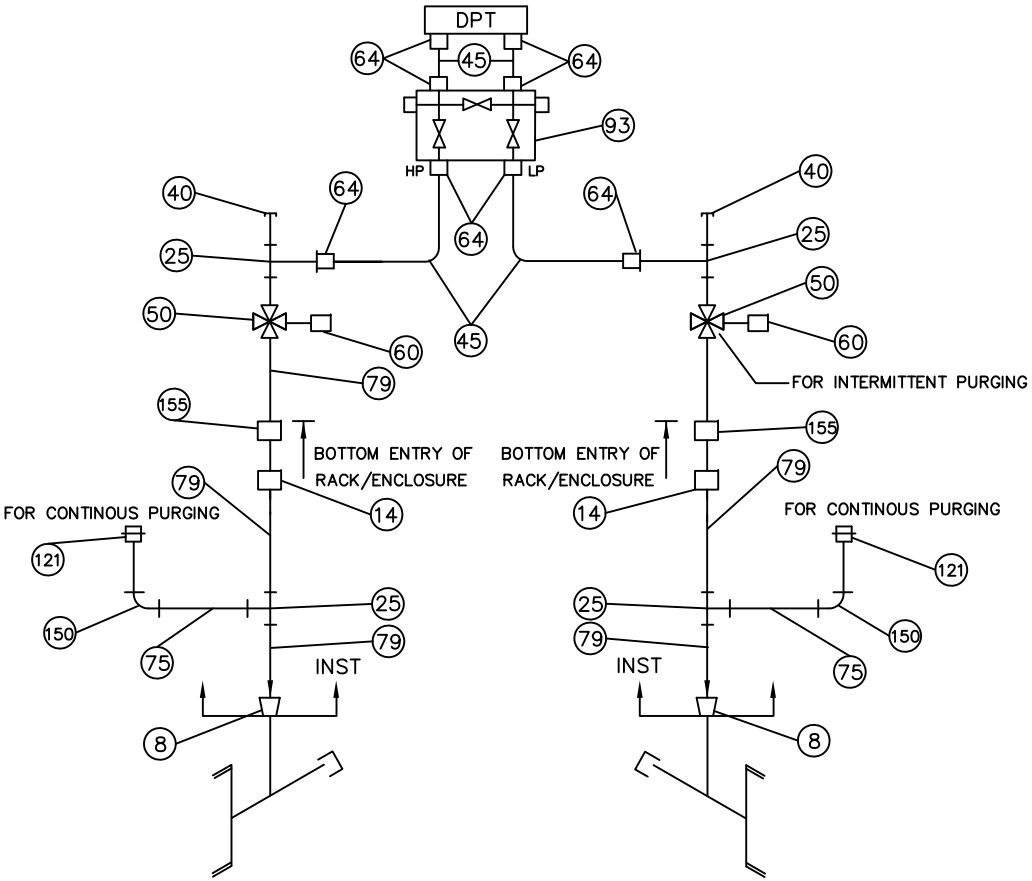


BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	2	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	2	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	4	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	2	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	2	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	2	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	8	MALE CONNECTOR 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
75	A/R	PIPE AS PER IS–1239 SIZE :1/2" NB–HEAVY GRADE
93	1	3 VALVE MANIFOLD 1/2" NPT(F)
150	2	GALVANISED ELBOW CL 3000 SIZE :1/2" NPTF
155	2	BULK HEAD COUPLING CL 3000 SIZE :3/4" NB SW /CL 3000/AS PER ANSI B16.11
121	2	BULK HEAD COUPLING CL 3000 SIZE :1/2" NPTF /AS PER ANSI B16.11

SERVICE : FLUE GAS, FURNACE ETC.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

DEVELOPMENT CONSULTANTS PVT. LTD.
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

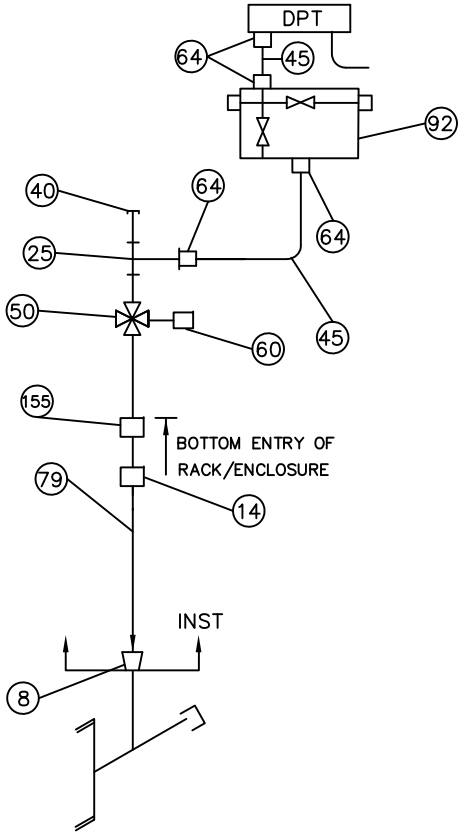
JOB NO. DCPL–K9213R | SCALE NIL | SHT. 17 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

K9213-DWG-I-0060-17-20-REV-0

A4_H (08–'06) [297 x 210]

DIFF. PRESSURE TRANSMITTER
MOUNTED ABOVE SOURCE POINT



BILL OF MATERIAL		
ITEM NO.	QTY./ INST	DESCRIPTION
8	1	REDUCER 1" BSPF X 3/4" NB–SW CL 3000
14	1	FORGED COUPLING 3/4" SW CL 3000/AS PER ANSI B16.11
25	1	FORGED UNEQUAL TEE AS PER ANSI B16.11 SIZE : 2 X 3/4" NB–SW X 1/2" NPTF/CL3000
40	1	NIPPLE & CAP 3/4" NB–SCH 80/CAP–3/4" NPTF
45	6 Mtrs.	SEAMLESS TUBE 1/2" OD X 2.1 MM THK.
50	1	FOUR WAY VALVE SIZE :(2 X 3/4" NB–SW)X(2 X 1/2"NPTF) CL:800
60	1	QUICK DISCONNECTING FITTING SIZE:1/2"NPTM
64	3	MALE CONNECTOR /SS 316 1/2" NPT(M) X TO SUIT 1/2" OD TUBE
79	30Mtrs	SEAMLESS PIPE/3/4" NB SCH 80
92	1	2 VALVE MANIFOLD 1/2" NPT(F)
155	1	BULK HEAD COUPLING CL 3000 SIZE :3/4" SW /CL 3000/AS PER ANSI B16.11

SERVICE : FLUE GAS, PRIMARY AIR, SECONDARY AIR ETC.

NOTE : AIR PURGING ARRANGEMENT SHALL BE INCLUDED.

PRELIMINARY
TENDER PURPOSE ONLY

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TYPICAL INSTRUMENT INSTALLATION DIAGRAM

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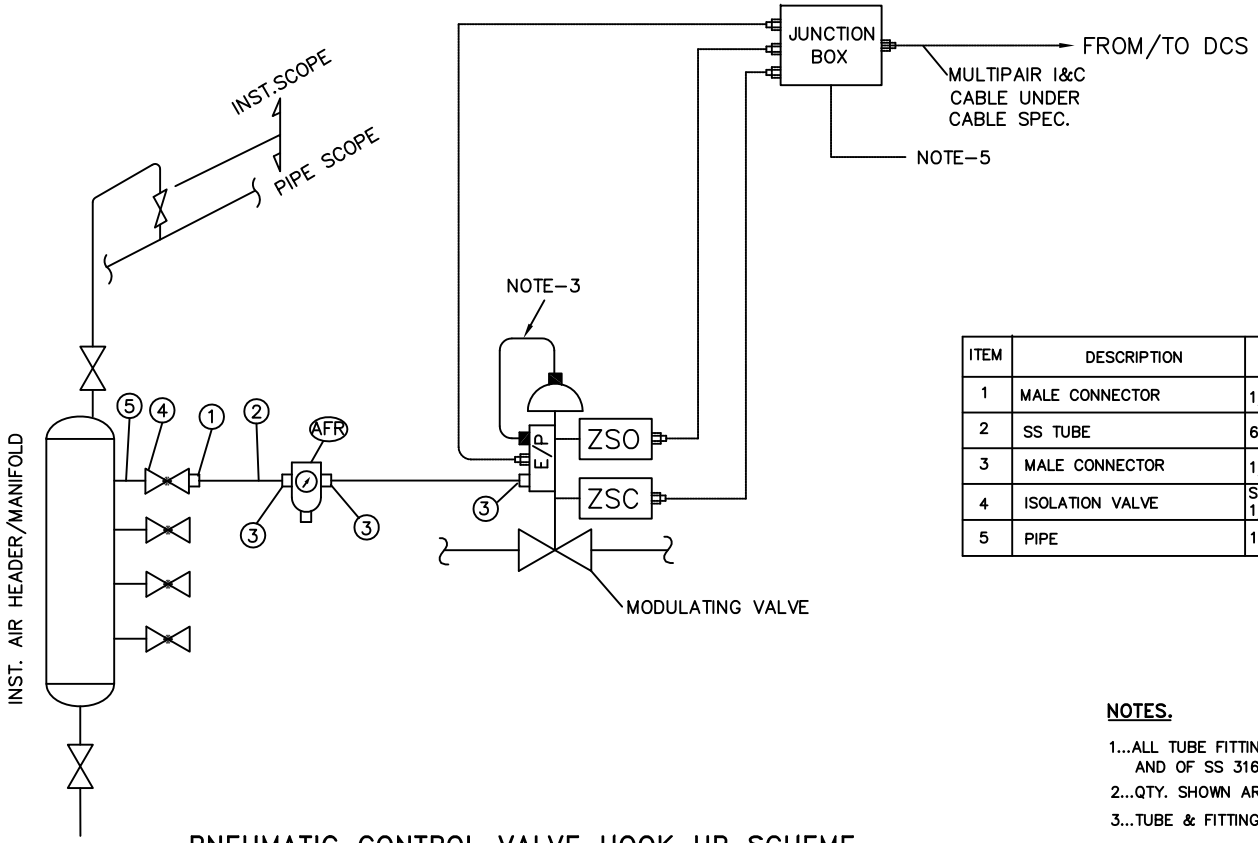
K9213-DWG-I-0060-18-20-REV-0

A4_H (08–'06) [297 x 210]



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

PNEUMATIC CONTROL VALVE HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.
2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.
3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.
4...LIMIT SWITCHES WILL BE CONNECTED WHEREVER APPLICABLE.
5...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.
6...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

GUJARAT STATE ELECTRICITY CORPORATION LIMITED
VADODARA, GUJARAT

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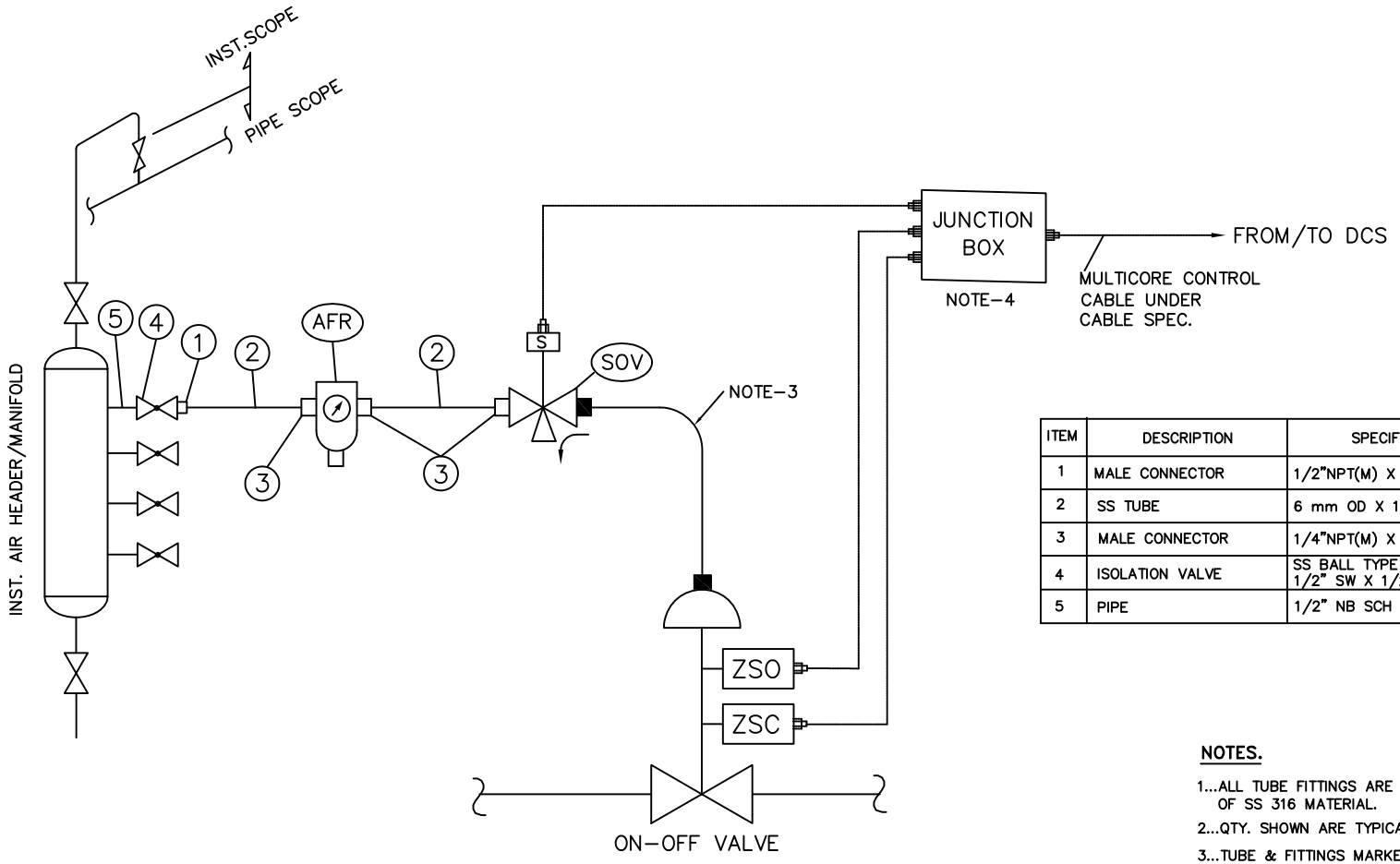
CONSULTING ENGINEERS
KOLKATA · MUMBAI · CHENNAI · NEW DELHI

JOB NO. DCPL-K9213R | SCALE NIL | SHT. 19 OF 20
DWG. NO. K9213R-DWG-I-0060 | REV. 0



ITEM	DESCRIPTION	SPECIFICATION	QTY.	REMARKS
1	MALE CONNECTOR	1/2"NPT(M) X 6 mm OD COMPRN.	1	
2	SS TUBE	6 mm OD X 1.0 mm THK.	10 MTRS.	
3	MALE CONNECTOR	1/4"NPT(M) X 6 mm OD COMPRN.	3	
4	ISOLATION VALVE	SS BALL TYPE 600LBS 1/2" SW X 1/2" NPT(F)		
5	PIPE	1/2" NB SCH 40S	A/R	

PNEUMATIC SOV HOOK UP SCHEME

NOTES.

1...ALL TUBE FITTINGS ARE OF DOUBLE COMPRESSION TYPE AND OF SS 316 MATERIAL.

2...QTY. SHOWN ARE TYPICAL FOR ONE INSTALLATION ONLY.

3...TUBE & FITTINGS MARKED ■ ARE INTEGRAL TO THE VALVE.

4...JUNCTION BOX WILL BE INTEGRAL TO ACTUATOR.

5...ISOLATION VALVE SHALL BE INSTALLED CLOSE TO THE VALVE ASSEMBLY.

PRELIMINARY
TENDER PURPOSE ONLY

GP	AT	SD		0	21.04.10
APPROVED	CHECKED	DRAWN	DESCRIPTION	REV.	DATE

TYPICAL INSTRUMENT INSTALLATION DIAGRAM

1x800MW SUPER CRITICAL THERMAL POWER PROJECT
(UNIT #8 AT WANAKBORI THERMAL POWER STATION, GUJARAT)

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JOB NO. DCPL–K9213R | SCALE NIL | SHT. 20 OF 20

DWG. NO. K9213R–DWG–I–0060 | REV. 0

SECTION: D
STANDARD TECHNICAL SPECIFICATIONS

EQUIPMENT SELECTION & DESIGN CRITERIA/ DATA SHEET

A. LDO/HFO Storage Tank

1) LDO/HFO storage tank shall be constructed as per technical specification clause no. 6.02.00, Vol. IIB, Sec. 3B.

   a) Minimum dimensions of HFO & LDO Tank provided: 9.0m (dia.) and 9.5 (ht)
   b) Minimum thickness of the tank shell and roof shall be 6.0mm including corrosion allowance.
   c) Thickness of the tank bottom shall be 8.0mm including corrosion allowance.
   d) Width of the plate can be considered out of these 1250/1500/1800/2000. As per IS803, minimum course width is 1500mm unless agreed otherwise mutually. Due to non-availability of plates at the time of detail engineering, option of course width of 1250mm has been also kept.
   e) Roof structure of tank shall be designed in Stadd. During detail engineering, mother format same to be submitted to BHEL for checking.
   f) Tank low-low level shall be decided in a way that suction heater and floor coil heater is always submerged.
   g) Additional height required to meet the effective capacity to be provided by the vendor without any commercial implication. Effective capacity shall be between low-low level and high-high oil level.
   h) Pipes required for tank nozzles (HFO and LDO, Drain Oil Tank etc.), manholes, pipe support etc. shall be in bidder scope.

2) Drain oil tank:
   a) Dimensions of Drain oil Tank: 4.5m x 2.5m x 2.0 m.
   b) Minimum thickness of the plate: 6.0mm including corrosion allowance
   c) Design Code: IS 800 / standard hand book

B. FLOOR COIL HEATER AND SUCTION HEATER

Floor Coil Heater shall be constructed as per technical specification Annexure-I, Vol. IIB, Sec. 3B. Page no. 13 except as agreed in pre/post bid discussion.

Floor coil heater pipe slope inside the tank shall be restricted to 1:500. Accordingly, no. of sections to be decided.

C. TRANSFER PUMPS / SUMP PUMP & OIL RECOVERY PUMP

HFO / LDO transfer pumps shall be constructed as per technical specification Annexure-II, Vol. IIB, Sec. 3B.

   a) HFO & LDO transfer pump will be designed for a viscosity of 130-140 cst and 2-20cst respectively.
   b) Design capacity of pump shall be based on lowest viscosity plus 10%
   c) For selection of pump head and motor rating, the criteria shall be as follows:
      - Pump head will have 10% margin over the calculated pump head. Motor rating be arrived at by considering higher of the following
      - 15% margin over BHP at duty point (duty point means specified discharge at 1.1 times the calculated head) @ highest viscosity
      - RV set pressure (10% or 1 kg/cm2 higher than duty point pressure whichever is higher) BHP @ highest viscosity

FOR SUMP PUMP AND OIL RECOVERY PUMP:

S.No	Characteristics	Drain oil pump / Recovery oil pumps	Sump Pump in Oil Dyke area	Sump Pumps in pump house
1	Type of Pumps	Vertical positive displacement. Single Screw	Vertical shaft centrifugal type	Vertical shaft centrifugal type
2	No. &Capacity of Pumps	As per scope of supply		
3	Type of Duty	Intermittent	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor		
5	Location	Indoor / Outdoor	Outdoor	Indoor
6	Nature of Fluid to be pumped	HFO/LDO	Water with traces of oil	Water with traces of oil
7	Design Viscosity range	2-140 cST	5-50cST	5-50cST
8	Sealing	Manufacturer Specific		
9	Design Code	API 676 with standard deviations as taken by approved sub vendors /HIS/VDMA as applicable.		
10	Bearings	Antifriction type	Manufacturer specific	
11	**Material of Construction**			
i)	Casing	Cast Iron to IS 210 Gr FG 260/ CS Fabricated/ASTM 106 Gr.B/Manufacturer Standard.		
ii)	Casing lining, if applicable	Manufacturer specific		
iii)	Rotor/ Impeller	13% chrome SS	Cast Iron to IS 210 Gr FG 260	
iv)	Rotor housing, if applicable	CI AS PER IS 210 GR. 260	Manufacturer specific	
v)	Shaft	13% chrome SS	BS 970 EN-8 or equivalent	
vi)	Relief valve body	Cast Iron to IS 210 Gr FG 260	NA	
vii)	Relief valve spring	Spring steel	NA	
viii)	Base Plate	Fabricated from MS to IS 2062		
ix)	Coupling	Manufacturer specific		
x)	Hydrotest Pressure	1.5 Times maximum discharge pressure		
xi)	Hydrotest Duration	30 Minutes		

D. STRAINERS FOR LDO/HFO TRANSFER PUMPS

Strainers shall be provided as per following details.

S.No.	Characteristics	Value
01	Type	Duplex Type for unloading pumps & Drain oil pumps (Integral to pump)
02	Fluid	LDO/HFO
03	Flow Rate	To match pump flow rate
04	Operating Pressure, maximum kg/cm^2 (g)	Bidder specific
05	Operating temperature, ° C	55
06	Design Pressure , kg/cm^2 (g)	1.1 times the operating pressure , min.
07	Design Temperature, ° C	65
08	Fluid Viscosity	As per Fuel Oil Characteristics
09 a)	Pressure drop in clean condition	0.15 kg/cm2

09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm2
10	Screen basket data	
a)	Dia. of perforations	40 mesh
b)	Minimum thickness	Bidder specific
11	Steam Jacket	Applicable for HFO transfer pump suction strainer.
12	Steam pressure for steam heating	4 kg/cm^2 (a) or higher as decided during detail engineering
13	End Connection details	
a)	Inlet & outlet size	Shall match connected upstream and downstream pipe size
b)	Type	Flanged
c)	Details / Standard	IS: 6392 /ANSI B 16.5 /Equivalent.
14	Material of Construction	
a)	Body	Fabricated from IS 2062/ Seamless pipe to ASTM A 106
b)	Cover	Fabricated from IS 2062 PLATES
c)	Screen basket	The strainer shall have screen of stainless steel (AISI-316) construction with wire diameter of about 0.01 inch and open area of about 50%.
15	Hydrotest Pressure	1.5 Times Design Pressure
16	Hydrotest Duration	30 Minutes

E. PIPES, FITTINGS & FLANGES

1) Oil Pipes shall be provided as per Volume IIB, Section C-2A, Annexure-III
2) Pipe in oil lines shall be API 5L Gr. B (ERW).
3) Steam and Condensate line shall conform to ASTM 106 GR. B, Schedule 40.
1) IA line shall be MS ERW to Stainless Steel as per ASTM A-312 Gr. 304.Size- as per schedule 40S (Min),ANSI B36.19.
2) Additional details of the above specified item / other items are also covered below:

Minimum Pipe Thickness shall be as follow:

Pipe Size	Thickness (mm)	Pipe Size	Thickness(mm)
15 NB	2.77	100 / 80 / 65 NB	3.96
20 NB	2.87	150 NB	4.78
25 NB	3.38	200/250 NB	5.56
40 NB	3.68	300/350 NB	6.35

Fittings / flange / gasket details

SR.	SIZE	MATERIAL STANDARD/ OTHER DETAILS	DIMENSION STANDARD
1	FITTINGS & FLANGES		
A.	FUEL OIL		

a.	**Fittings (Elbow, Tees and Reducers)**	**Material Standard**	**Dimension Standard**
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
b.	**Slip on Flanges / Blind Flanges**	**Material Standard**	**Dimension Standard**
	All sizes	Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
B.	**STEAM AND CONDENSATE SERVICE**		
a.	**Fittings (Elbow, Tees and Reducers)**	**Material Standard**	**Dimension Standard**
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
b.	**Slip on Flanges/Blind Flanges**	**Material Standard**	**Dimension Standard**
	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class suitable for intended service.
C.	**AIR LINE**		
a.	**Fittings (Elbow, Tees and Reducers)**	**Material Standard**	**Dimension Standard**
	25 NB and below	Stainless steel as per ASTM A-182 F304	SW ends to ANSI B 16.11 (3000#)
2	**GASKETS**		
A.	**STEAM**	Spiral wound SS316	
B.	**FUEL OIL**	Teflon	
C.	**AIR LINE & BILGE WATER LINE**	Grafoil	
3	**Bolts / Studs / Anchor Bolt**	ASTM A 193 Gr. B7	
4	**Nuts**	ASTM A 194 Gr 2H	

F. STEAM TRAPS

S.No.	**Characteristics**	**Value**
1	**Design Features**	
	Type	IB Type Traps for Floor Coil Heater & TD type or any other type as per trap vendor recommendation for other services
2.	Strainer	Integral
3.	End connection	All traps and strainers shall have socket weld ends as per ANSI B16.11 for size NB 50 mm and smaller, and butt weld ends as per B 16.25 for size NB 65 mm and above.
3a	Design criteria	2 times the actual condensate load

G. VALVES

4.	**Material of construction**	
a.	Body	SA105 /Equivalent
b.	Trims	SS conforming to AISI-316
c.	Strainer	Strainer shall be Perforated metal screen of type AISI-316 stainless steel with about 0.8 mm perforation.

Valves shall be provided as per Technical Specification, Volume IIB, Section 3A, Annexure-III, Clause no. 4.e,f,g,h,i.

The valves shall be provided in the oil lines as per the following:-

a) Size up to 200 NB: Ball valves

b) Size 250 NB and up to 350 NB: Plug valve

c) Size above 350 NB: Gate valve

H. HOSES

S.No.	**Characteristics**	**Value**
1	Type	Flexible rubber hose with steel / GI impregnated confirming to BS 1435/ IS 10733
2	Size	80NB x 8 m long for HFO & LDO
3	Quantity	As indicated in scope of supply
4	Temperature of fluid handled, °C	Capable of handling oil Up to 85 °C temperature
5	Type of end connection	To match railway wagon unloading nozzle (details to be checked and confirmed by customer)

I. PRESSURE REDUCING STATION AND DESUPERHEATER

S.No.	**Characteristics**	**Value**
1	Type	Self-actuated pilot operated
2	Steam pressure at inlet	16 kg/ cm^2 (a)
3	Steam Pressure at outlet	4 kg/ cm^2 (a) or more as required by FO System vendor.
4	Leakage class	Class- IV
5	**Material of Construction**	
a)	Body	Cast Steel
b)	Trim	SS
6	De-superheater- MOC	
a)	Spray nozzle with assembly	SS 316 (Spray Nozzle design pressure shall be equal to Design Spray Water Pressure)
b)	Body	A216 WCB
c)	Pipe	SA 106GRB

J. **CONTROL VALVE FOR SUCTION AND FLOOR COIL HEATER**

S. No.	**Characteristics**	**Value**
1	Type	Pneumatically operated control valve 1. Modulating SMART for Floor Coil heater 2. Modulating SMART type for Suction Heater

		3. On-off type of Drain oil tank
2	Steam pressure at inlet	4kg/cm2(a)
3	Controlling	Pneumatically controlled
4	**Material of Construction**	
a)	Body	Cast Steel
b)	Trim	SS 316

K. **SELF LIMITING SELF REGULATING TYPE HEAT TRACERS**

S. No.	**Characteristics**	**Value**
1	Maintenance temperature	70 Deg.C
2	Maximum process temperature	140 Deg.C
3	Exposure Temp. rating	
3.1	Continuous Power on temperature	140 Deg.C
3.2	Intermittent power ON Temperature	150 Deg.C
3.3	Intermittent power OFF Temperature	150 Deg.C
3.4	Maximum withstandable outside temperature	210 Deg.C
The total portion shall be apportioned into segments depending on tracer limitations. Each segment shall be provided with power supply modules and controls		
EHT shall be provided with dedicated thermostat for cutting off power to effect energy saving conditions.		
Piping layout shall be as finalized during contract engineering stage		
Insulation data shall be as mentioned elsewhere in the specification.		

1.0 **SCOPE**

The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, proper packing, delivery at site including freight, unloading, storage & handling at site, erection & commissioning, hydro test at site, painting, handing over, tools & tackles, commissioning spares etc. for Misc. Tanks- site fabricated as mentioned in different sections of this specification

2.0 **CODES & STANDARDS**

The design, fabrication & assembly, erection & performance of steel tanks shall comply with all latest statutory regulations and safety codes applicable in the locality where the tanks are to be installed. Tanks shall conform to the latest applicable Indian/British/ USA standards. The vendor shall not be construed to be relieved of his responsibility by virtue of this specification. The tank in general shall conform to the latest editions, as is applicable, out of the following standards.

1 IS-800 Code of practice for use if steel in general building construction

2 IS-803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.

3 IS-804 Specification for rectangular pressed steel tanks

4 IS-805 Code of practice for use of steel in gravity water tank.

5 IS-816 Code of practice for metal arc welding for general construction in MS .

6 IS-817 Code of practice for training and testing for metal arc welder

7 IS-2825 Code of practice for unfired pressure vessel

8 BS-2594 Specification for carbon steel welded horizontal cylindrical storage tank

9 BS-2654 Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry

10 Indian explosive act and statutory requirements of chief controller of explosives, Nagger. (For oil storage tanks.)

11 Indian Boiler Regulations

12 Indian Factories Act

13 American code for oil tanks API 650

3.0 **DESIGN REQUIREMENT**

3.1 General Requirement

3.1.1 All tanks will be mild steel tanks. The tanks will be of welded construction and will be designed to withstand satisfactorily the internal forces due to the liquid these tanks have to hold as specified and

external forces due to wind and seismic forces without deformation or undue strain. The plates will be cold rolled through plate bending machines by several no. of passes to the curvature.

3.1.2 All tanks will be designed for the capacities, dimensions and working conditions as specified in **TANKS DATA SHEET** given under section-C**.** These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 2.0 mm corrosion allowance until unless specified in **DATASHEET-TANKS** for shells, bottom and roof and beyond the required thickness shall be provided.

3.1.3 Vessel seams shall be so positioned that they do not pass through vessel connections.

3.1.4 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. Except where otherwise indicated in the specification, if the stiffening of shell and/ or roof is necessary, tanks will be stiffened from outside.

3.1.5 Flange faces of all nozzles shall be machined and squared with the vessel center line.

3.1.6 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m^2 of projected area.

3.1.7 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.

3.1.8 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface .The plate shall not be gouged or torn in process of removing lugs.

3.1.9 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

3.1.10 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in SI UNITS for the followings: -

a) The tanks shall be designed as per good engineering practice as applicable and referred code shall be of latest edition.

b) Plate thickness calculation (different courses of shell plate, bottom plate and roof plate thickness), roof curb angle, top wind girder, intermediate wind girder, tank internal pressure vis –a-vis. allowable value.

c) Design of roof and roof structures for vertical storage tanks shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young.

d) Tank stability calculation (wind load / seismic / overturning stability) shall be done as per good

engineering practice as applicable and referred code shall be of latest edition. However, factors / coefficients as required for the design of tank shall be obtained from BHEL by the bidder after placement of order.

e) Vent sizing calculation shall be done as per good engineering practice as applicable and referred code shall be of latest edition.

f) Sizing calculation for vent, NaOH / KOH breather, seal pot and breather valve.

g) Weight calculation of plates, appurtenances & structures separately shall be included in the design calculation/GA.

h) Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards.

3.1.11 **Alignment**

3.1.11.1 Plates to be joined by butt welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.

3.1.11.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of 3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under , the maximum shall be 1.5 mm.

3.1.11.3 Each tank shall be properly constructed ensuring perfect vertical alignment within 5 mm and tank circularity within 5 mm on diameter. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.

3.1.12 **WELDING**

3.1.12.1 Tanks and other attachments shall be welded as per AWS and the qualification of welder should be as specified in ASME.

3.1.12.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be shall be submitted for approval of BHEL giving details of material, welding position , sequence , type of electrode used , pre-heat & post weld requirement etc as per the code of construction . Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.

3.1.12.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.

3.1.12.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets , bolts, nuts etc shall be conforming to relevant standards of repute and approved by the purchaser prior to use.

3.1.13 Each tank shall be complete with access staircase and fittings like drain connection , overflow connection, tank inlet and outlet covers , level gauge glass, fittings with isolation cocks and protection covers , tank vent connection etc all complete with needed accessories for the completeness of the tanks and as specified in data sheet -A .

3.1.14 All openings in tank plate shall be well reinforced in approved manner by adding pad plates of adequate size and / or structural sections.

3.1.15 **STAIRCASE / ACCESS LADDER AND HAND RAILING**

3.1.15.1 All cylindrical vertical tanks shall be provided with spiral staircase and shall conform to the requirements specified in API 650 unless specified otherwise. All stair treads shall be 32 mm steel fabricated gratings. Each tread, if needed, shall be housed in individual steel fabricated frame which shall be adequately supported from the tank outer periphery. The staircase shall have minimum 750 mm clear width.

3.1.15.2 Access ladder, one (1) for each horizontal cylindrical / rectangular tank shall be provided for access to the tank roof. It shall be steel fabricated having minimum 450 mm width. Ladder stringers shall be heavy steel flats or angle section. All rungs shall be minimum 20 mm Dia rods spaced at not more than 30 cm center to center. All ladders shall have steel fabricated safety cage to the approved construction. Safety cage shall be provided about 2.5 m clear height of the ladder. Access ladder's stringers shall be widely spaced at top for free access to the tank roof.

3.1.15.3 All staircase and roofs of vertical cylindrical tanks shall be provided with pipe hand railings of 1070 mm effective height throughout. Handrails shall be constructed out of 32 NB medium class galvanized steel pipe conforming to ASTM A 53 Gr.B. Handrail posts shall be arranged at spacing not greater than 1850 mm. Two (2) sets of pipes horizontal runners all along the length shall be provided. All welds joints in the handrails shall be ground flush to protect any person getting injured. Steel toe plates of 100 mm flats shall be used. Hand railing shall be fabricated installed in an approved manner as directed by purchaser in accordance with approved drawings.

3.1.16 Unless otherwise specified, for all flanged connections vendor shall furnish suitable counter flanges and necessary nuts, bolts and gaskets materials.

3.1.17 Unless otherwise specified bolts and nuts shall be hexagonal head conforming to ISO -898-1:1999.

3.1.18 Gaskets shall be 3 mm thick full face rubber or CAF. On completion of hydraulic test / water fill test, contractor shall replace the gaskets used during testing at his own cost.

3.1.19 Float level indicators of approved make, as specified in data sheet-A shall be provided.

3.1.20 During erection of tank, shell plates shall be suitably supported both for outside and inside to avoid buckling / collapsing of tank due to high speed wind , gust or severe storm ,if any, occurring during erection.

3.1.21 The contractor shall furnish two (2) grounding pads for each vertical tank. Each pad shall be stainless steel plate 100 mm x 100 mm x 6 mm thick, with two 15 mm holes on 45 mm centers. Pads shall be edge welded to tank shell within 450 mm from the tank base. Two grounding lugs shall be provided for each horizontal tank.

3.2 VERTICAL CYLINDRICAL STORAGE TANKS

3.2.1 The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with API-650 / AWWA D - 100. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be increased as per API.

3.2.2 Conical roof shall be self-supported over the tank periphery. The roof shall have a slope of not less than 1 in 16 to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.

3.2.3 All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.

3.2.4 All bottom plates shall have lap weld joints on all sides with overlap not less than five times the plate thickness.

3.2.5 All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.

3.2.6 Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints are staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 6 mm.

3.2.7 The tank height shall be completed by the provision of top curb/ angle which shall be butt welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.

3.2.8 Tank roof shall be supported over steel fabricated central column(s). Adequately sized and spaced rafters and purlins shall be provided. All rafters shall have sliding bolted connections at one end and preferably on the tank periphery side. The roof supporting frame shall have needed tie rods or bracing sets.

3.2.9 Roof plates shall have lap joints with lap not less than 25 mm and lap weld over the top surface only. Roof plates shall have continuous fillet welds around the tank curb angle. No joint of roof plate over the supporting frame shall be made.

3.2.10 Needed openings for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall the bolted and shall have hinged covers unless otherwise specified.

3.2.11 All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.

3.2.12 The manhole shall be of hinged & bolted type with nuts, bolts and gaskets with minimum size of 600 mm.

3.2.13 NaOH / KOH breather and seal pot shall be located in the bottom / ground level and necessary connection from tank vent to NaOH / KOH breather shall be provided through 200 NB SS pipe. The sizing of NaOH breather and Seal pot shall be decided based on emptying and filling rate of tanks. A tentative rate of 5 cum/hr may be considered for both emptying and filling of tank. However, the complete information shall be provided to vendor during detail engineering.

3.2.14 Material of construction of all pipes, fittings, valves, nozzles, flanges and counter flanges shall be as per datasheets given at the end of this section.

3.2.15 Material of construction for standpipe (if applicable) shall be stainless steel (SS) and size shall not be less than NB 100 unless otherwise specified in Datasheet-A for tanks given at the end of section.

3.2.16 Two (2) nos NaOH / KOH breather shall be provided by the bidder for each tank, out of which one shall be used for in-breathing purpose and the other shall be used for out-breathing purpose.

3.2.17 The size of the drain and vent valve of standpipes shall be 25 NB and size of the isolating valves (2 nos) for standpipe shall be 50 NB unless otherwise specified in the specification.

3.2.18 The overflow pipe from overflow nozzle shall be connected to seal pot.

3.2.19 All stair treads and platforms shall be made from gratings

3.3.0 RECTANGULAR TANKS

3.3.1 Rectangular tanks shall be fabricated from steel material and shall be designed to withstand internal hydrostatic pressure. In addition these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per IS when their effect considered with tank load.

3.3.2 Tank bottom and / or side plates shall be of minimum 6 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.

3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.

3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point.

3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.

3.3.6 Where rectangular tanks are flushed in dual compartments the inside partition plate shall be well reinforced to withstand hydrostatic test pressure completely on one side throughout the full height.

3.4 **HORIZONTAL CYLINDRICAL TANK**

3.4.1 The horizontal cylindrical tank with dished ends shall be of mild steel welded construction and shall be designed in accordance with BS- 2594. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be considered, the permissible stress shall be increased as per IS.

3.4.2 The shell and dished end plate thickness shall be chosen as per design requirement but in no case the dished end and shell plate thickness shall be less than 8 mm.

3.4.3 All seams, longitudinal as well as circumferential, shall be butt welded. Longitudinal seams should not be situated in the lower third of a tank or on the top centre line.

3.4.4 All tank shall be supplied with integral saddle support and shall be designed in accordance with BS-2594.

4.0 **TESTING AND INSPECTION AT MANUFACTURERER'S WORKS**

4.1 **General**

4.1.1 The supplier shall provide inspection to establish and maintain quality of workmanship in his works and that of his subcontractors to ensure the mechanical accuracy of components, compliance with drawings identity and acceptability of all materials, parts and equipment. He shall conduct all tests required to ensure that the equipment and material furnished shall conform to requirements of the acceptable codes. All tests and test procedure proposed by manufacturer shall be submitted to the purchaser for their prior approval.

4.1.2 All materials used for manufacture of the equipment under this specification shall be of tested quality. Relevant test certificates shall be made available to the purchaser before the final shop inspection. In case the relevant correlating test certificates are not available, the supplier shall arrange to carry out the necessary tests required by codes at his own cost.

4.1.3 Alloy cast iron and cast steel components shall be tested for both physical and chemical properties in absence of purchaser's representatives. Test bears shall be either integral or taken from the same ladle of material as the casting they represent.

4.2 **TESTING AND INSPECTION FOR TANKS**

4.2.1 The scope of testing and inspection for pressure vessel / tanks covered in this specification shall generally comprise of the following:

i) Examination and approval of fabrication drawings to ensure that design, materials and fabrication details meet requirement of code and specifications. Purchaser will review these drawings for interface problems and conformity with the general arrangement drawings and accord their approval.

ii) Examination of materials of construction and identification with material test certificates.

iii) All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.

iv) Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.

v) Inspection of dished end flanges and alloy steel bolting where required.

vi) Inspection during fabrication at appropriate stages including fit ups.

vii) For all butt welds, the root run and final run shall be subjected to dye penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye penetrant / magnetic particle examination.

viii) Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.

ix) Examination of internal cleanliness before final closure.

x) Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.

xi) Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.

xii) Witnessing cleanliness, preservation, packing and marking.

xiii) Stamping of vessel and issue of certificates.

4.2.2 <u>NON - PRESSURE TANKS</u>

FIELD TESTING

Scope of testing and inspection for non-pressure tanks covered in this specification will comprise of the following:

4.2.2.1 Identification of materials to manufacturer's test certificates.

4.2.2.2 Inspection of plates, edges after edge preparation and checking curvature against template if shell plates sent after rolling.

4.2.2.3 Checking of dimension and match marking.

4.2.2.4 DPT / MPI on all welds (100%).

4.2.2.5 All cross / Tee joints and butt welds to be 10% Radio graphed.

4.2.2.6 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting.

4.2.2.7 All quality plans / checklists for various items shall be furnished during detail engineering stage for BHEL / customer's approval and any changes required by BHEL / customer shall be incorporated in the documents and adhered without any price implication. However, minimum requirement of MQP as indicated in the technical specification shall be followed. All necessary items as required for inspection and testing of the tank including instruments shall be arranged by the bidder

.

4.2.3 REPAIR OF LEAKS

4.2.3.1 All leaks detected during testing shall be repaired to the satisfaction of the purchaser and on completion retested for leakages as per approved procedure.

4.2.3.2 In the joints between roof plates only, pin hole leaks may be repaired by mechanical method. However, where there is any indication of considerable porosity, the leaks shall be sealed by laying down an additional layer of weld over the porous sections.

4.2.3.3 In the other joints, whether between shell plates or bottom plates or both, leak shall be repaired by only welding and if necessary, after first cutting out the defective part.

5.0 PAINTING REQUIREMENT

Surface preparation, being a pre-requisite for any paint application, shall be such as to clean the surface thoroughly of any materials which will be conducive to premature failure of the paint substrata. Blast clean type (Grit blasting by copper/ MS/other) shall de decided during detailed engineering for which no commercial implication shall be entertained by BHEL.

All surfaces shall be cleaned of loose substances and foreign materials, such as dirt, rust, scale, oil, grease, welding flux etc. in order that the prime coat is rigidly anchored to virgin metal surface.

Paint shall be applied in accordance with paint manufacturer's recommendation and shall meet the requirement of the exposure condition and specific system of painting thereof.

The above is the minimum requirement to be followed by the successful bidder. Any additional requirement to ensure prevention of atmospheric corrosion shall be provided by the successful bidder without any commercial implication.

6.0 OTHER TECHNICAL REQUIREMENTS

1. All drawings shall be prepared as per BHEL's title block and bear BHEL's drawing No. and customer / consultant's drawing no; which will be forwarded to the successful bidder during detail engineering stage.
2. All the drawings which are required to be furnished to BHEL during detailed engineering stage shall include technical parameters, details of paints, BOQ / BOM etc in tabular form indicating all components including bought out items and their quantity, material of construction indicating its applicable code / standard, weight, make etc.
3. All testing of tanks shall be done in line with testing requirement of this specification and as finalized during detailed engineering and customer approvals.

SPECIFICATION FOR ELECTRIC HEAT TRACING

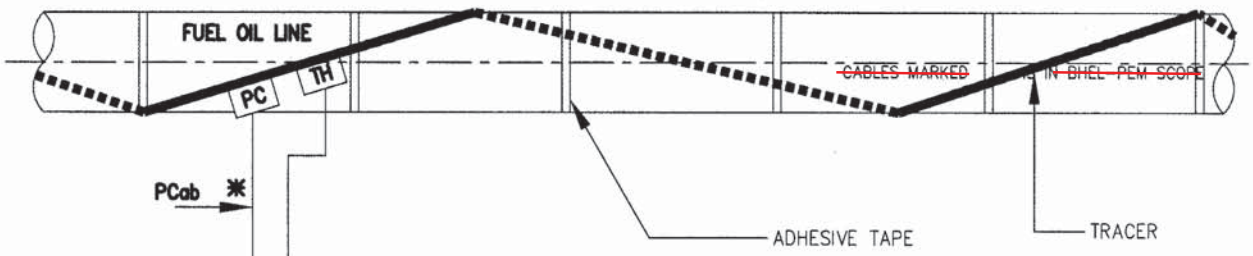
FIRST ANGLE PROJECTION (ALL DIMENSIONS IN MILLIMETRES)

DRAWING No 4-81-441-05249

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

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

CIRCUIT – 1 (TYPICAL)



PCab ✱

J.B

PCab ✱ CC ✱

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

✱✱ MAIN INCOMING CABLE By BHEL

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

nos of panels to be decided by Bidder.

PCab : POWER CABLE
CC : CONTROL CABLE

Scope of supply as per the electrical scope matrix provided in the electrical specification

NOTES :

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

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

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

04) RECOMMENDED SIZE OF MAIN INCOMER CABLE

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

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

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

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

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

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

11) REQUIREMENT OF JB TO BE DECIDED BY VENDORS

1. BHEL shall provide incoming power cable to ETH panel.
2. ETH power distribution panel shall be in bidder's scope, further power and control cables, JBs, power connectors, thermostats,tracer, tape, cable lugs and glands shall be as per the electrical scope matrix indicated in the section C-3.
3. Number of ETH power distribution panels shall be decided during detailed engineering.

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

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

ALL DIMENSIONS IN MILLIMETRE
PROJECTION SCALE NTS

TITLE CABLING SCOPE FOR E.H.T SYSTEMS

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

TECHNICAL SPECIFICATION FOR ELECTRCAL HEAT TRACING SYSTEM

1.0 SCOPE

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

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

2.0 GENERAL

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

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

3.0 CODES AND STANDARDS

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

4.0 DATA SHEET

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

5.0 GENERAL TECHNICAL REQUIREMENTS

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

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

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

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

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

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

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

5.5 General Requirements

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

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

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

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

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

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

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

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

5.6.2 Heat tracer shall have a metallic braiding.

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

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

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

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

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

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

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

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

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

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

5.17 Heaters shall not be affected by vibration and twisting.

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

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

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

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

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

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

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

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

5.26 Design shall account for following variances also:

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

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

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

5.27.2 Annunciation for following fault condition to be provided.

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

Necessary sensors for the same to be provided.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

6 INSPECTION & TESTING

Shall be as per the following standard QP

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

7 INSTALLATION REQUIREMENTS

(Important: Installation is not in scope).

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

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

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

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

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

8.0 DOCUMENTS

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

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

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

8.1.3 Single line power distribution diagram.

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

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

8.1.6 Quality control procedures & Quality assurance program.

8.1.7 Detailed BOM.

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

8.1.9 All other documents called under other sub-specification.

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

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

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