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

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

- | | | | |
|----|-----------|---|------------------|
| 10 | Spare EHT | : | 10% of each type |
|----|-----------|---|------------------|

NOTES

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

FUEL FIRING/PECB
BH&L, 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: K - Thermal Conductivity		Repeated Abrasion - Y/N
at a Mean Temp. of 50°C)		
3 TYPE OF HEATER :		Routine Tests :
SLSR/Constant Voltage		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



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;

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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

6.0 CONSTRUCTIONAL FEATURES

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

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

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

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



TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

- 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.



TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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 lamicaid or anodised aluminium label with 3mm thick white letters on black background.

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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 mm² 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.



TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

- 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.



TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

- 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 10mm² 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.

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

- 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



TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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.

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

- 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.

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL**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 mm² with 240° scale. They shall be suitable for semi-flush mounting with only flanges projecting on vertical panels.
- 14.9.2 The instrument dials shall be of white with black numerals and lettering. Dials shall be parallax free and shall be provided with knife-edge pointers. The instrument shall be provided with anti-dazzle glass.
- 14.9.3 Shall have zero adjustment provision in the front side. The instrument shall have an accuracy class of +/-2% full scale.
- 14.9.4 The enclosure protection shall be of IP 55. The meter shall satisfy the environmental test requirements when exposed to ambient temperatures within -10 to +55°C at all times and vibration test as said in IS 1248. The case of the meters shall be made of self extinguishing, flame retardant polycarbonate material.
- 14.9.5 The meter shall comply with IS 9249 (Part-I) safety requirement for indicating electrical instruments and their accessories.

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14.9.6 Ammeter shall continuously withstand 120% of rated current.

14.10 Current Transformers:

14.10.1 The current transformers shall be of Cast resin type.

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

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

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

14.10.5 Accuracy class for metering 0.5, Class 5P20 for relaying.

All secondary connections shall be brought out to terminal blocks where wye or delta connection will be made.

CT secondary shall be rated for 1A for metering and either 5A or 1A for protection.

14.11 Annunciators:

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

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

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

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

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

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

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

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

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14.11.9 The annunciator shall be designed for the following conditions.

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

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

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

15.0 MAKES

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

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

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

17.0 QUALITY ASSURANCE PROGRAMME

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

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

17.1.2 Documentation control system.

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

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

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

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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

ANNEXURE-A
CODES AND STANDARDS

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

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

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

ANNEXURE-B

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

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ANNEXURE-C
DOCUMENTS

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

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

TECHNICAL SPECIFICATION FOR POWER DISTRIBUTION PANEL

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

- | | | | |
|-----|--|---|---|
| 1 | Type of panel | : | Free standing, floor mounted, compartment modular, Non –Drawn out, Front Access |
| 2 | Bus bar and cable | : | Vertical and Horizontal runs with clearly Identifiable sections. |
| 3 | Cable Entry | : | Bottom |
| 4 | Protection | : | IP 55 |
| 5 | Colour | : | EXT: RAL 7032 with semi glossy finish

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) |



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

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 1.0×10^{14} ohms-cm at 27 deg C and 1.0×10^{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 ASTM D 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 ASTM D-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 ± 2 mm 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 (category -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 mm² 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 ASTM D-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 mm² (3 core) & Cu – 2.5 mm² (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 :

- 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.
- Fire resistance test as per SS 4241475 (F3 category)
- One length per size / lot for surface finish and length measurement
- 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.





TITLE :
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
FUEL OIL HANDLING SYSTEM
2X660MW ENNORE TPS**

SPECIFICATION NO.
VOLUME NO. : **II-B**
SECTION : **C**
REV NO. : **00** DATE : **05.11.16**
SHEET : 1 OF 3

SECTION -IB

TECHNICAL SPECIFICATION

FOR

FUEL OIL HANDLING SYSTEM

(ELECTRICAL PORTION)



TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR FUEL OIL HANDLING SYSTEM 2X660MW ENNORE TPS	SPECIFICATION NO.
	VOLUME NO. : II-B
	SECTION : C
	REV NO. : 00 DATE : 05.11.16
	SHEET : 2 OF 3

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The same shall be provided by the bidder without any extra charge.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Electrical load requirement for Fuel Oil Handling System.
- e) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- f) Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer/BHEL approval without any commercial and delivery implications to BHEL
- g) Various drawings, data sheets as per required format, Quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer/BHEL approval without any commercial implication to BHEL.
- h) Motor shall meet minimum requirement of motor specification.
- i) Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- j) Cable BOQ worked out based on routing of cable listing provided by the vendor for “ both end equipment in vendor’s scope”shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:

Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

- 3.1 The electrical specification without any deviation from the technical/quality assurance requirements stipulated shall be deemed to be complied by the bidder in case bidder furnishes the overall compliance of package technical specification in the form of compliance certificate/No deviation certificate.

- 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer.

4.0 List of enclosures :

- a) Electrical scope between BHEL & vendor (Annexure –I)
- b) Technical specification for motors.



TITLE :
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2X660MW ENNORE TPS**

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- c) Datasheets & quality plan for motors.
- d) Electrical Load data format (Annexure –II)
- e) BHEL cable listing format (Annexure –III)

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGE : FUEL OIL SYSTEM****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT:2 X660 MW ENNORE TPS**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	240 V AC (supply feeder)/415 V AC (3 PHASE 4 WIRE) supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract. Any other voltage level (AC/DC) required will be derived by the vendor.
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	Power cables, control cables and screened control cables for a) both end equipment in BHEL's scope b) both end equipment in vendor's scope c) one end equipment in vendor's scope	BHEL BHEL BHEL	BHEL Vendor BHEL	1. For 3.b) & c): Sizes of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL) in the form of cable listing. Finalisation of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly. 2. Termination at BHEL equipment terminals by BHEL. 3. Termination at Vendor equipment terminals by Vendor.
4	Junction box for control & instrumentation cable	Vendor	Vendor	Number of Junction Boxes shall be sufficient and positioned in the field to minimize local cabling (max 10-12 mtrs) and trunk cable.
5	Any special type of cable like compensating, co-axial, prefab, MICC, optical fibre etc.	Vendor	Vendor	Refer C&I portion of specification for scope of fibre Optical cables if used between PLC/ microprocessor & DCS.
6	Cable trays, accessories & cable trays supporting system 100/ 50 mm cable trays/ Conduits/ Galvanised steel cable troughs for local cabling	BHEL Vendor	BHEL Vendor	Local cabling from nearby main route cable tray (BHEL scope) to equipment terminal (vendor's scope) shall be through 100/ 50 mm. cable trays/ conduits/ Galvanised steel cable troughs, as per approved layout drawing during contract stage.
7	Cable glands ,lugs and bimetallic strip for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power and control cables.
8	Conduit and conduit accessories for cabling between equipment supplied by vendor	Vendor	Vendor	Conduits shall be medium duty, hot dip galvanised cold rolled mild steel rigid conduit as per IS: 9537.
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)**PACKAGE : FUEL OIL SYSTEM****SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT****PROJECT:2 X660 MW ENNORE TPS**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	Since vendor's Fuel oil pump house building is located as combined with Heating & Pumping building (BHEL-TRICHY), cable tray/trench layout inside combined building shall be prepared by BHEL-PEM. Vendor to furnish drawing (both in print form as well as in AUTOCAD) of Fuel oil pump house layout clearly indicating all pumps, panels, JB's etc. which require cabling along with their terminal box/location/ Foundation etc. Vendor to ensure the cable tray lay out shall confirm to NFPA (National fire prevention act)/TAC (Tariff advisory committee) applicable for hazardous area classification.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.

STANDARD ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR (FOR EPC PROJECTS)

PACKAGE : FUEL OIL SYSTEM

SCOPE OF VENDOR: SUPPLY, ERECTION & COMMISSIONING OF VENDOR'S EQUIPMENT

PROJECT: 2 X 660 MW ENnore TPS

3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

BASIC TECHNICAL FEATURES

FOR HT/LT MOTORS

(FOR BHEL-PEM SCOPE PACKAGES)

					PROJECT	2X660MW ENNORE SEZ SUPERCRITICAL THERMAL POWER PROJECT AT ASH DYKE OF NCTPS,CHENNAI					
REV	DATE	ALTD	CHD	APPD		OWNER	TAMIL NADU GENERATION & DISTRIBUTION CORPOARATION LIMITED				
02	13.05.15	RKG/ AB	SL	RG							
REVISED AS PER TANGEDCO COMMENTS DATED 10.04.2015						OWNER'S CONSULTANT	DESEIN PRIVATE LIMITED, DESEIN HOUSE,NEW DELHI				
						EPC CONTRACTOR					BHARAT HEAVY ELECTRICALS LIMITED POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA(U.P) INDIA
REV	DATE	ALTD	CHD	APPD		BHARAT HEAVY ELECTRICALS LTD. POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA	DEPT CODE	DRN	NAME BKR	SIGN	
01	13.03.15	BKR -SD-	SL -SD-	RG -SD-			E	DSGN	BKR	-SD-	13.01.15
REVISED AS PER TANGEDCO COMMENTS DATED 13.02.2015					TITLE	BASIC TECHNICAL FEATURES FOR HT/LT MOTORS	DRAWING NO. PE-DC-412-565-E003				
							SHEET 1 OF 7		REV. 02		



2 x 660 MW ENNORE SEZ STPP

**BASIC TECHNICAL FEATURES
FOR HT / LT MOTORS
(FOR BHEL-PEM SCOPE PACKAGES)**

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Dated	13-05-2015
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1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in **2 x 660 MW ENNORE SEZ STPP**.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors above 10 kW with continuous duty (S1) shall be energy efficient IE3 conforming to IS-12615: 2011.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 1500 kW	11 KV	11 KV
Above 160 kW up to & including 1500 kW	3.3 KV	3.3 KV
From 200W up to & including 160 kW	415 V	415 V
Below 200W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

Voltage variation (AC Supply) (+/-) 10%
Frequency variation (+) 3% to (-) 5%
Combined V & F variation 10% (sum of absolute values)

3.2.2 Motors shall be capable of running continuously at rated output for each of the conditions specified.

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 10% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

3.4.1 Motor shall start smoothly and rapidly. Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% of the motor's full load torque.