

**TELANGANA STATE POWER GENERATION
CORPORATION LTD**

5X800 MW YADADRI TPS

***TECHNICAL SPECIFICATION
FOR
FUEL OIL HANDLING SYSTEM***

SPECIFICATION NO.: PE-TS-417-166-A001



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA (INDIA)**



TITLE FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS
INDEX

SPECIFICATION NO. PE-TS-417-166-A001

REV 00

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**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5X800 MW YADADRI TPS**

SPECIFICATION NO. PE-TS-417-166-A001

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SECTION- I

INTENT OF SPECIFICATION

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1.0 INTENT OF SPECIFICATION

- 1.1** This specification includes, but not limited to Supply part, Services part and Mandatory spares comprising of design (i.e. Preparation and submission of drawing /documents including “As Built” drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, obtaining CCOE approval, minor civil work, trial run at site, and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff (if applicable) and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order for **5X800 MW YADADRI TPS**.
- 1.2** The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, demonstration testing of **Fuel Oil Handling System**
- 1.3** It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4** The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5** The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.

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- 1.6 While all efforts have been made to make the specification requirement complete & unambiguous, it shall be bidders' responsibility to ask for missing information, ensure completeness of specification, to bring out any contradictory / conflicting requirement in different sections of the specification and within a section itself to the notice of BHEL and to seek any clarification on specification requirement in the format enclosed under SECTION-III of the specification **within 10 days of receipt of tender documents**. In absence of any such clarifications, in case of any contradictory requirement, the more stringent requirement as per interpretation of Purchaser / Customer shall prevail and shall be complied by the bidder without any commercial implication on account of the same. Further in case of any missing information in the specification not brought out by the prospective bidders as part of pre-bid clarification, the same shall be furnished by Purchaser/ Customer as and when brought to their notice either by the bidder or by purchaser/ customer themselves. However, such requirements shall be binding on the successful bidder without any commercial & delivery implication.
- 1.7 The bidder's offer shall not carry any sections like clarification, interpretations and /or assumptions.
- 1.8 Deviations, if any, should be very clearly brought out clause by clause along with cost of withdrawal in the enclosed schedule (in SECTION – III); otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification. If no cost of withdrawal is given against the deviation, it will be presumed that deviation can be withdrawn without any cost to BHEL/its customer.
- 1.9 In the event of any conflict between the requirements of two clauses of this specification documents or requirements of different codes and standards specified, more stringent requirement as per the interpretation of the owner shall apply.
- 1.10 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.11 For definition of word like Contractor, bidder, supplier, vendor, Customer/ Purchaser / Employer, consultant, please referred relevant clause(s) of GCC.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5X800MW YADADRI TPS**

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SECTION: I

**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN
CRITERIA**

YADADRI THERMAL POWER STATION

PROJECT INFORMATION

1	Name of the Project	YADADRI Thermal Power Station
2	Station Capacity	5X800 MW (Coal based)
3	Owner	Telangana State Power Generation Corporation Limited (TSGENCO)
4	Site Location	Site is located 7 km from the NH5.
5	Latitude	16° 42'20.40 N
6	Longitude	79° 34'41.56 E
7	Nearest Town	30 Km Miryalaguda
8	Nearest Railway Station	6.5 Km Damercherla
9	Nearest Airport	130 Kms (Vijayawada)
10	Site Conditions	
	Ambient Temperature	
	Daily minimum (average)	10°C
	Daily maximum (average)	47°C
	Design Ambient Temperature	50°C
	Ambient temperature (performance)	38°C
	Relative Humidity for design / efficiency	48-84 %
	Annual rainfall, mm	600 mm
	Plant Elevation above MSL	85 m above MSL
	Wind Pressure	As per the latest revision of IS 875/1987

TELANGANA STATE POWER GENERATION CORPORATION LIMITED

From
Chief Engineer/Civil/ Thermal
TSGENCO, Vidyut Soudha,
Hyderabad – 500082

To
✓ The Dy.General Manager,
M/s.BHEL Camp Office,
Vidyut Soudha,
Khairtabad,
Hyderabad – 500082

Lr.No.CE/C/Thermal/KTPSD/E1/F.YTPS-M/s.BHEL/D.No. 247 /2015-16.Dt. 29.08.2015

Sir,

Sub:- YTPS – 5x800MW- Wind load & Seismic zone details - Reg

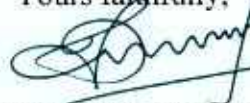
Ref: email: dated.11.08.2015 from M/s.BHEL.

...

With reference to the email cited,the details of wind load & seismic zone pertaining to proposed Yadradri Thermal Power Station (5x800MW) are herewith furnished for taking further action.

Wind load		Seismic zone	
Wind Speed	Terrain category	Seismic zone	Type of soil
44m/Sec	Category-2	Zone-III as per IS 1893:2002	Type of soil may be confirmed at your end after conducting soil investigation in the plant area.

Yours faithfully,



19/8/2015
CHIEF ENGINEER/CIVIL/THERMAL

Copy to the:

Chief Engineer/TPC/TSGENCO/Vidyut Soudha/Hyderabad.

A.S to Director/Projects/ TSGENCO/Vidyut Soudha/Hyderabad

M/s.DESEIN Private Limited, 102, First floor, My Home Sarovar Plaza, Secretariat Road, Hyderabad-500063.

जलवायवी सारणी
CLIMATOLOGICAL TABLE

BACK

स्टेशन : नलगोंदा
STATION : Nalgonda

अक्षांश
LAT. 17°03'
देशांतर
LONG. 79°16'

समुद्री तल माध्य से ऊंचाई
HEIGHT ABOVE M.S.L. 227
मीटर
METRES

प्रक्षेपों पर आधारित
BASED ON OBSERVATIONS 1975-2000

माह		स्टेशन का सतह दाब	वायु तापमान										आर्द्रता		मेघ की मात्रा		BASED ON OBSERVATIONS 1975-2000						
			माध्य				चरम										वर्षा						
			शुष्क बल्व	नम बल्व	दैनिक अधिक नम	दैनिक न्यून तम	माह में उच्चतम	माह में निम्नतम	दिनांक और वर्ष	उच्चतम	निम्नतम	दिनांक और वर्ष	सापेक्ष आर्द्रता	वाष्प दाब	समस्त मेघ	निम्न मेघ	मासिक योग	वर्षा के दिनों की संख्या	वर्षा सहित सबसे नम महीने का योग	वर्षा सहित शुष्कतम महीने का योग	24 घंटों की सबसे भारी वर्षा	दिनांक और वर्ष	माध्य पवन गति
MONTH		STATION LEVEL PRESSURE	AIR TEMPERATURE						HUMIDITY				CLOUD AMOUNTS		RAINFALL								
			DRY BULB	WET BULB	DAILY MAX	DAILY MIN	HIGHEST IN THE MONTH	LOWEST IN THE MONTH	HIGHEST	DATE AND YEAR	LOWEST	DATE AND YEAR	RELATIVE HUMIDITY	VAPOUR PRESSURE	ALL CLOUDS	LOW CLOUDS	MONTHLY TOTAL	NO. OF RAINY DAYS	TOTAL IN WETTEST MONTH WITH YEAR	TOTAL IN DRIEST MONTH WITH YEAR	HEAVIEST FALL IN 24 HOURS	DATE AND YEAR	MEAN WIND SPEED
		एच.पी.ए. hPa	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	डि. से °C	प्रतिशत %	एच.पी.ए. hPa	आकाश के अष्टमारा Oktas of sky	मि.मि. mm		मि.मि. mm	मि.मि. mm	मि.मि. mm			कि.मी. प्र. घं. Km/h	
जनवरी JAN	I II	989.9	21.3	19.3	30.8	18.4	33.8	16.1	36.0	17 1998	14.4	7 1992	82	21.2	2.0	1.8	13.5	0.4	155.7 1978	0.0	55.4	11 1978	
फरवरी FEB	I II	988.0	23.6	21.5	33.5	20.7	36.5	18.0	39.0	26 1980	15.4	5 1988	82	24.1	3.0	2.5	7.2	0.5	14.0 1999	0.0	49.2	20 2000	
मार्च MAR	I II	985.8	26.2	23.7	37.3	22.8	40.9	19.9	42.0	14 1983			80	27.4	1.7	1.4	6.5	0.4	88.5 1981	0.0	43.6	13 1981	
अप्रैल APR	I II	983.6	29.2	25.5	39.6	25.5	43.0	22.4	44.5	30 1991	14.6	15 1987	73	29.7	2.1	2.0	17.6	1.0	65.6 1981	0.0	40.6	24 1981	
मई MAY	I II	980.8	31.9	26.3	41.2	28.2	44.8	23.5	46.1	26 1984			63	29.7	2.7	2.5	27.0	1.4	94.3 1991	0.0	49.0	5 1981	
जून JUN	I II	978.2	29.8	25.7	37.6	27.2	42.6	23.4	46.3	2 1998	21.8	12 1991	71	29.9	5.1	4.4	65.9	3.5	48.2 2000	0.0	81.7	12 1991	
जुलाई JUL	I II	978.8	27.7	24.7	33.9	25.5	37.3	23.2	39.2	7 1992	22.0	2 1992	77	28.6	6.3	5.8	124.6	6.0	176.7 1977	36.8 1979	99.2	24 1977	
अगस्त AUG	I II	979.6	27.1	24.3	32.8	25.0	35.4	22.8	37.5	25 1979	22.0	2 1981	78	28.2	6.1	6.0	133.0	6.7	189.0 1998	33.2 1979	88.2	14 1977	
सितम्बर SEP	I II	982.0	27.4	24.4	33.6	24.9	36.4	22.8	38.5	23 1987	21.6	8 1989	77	28.3	4.9	4.2	145.5	5.8	393.1 1991	20.3 1984	152.2	21 1991	
अक्टूबर OCT	I II	985.3	26.6	23.8	33.1	23.7	36.2	21.4	36.5	1 1987	19.2	28 1980	78	27.2	4.0	3.7	104.3	3.8	333.1 1981	4.2 1984	109.2	6 1987	
नवम्बर NOV	I II	987.9	24.2	21.0	31.1	21.2	33.5	17.9	35.5	7 1996	14.6	27 1981	75	22.6	3.2	2.6	48.1	2.8	66.8 1991	1.1 1981	163.5	4 1987	
दिसम्बर DEC	I II	990.3	21.7	18.6	30.0	18.6	32.2	15.7			12.6	16 1993	73	19.4	2.7	2.3	3.8	0.3	3.1 1987	0.0	3.1	10 1987	
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	I II	983.9	26.7	23.4	34.8	23.7	44.3	15.9	46.3	2 1998	12.6	16 1993	75	26.6	3.7	3.2	696.8	32.5	631.7 1982	631.7 1982	163.5	4 1987	
वर्षों की सं NUMBER OF YEARS	I II	19	19	19	19	21	22		19		19		19	19	18	17	20	20	16	16	23		

जलवायवी सारणी
CLIMATOLOGICAL TABLE

स्टेशन : नलन्दा
STATION : Nalanda

	मौसम परिघटना						पवन														मेघ														दृश्यता					
	के साथ दिनों की संख्या						पवन की गती के साथ दिनों की संख्या (कि. मी. प्र. घं.)				पवन की दिशा के दिनों की संख्या का प्रतिशत										मेघ मात्रा (सभी मेघ) सहित दिनों की संख्या - अष्टमांश					निम्न स्तरी मेघ मात्रा सहित दिनों की संख्या - अष्टमांश									दृश्यता सहित दिनों की संख्या					
माह	वर्षा 0.3 मि.मि.या अधिक	ओले	गर्जन	कुहरा	धूल भरी आंधी	चंड वात	62 या अधिक	20-61	1-19	0	उ	उपू	पू	दपू	द	दप	प	उप	शांत	0	ले-2	3-5	6-7	8	0	ले-2	3-5	6-7	8	कुहरा 8	1 कि.मी. तक	1-4 कि.मी.	4-10 कि.मी.	10-20 कि.मी.	20 कि.मी. से अधिक					
	WEATHER PHENOMENA						WIND														CLOUD														VISIBILITY					
	No. OF DAYS WITH						No. OF DAYS WITH WIND SPEED (Km. p. h.)				PERCENTAGE No. OF DAYS WIND FROM										No. OF DAYS WITH CLOUD AMOUNT (ALL CLOUDS) O K T A S					No. OF DAYS WITH LOW CLOUD AMOUNT O K T A S									No. OF DAYS WITH VISIBILITY					
MONTH	PFT 0.3 mm Or more	HAIL	THUN DER	FOG	DUST STORM	SQU ALL	52 Or more	20-61	1-19	0	N	NE	E	SE	S	SW	W	NW	CALM	0	T-2	3-5	6-7	8	0	T-2	3-5	6-7	8	FOG 8	UP TO 1 Km.	1-4 Kms.	4-10 Kms.	10-20 Kms.	OVER 20 Kms.					
जनवरी JAN	0.5	0.0	0.0	0.0	0.0	0.0	0	0	29	2	0	30	3	39	3	4	0	11	10	25	0	2	1	3	25	0	2	1	3	0	0.6	6.7	21.3	2.3	0.1					
फरवरी FEB	0.6	0.0	0.0	0.0	0.0	0.0	0	0	28	0	1	26	1	55	3	5	0	7	2	18	1	3	2	4	21	1	2	1	3	0	0.1	7.8	18.0	1.7	0.5					
मार्च MAR	0.7	0.0	0.1	0.0	0.0	0.0	0	1	30	0	1	25	1	55	3	5	0	9	1	23	2	3	1	2	25	1	3	1	1	0	0.0	3.8	24.1	2.9	0.3					
अप्रैल APR	1.1	0.0	0.0	0.0	0.0	0.0	0	0	29	1	0	20	1	46	4	18	0	8	3	20	2	4	2	2	21	1	4	2	2	0	0.0	3.0	21.5	4.3	1.1					
मई MAY	1.8	0.0	0.0	0.0	0.0	0.0	0	0	31	0	1	14	0	27	3	21	3	30	1	19	2	5	2	3	21	2	4	1	3	0	0.0	3.1	22.5	3.4	1.9					
जून JUN	4.5	0.0	0.0	0.0	0.0	0.0	0	1	29	0	1	2	0	6	0	36	8	47	0	5	1	5	4	15	7	1	4	3	15	0	0.0	4.7	20.2	3.1	2.0					
जुलाई JUL	7.1	0.0	0.1	0.0	0.0	0.0	0	1	30	0	1	1	0	1	0	43	10	44	0	2	1	3	5	20	4	1	2	3	21	0	0.0	4.3	23.1	1.9	1.6					
अगस्त AUG	7.7	0.0	0.0	0.0	0.0	0.0	0	1	30	0	1	1	0	2	0	32	8	55	1	2	1	5	3	20	3	1	4	2	21	0	0.0	4.1	22.8	2.5	1.6					
सितम्बर SEP	6.6	0.0	0.0	0.0	0.0	0.0	0	0	29	1	1	6	0	11	1	29	4	42	6	4	1	6	4	15	5	1	4	3	17	0	0.0	3.2	20.9	3.6	2.3					
अक्टूबर OCT	3.9	0.0	0.0	0.0	0.0	0.0	0	0	29	2	1	29	4	16	1	15	2	23	9	18	1	5	2	5	21	0	3	2	5	0	0.1	3.7	22.4	3.8	1.1					
नवम्बर NOV	3.3	0.0	0.0	0.0	0.0	0.0	0	0	26	4	3	33	7	18	2	4	0	19	14	16	1	4	3	6	21	1	2	2	4	0	0.0	8.8	17.8	2.9	0.4					
दिसम्बर DEC	0.4	0.0	0.0	0.0	0.0	0.0	0	0	29	2	3	46	3	22	1	2	1	14	8	21	1	4	1	4	23	1	3	1	3	0	0.1	6.8	20.8	3.3	0.0					
वार्षिक योग या माध्य ANNUAL TOTAL OR MEAN	39.3	0.0	0.1	0.0	0.0	0.0	1	5	346	13	1	19	2	24	2	18	3	26	5	205	13	46	29	70	238	11	37	22	57	0	0.8	60.1	255.4	35.6	13.0					
वर्षों की संख्या OF YEARS	22						22				22									21					21					22										

5 X 800MW YADADRI TPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

SECTION I-A
(SPECIFIC TECHNICAL EQUIREMENT-MECHANICAL)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 5X800MW YADADRI TPS	SPECIFICATION NO. PE-TS-417-166-A001	
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1.0.0 SCOPE OF WORK

This specification includes, but not limited to Supply part, Services part and Mandatory spares (if applicable) comprising of design (i.e. Preparation and submission of drawing /documents including "As Built" drawings and O&M manuals), engineering, manufacture, fabrication, assembly, inspection / testing at vendor's & sub-vendor's works, painting, maintenance tools & tackles (as applicable), fill of lubricants & consumables, mandatory spares along with spares for erection, start up and commissioning as required, forwarding, proper packing, shipment and delivery at site, unloading, handling, transportation & storage at site, in-site transportation, assembly, erection & commissioning, final painting at site, obtaining CCOE approval, minor civil work, trial run at site, and carrying out Performance guarantee / Functional / Demonstration tests at site (As applicable), training of customer/client O&M staff (if applicable) and handover in flawless condition of the package to the end customer complete with all accessories for the total scope defined as per BHEL NIT & tender technical specification as specified above, amendment & agreements till placement of order.

1.1.0 SCOPE OF SUPPLY

Scope of supply by bidder shall comprise of but not necessarily be limited to the following. P&I Diagrams given with this specification may pls. be referred.

- 1) Two (2) nos. of vertical cylindrical, fixed roof type HFO storage tanks each of net capacity 4000 cum dully fitted with steam heated floor coil heaters and other appurtenances, accessories, instrumentation, controls and fittings etc.
- 2) Two (2) nos. of vertical cylindrical, fixed roof type LDO storage tank of net capacity 1000 cum dully fitted with appurtenances, accessories, instrumentation, controls and fittings etc.
- 3) One (1) no drain oil tank (with steam heating coils) of 20m³ capacity to be located in the fuel oil unloading pump house, including its all the accessories.
- 4) Three (3) (2W+1S) nos. LDO twin screw unloading pump motor set each of capacity 50 cum/hr. with simplex type strainers of matching capacity at the suction of each pump.
- 5) Five (5) (4W+1S) nos. HFO twin screw unloading pump motor set each of capacity 150 cum/hr. with simplex type strainers of matching capacity at the suction of each pump.
- 6) Two (2) (1W+1S) nos. HFO twin screw unloading pump motor set each of capacity 25 cum/hr. with simplex type strainers of matching capacity at the suction of each pump.
- 7) Two (2) (1W+1S) nos. LDO twin screw unloading pump motor set each of capacity 25 cum/hr. with simplex type strainers of matching capacity at the suction of each pump.
- 8) 100 Nos. HFO unloading flexible neoprene/ metallic hoses. Ten (10) nos. LDO unloading flexible neoprene/ metallic hoses. Length of each hose shall be to suit the layout in unloading area. However minimum length shall be 8 m.
- 9) Four (4) nos. suction heater on HFO tanks of required size.
- 10) Floor coil heater for the tank (pipe for floor coil heater of drain oil tank and main storage tank shall be in vendor scope).
- 11) Control valves for controlling steam flow to Floor coil heating and Suction heater installed on FO storage tank and Drain oil tank inside FO unloading pump house.
- 12) Pressure reducing and De-Superheating station of required size (No heating of rail wagons to be considered).
- 13) Traps for separating condensate from steam.
- 14) Coriolis type mass flowmeter in HFO and LDO discharge header.

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- 15) One (1) no. single chamber gravity type oil water separator pit along with its accessories.
- 16) Instrumentation & control System including instruments, interlocking & protection devices complete in all respects required for safe, efficient and reliable operation of the plant and to be read in conjunction with C&I portion of specification. Minimum instrument and control system requirement is mentioned in the P&ID.
- 17) Two (2) nos. (1W+1S) Vertical Single screw type Drain oil pump motor set of capacity 5 m³/hr. in Drain oil tank.
- 18) Two (2) nos. (1W+1S) Vertical Single screw type recovery oil pump motor set of Capacity 5 m³/hr. in Oil pit of Oil Water Separator.
- 19) Two (2) nos. (1W+1S) sump pump motor set in of capacity 10 m³/hr. in Oil unloading area.
- 20) Two (2) nos. (1W+1S) sump pump motor set in of capacity 10 m³/hr. in Unloading Pump House.
- 21) Complete Fuel oil piping including steam tracing, drain piping, vent piping, valves, insulation & cladding (for restricting heat loss and maintaining outside temp below 60 deg. C) etc. as applicable to Fuel oil unloading & storage system.
- 22) Drain and vent connection in lines along with isolation valve at every low and high point as per layout requirement of FOHS.
- 23) All foundation bolts/ anchor bolts required for any equipment foundation under the package. For HFO tank minimum 40 nos. anchor bolts (M42 grade) and for LDO tank minimum 24 nos. anchors bolts (M33 grade) to be considered irrespective of calculation.
- 24) Pipes will be free issued to bidder. However, flanges, fasteners, gaskets with suitable hangers, supports, pipe trestle within dyke and pump house as required etc. as applicable within the terminal point will be in vendor scope.**
- 25) Pipe-supporting structures over the insert plates for pedestal supported pipes and also on pipe rack supported pipe.
- 26) Pipes required for tank nozzles (HFO and LDO, Drain Oil Tank etc.), manholes, pipe support etc. shall be in bidder scope.
- 27) Nozzle for foam pourer, heat detector on tank roof & pad plates welded to the tanks as per details to be furnished to the successful bidder for welding supports for water piping and hydrant piping.
- 28) Platform and approach ladder to the platform for foam pourer.
- 29) Wrapping and coating of any buried MS pipes as required.
- 30) All MS structures for cross overs, valve / instruments / equipment operating & maintenance platforms, approach ladders for access to platforms, trench/pit.
- 31) Painting of equipment along with their accessories within battery limit.
- 32) Electrical scope as per enclosure elsewhere in the specification.
- 33) C&I Scope as per enclosure elsewhere in the specification.
- 34) Erection & commissioning spares as required for the complete system.
- 35) One set of special maintenance tools & tackles, if any. These tools shall not be used for erection/ commissioning purposes and shall be in an unused and new condition when they are handed over to the customer at site. Each tool shall be stamped so as to be identified easily for its use. The tools shall be supplied in a steel toolbox. This list shall be reviewed during detail engineering.
- 36) Mandatory spares as per enclosure elsewhere in the specification.

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- 37) Initial charge of all lubricants and fluids except LDO / HFO
- 38) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- 39) Flowable non- shrink grout of one grade higher than concrete used for civil work grouting below base plate for all structure/ equipment & for grouting of foundation / anchor bolts.
- 40) Any other item covered in specification for Fuel Oil Handling System
- 41) Relevant scope of supply as per GTR, GCC & SCC.
- 42) Valves in pit outside dyke as required as per latest OISD recommendation complying with requirement whichever is more stringent.
- 43) Any other instrument, equipment / item required for making the installation complete in all respect and for satisfactory operation of the system for the scope within the terminal point, as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of supply.
- 44) All **mechanical items for oil water separator pit including skimmer pipe, butterfly valve, heating arrangement, rung ladder etc. for OWS.**
- 45) Any changes required to take care of temperature effect to be considered by bidder as part of total cost quoted.

1.2.0 SCOPE OF SERVICES

Scope of services by bidder will include but not necessarily limited to the following:

- 1) Unloading, Storage, handling and transportation at site.
- 2) Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself, excavation & filling of earth for buried MS pipes if and as required. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.
- 3) Pre-Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
- 4) Erection & Commissioning of Fuel Oil System **(including pipes free issued to bidder)**
- 5) Erection of all foundation bolts/ anchor bolts etc. as required for any equipment. In case these are not erected when foundation is being cast refer point no b above.
- 6) Inspection & testing, Performance Requirements and Performance Guarantees.
- 7) Painting of tank and all other items within scope of supply.
- 8) Making Good/Repairing/replacement of and damaged done by bidder to adjacent structure, pipes etc. while erecting equipment's related to Fuel Oil system
- 9) Electrical scope as per enclosure elsewhere in the specification
- 10) Preparation of drawing showing common facilities, if any, between BHEL & Vendor supplied equipment.
- 11) Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. and review of civil drawing prepared by customer based on civil assignment drawing of bidder. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the vendor.

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12) Preparation of all drawings as per list enclosed under Annexure -D.

13) Void

14) Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE, IBR, Weight & Measures Department and any other agency/ competent authority related to installation of Fuel Oil Handling System on behalf of the customer. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.

15) Layout drawing to be prepared for statutory approval apart from showing the technical requirements shall necessarily show key plan showing approach to site with mile stone, Survey No., Khesra No, Plot No. etc.

16) Supply of temporary equipment and services for chemical cleaning, steam blowing, energization, testing etc. as applicable.

17) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.

18) All other facilities/ services as described in section on site services in specification and related to Fuel Oil Handling System scope of work within terminal point.

19) Relevant requirements as per GTR, GCC, ECC & SCC.

20) Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

2.0.0 EXCLUSION

a) Supply of pipes. However, E&C of the same including supporting arrangement shall be in bidder's scope of supply:

b) Civil work for fuel oil unloading & storage system including

- i. Civil work in Railway wagons unloading area
- ii. Road tanker unloading platform
- iii. Tank & Pump foundations
- iv. Unloading Pump House
- v. Dyke wall and barbed fencing
- vi. Encasing of buried pipes, providing culvert for the same, if required.
- vii. Hume Pipes, if any
- viii. Civil works like pits, wherever required.
- ix. Handrails other than those on the storage tanks.
- x. Various cable & pipe trenches, pipe pedestals, drains, sumps, insert plates for pedestals for pipe supports.
- xi. Pipe rack/trestle (refer definition of pipe rack/ trestle elsewhere in the specification) outside pump house and dyke area.

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However, location, sizing and loads, top of concrete elevations, top of grout elevations etc. and any other input related to above as applicable for above shall be given by the vendor.

- c) Fire Protection system for storage tanks,
- d) Air Conditioning / ventilation of Fuel Oil pump houses.
- e) Control/IO panel for Fuel Oil pump houses
- f) Lifting equipment (electric operated hoist) for unloading pump house for maintenance purpose of these pumps. Capacity of lifting equipment is envisaged as 2 T with lift as 11.0m. Bidder to confirm adequacy of the same.
- g) DCS control. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.
- h) Exclusion as indicated in Electrical & C&I portion of technical specification
- i) Relevant exclusion as per GTR, GCC, SCC & ECC.

3.0.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

- a) Relevant services as per GCC, SCC & ECC.

4.0.0 TERMINAL POINT

LDO

: **Near oil unloading area:**

LDO Road Tanker nozzle connections towards LDO U/L Pump suction side.

Near fuel oil unloading & pressurizing pump house:

Up to 2000 mm outside Pump house wall for suction & return line of LDO. Further routing shall be in BHEL-Try scope.

Bidder to plan the layout and size the pipe between storage tank and P&H unit in a manner so as to ensure availability of above TP pressure 1.0 Kg/cm² (a) limiting the tank foundation height for storage tanks to 1 m and the P&H unit FFL approx. 500 mm above ground level

HFO

: **Near oil unloading area:**

HFO Railway wagons nozzle connections towards HFO U/L Pump suction side.

Near fuel oil unloading & pressurizing pump house:

2000 mm outside pump house towards suction of HFO pressurizing pumps. Further, routing shall be in BHEL-Try scope.

Bidder to plan the layout and size the pipe between storage tank and P&H unit in a manner so as to ensure availability of above TP pressure 1.0 Kg/cm² (a) limiting the tank foundation height for storage tanks to 1 m and the P&H unit FFL approx. 500 mm above ground level

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Aux. Steam : Steam header at **16 kg/cm², 290 degC** by BHEL at 2000 mm from FO pressurizing building.

At the TP BHEL shall supply 13 MT/hr of steam. Bidder shall check the adequacy of the same. In case this is not adequate, bidder to inform the maximum aux. steam requirement at this TP along with manual calculation for the same.

Effluent from Oil Water Separators : Water pit of OWS. Further, pumps and piping up to CMB be under ETP scope).

Drain from dyke area : To OWS during normal condition & to plant drain during rainy season through two-way valve pit. Valves in the valve pit along with limit switch for the same are included in bidder's scope. In case the tanks are provided with intermediate dyke wall of height 0.6m, separate draining arrangement for dykes independent of each other shall be provided.

Condensate from FO U/L : area Condensate from condensate flash tanks shall be terminated at oil water separator near tank farm area.

Change in location of terminal points by up to 50 meters in plan view and 10 m in elevation view shall have no price implication. Isolation valves at the terminal points shall be in the scope of the bidder.

Wherever exact coordinate of TP is not given, bidder to consider location at specified distance from the respective facilities from where distance in bidder's scope will be maximum.

5.0.0 PERFORMACE REQUIREMENTS

This will comprise of:

5.0.1 PERFORMANCE requirement at shop:

- Capacity, total dynamic head, noise & vibration level of all pumps in isolation.
- Noise level for safety valve to be limited to 105 dB (A)
- Inspection and testing of all valves as per approved QAP.

5.0.2 Functional Guarantees at site:

- Capacity, total dynamic head and power consumption, noise & vibration level of all operating pumps in parallel. The capacity of pumps while operating in parallel will be verified by indication in tank level difference.
- Noise level for safety valve to be limited to 105 dBa
- Entire piping & support for smooth operation
- All other machines / components / system shall be acoustically designed for a surface sound pressure level of $L_p < 85$ dB (A), measured in accordance with ISO 3746 / IEC 651 / BS: 5969 /

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IS:9779 respectively at a distance of 1.0 m from equipment surface and at a height of 1.5m above ground level. The surface sound pressure level (Lp) shall be averaged over the measurement surface and corrected for effect of background noise and the influence of reflected sound at measurement surface (environmental correction). With sound pressure levels of 85 dB (A) or less according ISO it shall be ensured that maximum surface noise levels of any item of plant of less than 85 dB (A) at 1.0 m from outline and a height of 1.5m from the floor shall be met during normal operating conditions.

- e. In case during test it is found that the equipment/system has failed to meet the guarantees, the contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer. However, if the contractor is not able to demonstrate the guarantees, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by BHEL, after the tests have been completed, BHEL will have the right to Reject the equipment / system / plant and recover the payments already made or accept the equipment / system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by BHEL.
- f. The successful bidder will prepare a document titled “HANDLING OVER PROTOCOL” consisting various activities to be demonstrated by them for handing over of the package.

6.0.0 LAYOUT REQUIREMENTS

- a) System layout shall conform to the requirements of the Petroleum Act 1934 & Petroleum Rules 2002, OISD 118 latest edition whichever is more stringent. The layout shall also conform to all other relevant OISD specifications
- b) All established engineering practices with regard to layout of various equipment & piping shall be followed and the same shall be subject to customer approval during detail engineering without any commercial implication.
- c) The pipes between storage tank, fuel oil unloading area shall be running on Pipe rack or pedestal as applicable.
- d) Tentative Location of items related to Fuel Oil handling System is shown in enclosed **PLOT PLANS**. This will be finalized during detail engineering based on equipment dimensions and other layout related requirements. There will however be no cost implication on account of the same.
- e) For railway wagons unloading of fuel oil, LDO/HFO pumps will be located below ground level.
- f) While selecting pipe size, velocity inside the pipe shall not overshoot the velocity criteria indicated elsewhere in the specification.
- g) To the extent possible, all valves shall be located at grade level for easy operation & maintenance. Where location at grade level is not possible, suitable operating and maintenance platform made of MS grating and access ladder/ staircase/walkways to the same shall be given by the bidder. The platform and walkways will be designed by considering load of at least 750Kg/M².
- h) Where pipes are routed in a manner that it hampers man movement in any area, suitable no. of cross overs made of MS gratings shall be given across such pipes to facilitate easy man movement. Further suitable access ladder of MS construction shall be given for access to equipment/ pipes located in pit/ trench. Such structures shall be designed by considering a load of at least 750Kg/M².

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- i) Expansion bellows / pipe loops shall be provided in the steam line and HFO lines to accommodate pipe expansions at suitable distances as per calculation to be furnished by the successful bidder during detail engineering.
- j) For all pedestal supported pipes, BHEL scope will be limited to pedestal with insert plates. Maximum height of pedestal to be provided by BHEL shall be 300 mm from FGL/FFL in the corresponding area. Structures required above these pedestals for supporting the pipes are included in the scope of the bidder. However, inside the pump house no pedestals / insert plate shall be provided for fixing. Bidder shall support the pipes using pipe supports and anchor fasteners inside the pump house.
- k) Layout shall be prepared in a way to avoid the buried piping to the maximum possible extent.
- l) Oily water collected in storage tank area, oil unloading area will normally be collected in OWS pit by gravity either through trench (limited to a depth of 0.5 m) or through buried pipe (limited to a depth of 1.0 m) . However, in case depth of pipe between the pit and OWS pit exceeds 1 m or gravity flow is not possible due to layout constraints (which can be reviewed during detail engineering), the oily water waste shall be collected by pumping to OWS pit. Necessary pumps, valves, pipes, pipe supports, and instruments etc. for the same shall be in the bidder's scope.
- m) Straight length required before and after control valve s, flow element/ flow meters, shall be provided as per latest standard/ applicable codes.
- n) Rainwater collected inside the dyke shall be diverted to storm water drain while contaminated oily waste shall be sent to OWS. All valves required in pits outside the dyke are included in bidder's scope of supply.
- o) Instruments to be mounted on tank shall be suitably located so as to have easy access from the staircase without interfering with man movement on the staircase. Wherever this is not possible, suitable platform along with access to the same shall be provided by FO System bidder.
- p) Signals from all field instruments shall be first terminated in Junction boxes before transmitting this signal either to Control panel or to I/O rack or to DCS. Junction box is included in bidder's scope. Erection of cable between field instruments to Junction Box is also included in bidder's scope. Scope of cable supply shall be as per project specific scope split sheet given under electrical portion of this specification.
- q) All piping shall be arranged to provide clearance for removal of equipment requiring maintenance and easy access to valve and other piping accessories required for operation and maintenance. The layout drawing to be submitted by the successful bidder will necessarily show the valve orientation and access to valve and accessories.
- r) Instrument/ LIE/LIR shall not be located in space meant for walkway & maintenance space across the equipment, maintenance bay of building. Location of all instruments shall be marked in layout drawing to ensure correct location of the same.

7.0.0 EQUIPMENT SELECTION & DESIGN CRITERIA

The minimum design criteria/ technical details to be followed for various equipment shall be as per Data Sheets / Design criteria under given under SECTION-I. Any contradictory requirement for specification of particular equipment, and clarifications not having been sought by the bidders, the most stringent requirement as per interpretation of the BHEL will prevail. Successful bidder will furnish detailed data sheets/ specifications / design calculations for various equipment for customer's/ consultant's approval during detail engineering. For items for which specific technical specification is

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not enclosed, data sheet / dwgs / design calculations for such items shall be subject to customer/ consultant approval during detail engineering. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

8.0.0 SYSTEM WRITE UP & CONTROL

For system write up and control requirement of fuel oil unloading and storage system, pls refer **Section-IA**.

9.0.0 PAINTING / CORROSION PROTECTION REQUIREMENT

This will be as per specification given under **Annexure–G**. During detailed engineering stage, successful bidder shall prepare and submit the painting schedule for FOHS in line with customer specification for each equipment pipe, tanks, structure etc. for customer approval and changes suggested shall be taken care without any commercial implication.

10.0.0 QUALITY ASSURANCE, QUALITY PLANS, INSPECTION & TESTING PROCEDURE:

- The Quality plans / checklist for the previous executed jobs for the equipment's / instruments are attached under **Section IA**.
- The successful bidder shall furnish Quality Plans/ Inspection Check Lists for various item for the package in line with minimum requirement indicated in specification during detail engineering for Customer's approval.
- For other items for which any specific inspection requirement is not indicated in the specification but the same included in scope of work , vendor specific QPs/ CLs shall be furnished by the successful bidder for Customer/Consultant's review and approval. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.
- The Field Quality Plan of bidder shall also be submitted by the successful bidder during detail engineering for customer's / consultant's approval. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.
- For flame proof actuator, motors, junction boxes, instruments etc. as per specification requirement, valid test certificate for the same shall be submitted by the vendor as part of QC documentation. In case valid test certificates are not available, necessary test shall be conducted in line with applicable standard in presence of customer and cost of such test shall be deemed to be included in the contract price

11.0.0 SUB-VENDOR ITEMS

The tentative make of Sub-vendor items shall be generally as per **Annexure-B** enclosed which is subject to customer approval during detail engineering. Make of any unlisted items shall be subject to customer approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for BHEL's review and approval. Bidder shall furnish along with his offer the following supporting documentation within 1 month of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.

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a) Documentation to show that the equipment /system have been supplied for a plant of similar or higher capacity.

b) Documentation in the form of certificate that the equipment/system has been **operating satisfactorily for one year as on the scheduled date of bid opening.**

The successful bidder will get the makes of all items approved from Customer/ Consultant during detail engineering within two months of placement of LOI. The complete list will be necessarily be submitted within one month of placement of LOI to ensure timely placement of order for BOIs.

Bidder to assess the capability of their proposed sub-vendors in terms of preparation of drawings, calculations, documents, quality assurance, supply of material etc. as per project schedule before placing the order on them.

Dealers are not acceptable for any item of the package. Bidder shall procure all items including plates, structural, flanges; counter flanges etc. from approved sub vendor only.

12.0.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The drawings and documents to be submitted with the bid shall strictly be as per list given under **SECTION-III**. Any documents other than those indicated in the list will not be reviewed and will not form part of contract.

13.0.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

Tentative list of drawing / document required during detail engineering is attached in **Annexure –D**. Any other drawings and documents as required by BHEL / Customer / Consultant shall be furnished by the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL.

14.0.0 DRAWINGS DISTRIBUTION SCHEDULE

Vendor needs to submit hard copies of each drawing/document during detail engineering along with editable soft copy of the same as per **Annexure-C**. However, exact no. of drawings / documents and submission/distribution procedure for the same shall be intimated to the successful bidder after award of contract and the same shall be complied by the successful bidder without any commercial implication.

15.0.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Input drawings for this package are given under **Annexure-E** namely:

- Plot plan, **PE-DG-417-100-M001**
- Process & Instrumentation Diagram of LDO, PE-DG-417-166-A001 (Sheet 1 of 3)
- Process & Instrumentation Diagram of HFO, PE-DG-417-166-A001(Sheet 2 of 3)
- Process & Instrumentation Diagram of steam & condensate, PE-DG-417-166-A001 (Sheet 3 of 3)
- GA Drawing of HFO Tanks, PE-DG-417-166-A002 (Sheet 1 of 2)
- GA Drawing of LDO Tanks, PE-DG-417-166-A002 (Sheet 2 of 2)
- UNLOADING PUMP HOUSE AND DYKE AREA FOR FOHS, PE-DG-417-166-A003

The flow diagrams are indicative and show the minimum requirement to be followed including minimum requirement of instruments. Any other item and instruments required (within the terminal points) to make the system complete in all respect and for satisfactory operation of the system shall also deemed to have been included by the bidder in their scope.

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16.0.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer.

Bidders shall make Site visit in order to familiarize themselves with existing condition of site before submitting the bid in order to make their offer complete. During detail engineering also, the successful bidder shall be responsible for the correctness of details wrt existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reason for any shortcoming in the work by them. BHEL shall also not entertain any cost implication for any lack of input data with regard to site during detail engineering.

ii) Bidder shall submit detail erection manual for each of the equipment as well as complete system supplied under this contract at least 3 months before the scheduled erection of the concerned equipment / component or along with supply of concerned equipment / component whichever is earlier.

iii) The O&M Manual to be submitted by the successful bidder should necessarily address "Checklist of O&M Manual" given under **SECTION-IIB**.

iv) Document approval by customer under Approval category or information category shall not absolve the vendor of their contractual obligations of completing the work as per specification requirement. Any deviation from specified requirement shall be reported by the vendor in writing and require written approval. Unless any change in specified requirement has been brought out by the vendor during detail engineering in writing while submitting the document to customer for approval, approved document (with implicit deviation) will not be cited as a reason for not following the specification requirement.

v) In case vendor submits revised drawing/doc after approval of the corresponding drawing/doc, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion. However, in case changes are necessitated due to any constraints at customer end, delay in review/ approval of such revised drawing beyond one month will be to customer's account.

vi) Bidder to note that the successful bidder, during detail engineering, will submit the drg/doc through web based Document Management System in addition to hard copies to be submitted as per dwg/ document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized after award of contract. Bidder to ensure following at their end

- Internet explorer version – Minimum Internet Explorer 7
- Internet speed – 2 mbps (Minimum preferred)
- Pop ups from our external DMS IP (124.124.36.198) should not be blocked
- Vendor's Internal proxy setting should not block DMS application's link (<http://124.124.36.198/wrenchwebaccess/login.aspx>)

DMS user manuals to be used by BHEL PEM vendors for uploading, viewing, revising, commenting and tracking documents on PEM's DMS have been uploaded on PEM internet website (www.bhelpem.com) under the Vendor session.

For quick access bidder may refer the link <http://bhelpem.com/DMSManuals/DMSManuals.html>

vii) Engineering for this project is being carried out in 3D environment at BHEL end. Name of engineering platform on which BHEL is doing the project is Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. Hence bidder, in their own

	TECHNICAL SPECIFICATION FOR FUEL OIL UNLOADING & STORAGE SYSTEM 5X800MW YADADRI TPS	SPECIFICATION NO. PE-TS-417-166-A001	
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interest, is requested to prepare all layout drawings using 3D Modelling software. These drawings will also be made available to BHEL in soft for checking interface with other agencies in consolidated layout drawings. Bidder's inability to prepare drawing using 3D Modelling software will not be criterion for evaluation of their bid.

- viii) Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.
- ix) Wherever CIVIL works is excluded from the bidder's scope, successful bidder shall furnish civil assignment drawings. The corresponding CIVIL drawing prepared by BHEL / CIVIL agency, based on civil assignment drawing of bidder will be furnished to the successful bidder for concurrence. In case any modification is required in the civil work already carried out based on final civil inputs given by vendor, BHEL reserves the right to debit cost of such rework to vendor".
- i) Site storage and preservation manual has been placed under **SECTION-IIC**. Bidder to note down all the requirement of storage and preservation required for several items given under this manual. Bidder shall necessarily follow all the practices given in the manual as applicable for its items/ equipments under scope of supply.

5 X 800 MW YADADRI TPS

TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & STORAGE SYSTEM

(SYSTEM WRITE UP)



BHARAT HEAVY ELECTRICALS LTD
POWER SECTOR PROJECT ENGINEERING MANAGEMENT PPEI, NOIDA-
INDIA

	FUEL OIL UNLOADING & STORAGE SYSTEM 5 X 800 MW YADADRI TPS	SPECIFICATION. No: PE-TS-417-166-A001	
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1.0 SYSTEM DESCRIPTION Light Diesel Oil (LDO) shall be used as initial start-up/ warm up fuel while heavy Fuel Oil (HFO Gr HV) shall be used for flame stabilization during low load operation. The Fuel Oil Handling System to be considered comprises unloading & storage of LDO and Heavy Fuel oil (HFO Gr HV). The basic operation & control philosophy of fuel oil unloading & storage system is described in succeeding sections. The bidder shall provide all the features as specified herein including other features as required for safe, efficient and trouble free operation of the system. Fuel Oil Characteristics are provided at Annexure-A, SECTION-IA of specification 1.1 HEAVY FUEL OIL SYSTEM 1.1.1 Heavy Fuel Oil (HFO Gr HV) shall be delivered to power station by one (1) full rake of 50 nos BTPN type railway wagons having capacity of approx. 55-65 cum per wagon. The railway wagons shall be unloaded through neoprene unloading hoses of 8.0m length with fire safe type ball valve for isolation and a hose stand for each unloading hose. The Fuel Oil unloading header will have hundred (100) Nos. unloading points. The HFO unloading header shall be steam heat traced and insulated. 1.1.2 BTPN wagons are not equipped with heating facility. Hence, no heating of wagons is provided. Steam header in the unloading area shall be provided for Unloading header tracing only. Fuel oil from wagons will be collected in unloading header (min. size 550NB) laid along with track. Oil from the unloading header shall be pumped to HFO storage tank with the help of unloading pumps as indicated in the flow diagram. The Fuel Oil unloading pumps shall be rotary positive displacement, twin screw type, sump heated and provided with matching capacity simplex strainers (steam, sump heated) at their suction with interconnecting piping and valves as shown in the P&I diagram, Drwg No.- PE-DG-417-166-A001. 1.1.3 Two (2) nos. HFO storage tanks each of capacity 4000 m³ is envisaged. The tank shall be provided with steam floor coil heaters at the bottom of the tank to raise the temperature of oil from 5°C to the handling / tank maintenance temp. of 50 °C in 72 hrs. and maintaining the temperature inside the tank at 50°C . The floor coil heater for the Fuel oil storage tanks shall have adequate nos. of sections and shall be regulated through two no. pneumatically operated modulating type control valve provided on steam supply line. This shall be actuated from tank temperature. 1.1.4 Each HFO Storage Tank shall be insulated and cladded on the shell. 1.1.5 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram of HFO System (Drwg.no. PE-DG-417-166-A001) shall be provided. Piping, valves and other equipment shall be steam traced and insulated. 1.1.6 Two (2) nos. shell and tube type suction heater (one designed for three units oil supply and other designed for two units oil supply) is also provided in each HFO tank to supply oil to pressurizing pump house at required temperature. Temperature will be regulated through one pneumatically operated modulating type control valve on each steam supply line. Initial and final temperature for suction heater shall be 50 deg. C and 60 deg. C respectively. However, suction heater will be designed for a temperature rise of 20 deg. C. All modulating control valves shall be of SMART type. 1.2 LIGHT DIESEL SYSTEM 1.2.1 LDO shall be delivered to power station by ten (10) nos road tankers. The road tankers shall be unloaded through flexible metallic / neoprene unloading hoses of min. 8.0m length with fire safe type ball valve for isolation and a hose stand for each unloading hose. The LDO unloading header will have 10 Nos. unloading points. 1.2.2 LDO from unloading header shall be pumped to LDO storage tank with the help of Three (3) Nos (2W+1S) unloading pumps as indicated in the LDO Unloading and Storage system flow diagram. The LDO unloading pumps are of rotary positive displacement, twin screw type and provided with matching capacity simplex strainers at their suction with interconnecting piping and valves as shown in the P&I diagram for FO System, Drwg No. - PE-DG-417-166-A001.			

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1.2.3 Two (2) nos. LDO storage tanks, each of net capacity 1000 m3 are envisaged.

1.2.4 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for LDO system (Drwg.no. PE-DG-417-166-A001) shall be provided.

1.3 STEAM & CONDENSATE SYSTEM

1.3.1 One no. pressure reducing station shall be provided for reducing auxiliary steam available at 16 kg/cm² (a) to 4.0 kg/ cm² (a) and at 290 deg. C. De-superheated is also provided at downstream of PRS to bring steam temperature to saturated temperature. Reduced steam shall be used for unloading header heating, strainer and pump heating and tank heating and steam tracing of pipes.

1.3.2 A condensate flash tank shall be provided by BHEL-Piping Center in the tank farm for collecting condensate from tank (floor coil heater and Suction heater) before discharging it to Oil Water Separator pit. Condensate formed in Common unloading pump house i.e. pumps, strainers, drain oil tank shall be fed to sump in common FO unloading pump house.

1.3.3 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for STEAM & CONDENSATE system (Drwg.no. PE-DG-417-166-A001) shall be provided.

1.4 DRAIN OIL SYSTEM, SUMP WATER & OIL WATER SEPARATION

1.4.1 One no. drain oil tank of capacity 20 cum (4.5m x 2.5m x 2.0m (ht.)) shall be provided in the HFO unloading pump house to collect drain from HFO unloading pumps and Strainer inside U/L pumps, strainer by gravity.

1.4.2 The above drain oil tank in the unloading pump house shall be provided with a steam coil with isolation valve. The condensate formed shall be discharged through a trap in to the sump.

1.4.3 All oil drain headers will have a size not less than 25 NB and adequately sloped.

1.4.4 Two (2) no. (1W+1S) vertical single screw type drain oil pump of capacity 5 m³/hr. each shall be provided to transfer oil collected in the drain oil tank. Discharge from the pump shall be connected to HFO discharge header after flowmeter.

1.4.5 Two (2) nos. vertical centrifugal type pumps of capacity 10 cum/hr. is also envisaged in HFO unloading pump house to pump the oil water mixture collected in pump house to oil water separator pits provided in Tank farm area.

1.4.6 Two (2) nos. vertical centrifugal type pumps of capacity 10 cum/hr. is also envisaged in HFO unloading area to pump the oil water mixture in unloading area to oil water separator pits provided in Tank farm area.

1.4.7 Discharge of both sumps pumps (Inside HFO unloading pump house and HFO unloading area) shall be connected and a common line shall be taken to Oil Water Separator pit in the Tank Farm area.

1.4.8 A single chamber gravity type oil water separator of adequate capacity in tank farm area shall be provided for receiving oil water mixture during normal operation from the unloading area & unloading pump house and tank dyke area respectively. Separated oil collected in oil pit shall be pumped HFO storage tank. Two (2) no. (1W+1S) vertical single screw type oil recovery pump of capacity 5 m³/hr each shall be provided in oil pit of OWS to transfer collected oil to HFO storage tank.

1.4.9 Separated water from the oil water separator water pit shall be taken to CMB as per ETP philosophy. Pumps, instruments required for it are in ETP supplier scope.

1.4.10 During rainy season, water from unloading area drain trench and from tank dyke area having very little or no trace of oil shall be diverted to nearest plant drain without letting it go to the OWS facility. Two valves in catch pit will be provided. By opening one valve, water inside dyke area will be routed to Oil water separator pit and from other valve it will be channeled towards plant drain (rainy season).

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1.4.11 All valves in the system shall be manually operated except the tank inlet and outlet valves and Unloading pump discharge valves. Unloading pumps will start manually. However, pump tripping will be automatic on reaching high level of oil in the storage tank. Sump pumps in unloading pump house & HFO unloading area, drain oil pump & Oil recovery pump of OWS shall start manually on generating alarm for high level or if the level is visually found high. However, the pumps shall trip automatically on reaching low level in the tank / sump / pit as the case may be

2.0 INSTRUMENTATION & CONTROL

2.1 Operation and Control of Fuel Oil unloading and storage system will be from plant DCS (BHEL scope) as well as through local control panel provided in HFO unloading pump house.

2.2 Local control panel will act as an interface between DCS and the field devices for commands & feedbacks. LCP shall have the provision of command (start/stop), annunciation & feedback interface with the plant DCS. LCP will be under bidder's scope.

2.3 Instrumentation shall be as shown in Process & Instrumentation Diagram for HFO, LDO, and Steam & Condensate system given under this specification.

2.4 Following functions shall be done through DCS:

2.4.1 Filling any of the HFO/LDO storage tanks by ensuring proper and safe selection of these tanks. Simultaneous filling and emptying of same HFO storage tanks will be avoided. Signals from Limit switches at the inlet and outlet valves of storage tanks shall be used for this purpose.

2.4.2 Start the HFO/LDO unloading /decanting pumps **through DCS/LCP** for filling the tanks after ensuring safe start permissive. The safe start permissive shall comprise of:

- MCC healthy
- Selected storage tank level not HI (high).
- Pump suction header inlet pressure not LO (low).
- Unloading header is completely filled with oil (signal from LS)
- DP across pump suction strainer not HI (high).
- Valve at tank inlet is open

2.5 Stop the running unloading pump(s) **through DCS/LCP** in case of annunciation for Level HI in corresponding tanks.

2.6 Stop/Trip the running HFO / LDO unloading pump(s) automatically in case of following:

- Level HI-HI in corresponding tanks.
- Pressure Hi in pump discharge header
- DP across corresponding suction strainer is HI.

2.7 Start standby unloading pump **through DCS/LCP** only in case running pumps trips either due to any mechanical or electrical failure

2.8 Start the drain pump through DCS/LCP on receipt of level alarm-HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:

- MCC healthy
- Levels in DOT not low.
- Selected storage tank level for dumping of drained oil is not HI.

2.9 Stop the running drain oil pump automatically in case of annunciation for Level LO in drain oil tank.

2.10 Start standby drain oil pump **through DCS/LCP** only in case running pumps trips either due to any mechanical or electrical failure

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2.11

Start the sump pump in respective areas **through DCS/LCP** on receipt of level alarm HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:

➤

MCC healthy

2.12

Stop the running sump pump automatically in case of annunciation for Level LO in sump

2.13

Start standby sump pump **through DCS/LCP** only in case running pump trips either due to any mechanical or electrical failure.

2.14

Signals (annunciation & indication) from various switches / transmitters.

2.15

Running status (on/off) of all pumps.

2.16

Control of steam flow to floor coil heater and suction heater of HFO storage tanks through pneumatically operated control valve as indicated in respective flow diagram.

2.19

All signals from the field instruments will be first terminated on a field mounted

Junction box (JB) before transmitting the signals to DCS.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
5 X 800MW YADADRI TPS**

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SECTION: I-A

CUSTOMER SPECIFICATIONS

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & TRANSFERRING SYSTEM**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	GENERAL INFORMATION
2.00.00	CODES & STANDARDS
3.00.00	SHORT DESCRIPTION OF THE SYSTEM
4.00.00	SCOPE OR SUPPLY
5.00.00	SYSTEM DESIGN CRITERIA
6.00.00	DESIGN AND CONSTRUCTION
7.00.00	CONTROL & INSTRUMENTATION
8.00.00	INSPECTION AND TESTING
9.00.00	DRAWINGS, DATA AND MANUALS

ATTACHMENTS

ANNEXURE-I	HFO TANK HEATERS - DESIGN PARAMETERS
ANNEXURE-II	DATA SHEET FOR FUEL OIL UNLOADING & TRANSFER PUMPS

VOLUME : IIB/3

SECTION-III B

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING & TRANSFERRING SYSTEM**

1.00.00 GENERAL INFORMATION

1.01.00 The Fuel Oil Handling System shall include:

- a) Fuel Oil unloading and storage system meant for unloading of both Heavy Fuel Oil (HFO) and Light Diesel Oil (LDO)/ High Speed Diesel (HSD) from Rail Wagons and Storage of the same.
- b) Fuel oil pressurising system for both HFO and LDO/ HSD and heating of HFO meant for supply of oil at required atomising pressure and temperature from the storage tanks to the burners of the boiler.

1.02.00 For the design of the transferring and storage, the properties of HFO & LDO/ HSD shall be considered as indicated in Tables enclosed in Volume-IIA.

2.00.00 CODES AND STANDARDS

2.01.00 The design, manufacture and testing of the equipment or any item as specified in this section shall comply with the requirements of the latest revisions of one or more of the following standards as applicable :

2.01.01 IS-1593 : Code for Heavy fuel Oil (HFO)

2.02.00 IS-15770 : Code for Light Diesel Oil (LDO)

IS-1460 : Code for High Speed Diesel Oil (HSD)

2.03.00 IS-817 : Code of practice for training & testing of metal arc welders.

2.04.00 IS-823 : Code of procedure for manual metal arc welding of mild steel.

2.05.00 API- 620 : Recommended rules for design and construction of large welded low pressure storage tanks.

2.06.00 API- 650 : Welded steel tank for oil storage.

2.07.00 ASME Boiler & Pressure Vessel (B & PV) Code : Section VIII, Division I, Pressure Vessel.

2.08.00	ASME Boiler & Pressure Vessel (B & PV) Code : Section IX, Welding & Brazing qualification.		
2.09.00	API-12D	:	Large welded production tanks.
2.10.00	IS-803	:	Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
2.11.00	IS-816	:	Code of practice for use of metal arc welding for general construction in mild steel.
2.12.00	IS-4503	:	Code for design & manufacture of Heater
2.13.00	ANSI B31.1	:	Design of power piping system
2.14.00	API-600	:	Code for design & construction of gate valve for sizes 50 NB or above
2.15.00	API-602	:	Code for design & construction of gate valve for sizes below 50 NB
2.16.00	API-598	:	Code for testing of gate valve
2.17.00	BS-1873	:	Code for design & testing of globe valve
2.18.00	BS-1863	:	Code for design & testing of check valve
2.19.00	BS-5351	:	Code for design & testing of ball valve
2.20.00	API-599	:	Code for design & testing of plug valve
2.21.00	IS-8183	:	Specification for Bonded Mineral Wools Group 4
2.22.00	IS-9842	:	Specification for Preformed Fibrous Pipe Insulation, Group 3
2.23.00	IS-277	:	Specification for Galvanized Steel Sheet
2.24.00	IS-7413	:	Code of practice for the Application and Finishing of Thermal Insulating Materials at temperatures between 40°C and 700°C.
2.25.00	If the equipment supplied does not conform to the above codes and standards, but is manufactured to the Bidder's own standard developed from his experience, it shall be clearly identified in the Bid, with sufficient data to support his design. The design shall be accepted by the Owner/Consultants only if the Owner is satisfied that sufficient experience exists with the design proposed.		
2.26.00	In addition to the above requirements, all equipment and procedure shall comply with applicable laws regulations and requirements of the State and Central Authorities.		

3.00.00 **SHORT DESCRIPTION OF THE SYSTEM**

3.01.00 Oil both HFO and LDO shall be brought to plant site by Railway wagons.

3.02.00 Wagons shall be positioned by the side of the unloading manifold and unloading pumps shall be used for unloading of oil & storage of the same. Before unloading HFO, it shall be heated by steam, in the wagon, to make it flowable, if necessary.

No heating is envisaged for HFO rail tankers

50 nos. BTPN

Heating of rail tankers considering 76 nos. wagons to be provided for HFO. Adequate steam heating provision shall be kept for HFO tanker full rake heating to heat the HFO within specified time to avoid rake retention demurrage charge.

3.03.00 HFO shall be heated in the storage tank to maintain a suitable temperature by supplying steam through mat coil heaters. Tanks shall also be provided with suction heaters with steam as the heating source to heat the oil before sending it to heating and pressuring unit. No such heating is required for LDO.

3.04.00 Both HFO & LDO/ HSD shall be pumped from the storage tanks to day tanks by transfer pumps. HFO & LDO/ HSD transfer pumps along with strainers etc. will be located in the Fuel Oil Transfer Pump House adjacent to HFO and LDO/ HSD dyke area.

3.02.00 Suitable provision shall be provided for drainage of oil pumps, strainers, pipings, etc. There shall be a drain oil tank to receive the miscellaneous drains and wastes from the system, and this oil shall be returned to the HFO tanks by the help of drain oil pumps, provided the oil so collected is reasonably clean.

3.03.00 The HFO lines shall be steam traced. HFO pumps and strainers shall, however, be steam-jacketed type. Steam for tracing shall be arranged by the Bidder from auxiliary steam header.

3.04.00 Steam lines shall be provided with necessary control stations and traps as shown. Condensate drain from traps shall be disposed to the nearest station drain/pipe trench.

3.05.00 Suitable drainage shall be provided as required to get the approval of the Explosive Authority and Pollution Control Board.

3.06.00 ~~The scheme for Fuel Oil Handling is shown in Drawing No. 13A06-DWG-M-001T.~~

4.00.00 **SCOPE OF SUPPLY**

The scope of work under this section shall include the entire Fuel Oil transferring & storage system as detailed below, elsewhere in this section and in the tender drawing.

The list is by no means exhaustive and the items though not specifically mentioned but needed for safe, efficient, trouble-free and coordinated operation of the system shall be provided by the bidder under this section.

- 4.01.00 Unloading & Storage of HFO and LDO/ HSD
- 4.01.01 **As per scope of supply** HFO unloading and another similar LDO/ HSD unloading manifold complete with **As per scope of supply** stand pipes with isolation valves and caps, **As per P & ID** 80 mm NB flexible hoses of sufficient length and each provided with universal type coupling and matching pieces as required for connecting to Indian Railway Oil Tanker Wagons. Tapping points on the oil headers shall be suitably located.
- 4.01.02 **HFO and LDO pumps as mentioned in scope of supply shall be provided** (Steam jacketed in case of HFO only), rotary positive displacement type unloading pumps complete with flame/explosion proof electric drive motors and all other accessories as required or specified in enclosed Annexure shall be provided, -one (1) set for HFO system and another for LDO/ HSD system.
- 4.01.03 Simplex type heavy duty oil suction strainers (one for each pump) each of capacity equal to that of the pump with isolating valves, drain valves, vent valves with goose neck piping and other accessories.
- 4.01.04 **Two (2)** no. HFO storage tank of **4000 m³** capacity (minimum) complete with mat coil heater and suction heaters, each of capacity as per the guidelines explained in with accessories as specified in the Annexure enclosed and as required. **Two** no LDO/ HSD storage tank **1000 m³** capacity (minimum) along with necessary accessories as specified shall be provided.
- ~~4.02.00 **HFO Transferring System**~~
- ~~4.02.01 Two (2) (1 working + 1 standby) nos. positive displacement pumps with drives and other accessories as required and as specified in data sheets enclosed for transferring HFO from HFO storage tank to HFO day tank.~~
- ~~4.02.02 One (1) duplex heavy duty fuel oil pump suction strainer and one (1) duplex heavy duty fuel oil pump discharge strainer for pumps with isolating valves, drain valve and vent valve with pipe.~~
- ~~4.03.00 **LDO/ HSD Transferring System**~~
- ~~4.03.01 Two (2) nos. Light diesel oil (LDO)/ High Speed Diesel (HSD) pumps (1 working + 1 standby) with drives, base plates, support plates, grounding pads, lifting lugs, eye-bolts, anchor bolts & nuts and accessories for transferring LDO/ HSD from LDO storage LDO day tank.~~
- ~~4.03.02 One (1) duplex heavy duty LDO/ HSD pump suction strainer with isolating valves, drain valve and vent valve with piping.~~
- ~~4.04.00 One (1) no. HFO day tank of capacity suitable for one day consumption (minimum 500 m³) complete with mat coil heater and suction heaters, each of capacity as per the guidelines explained in with accessories as specified in the Annexure enclosed and as required. One (1) no. LDO/ HSD day tank of~~

- 4.05.00 **Tracing of HFO Pipe Lines**
- 4.05.01 For HFO pipelines complete steam tracing system and necessary equipment for tracing shall be provided.
- 4.05.02 For steam tracing necessary steam/condensate drain line, control stations and trap assembly as required shall be provided by the bidder.
- 4.06.00 One drain oil tank of adequate capacity (minimum 20 m³) for HFO & LDO/ HSD unloading and Transferring system with necessary heater (steam heated) shall be provided to receive the miscellaneous drains of HFO, LDO/ HSD system.
- 4.07.00 Two (2) nos. drain oil pumps shall be provided to recirculate oil from oil water drain oil tank to HFO tank.
- 4.08.00 Portable hand pumps of suitable design complete with discharge spout for removal of oil from the HFO day tank dyke area drain sumps.
- 4.09.00 **Pipe, Fittings, Specialties and Valves**
- 4.09.01 Pipes, fittings, specialties, traps, strainers, valves, supports/ hangers etc. as per the piping system design requirement for the system. For details, refer Cl. No. 4.05.00 of Sec. IIIA of Vol-IIB.
- 4.10.00 **Thermal Insulation**
- Refer Cl. No. 4.06.00 of Sec. IIIA of Vol-IIB.
- 4.11.00 All access platforms for various valves & all pipe cross-over platforms, as required for necessary approach and crossings.
- 4.12.00 Anchor Bolts, Sleeves, Inserts, Foundation Plates, Lifting Lugs, Eye Bolts etc. shall be supplied.
- 4.13.00 **Control & Instrumentation**
- 4.13.01 Volume- VI of this specification shall be referred for detailed Control & Instrumentation requirements.
- 5.00.00 **SYSTEM DESIGN CRITERIA**
- 5.01.00 Fuel oil system and its facilities shall be designed as per Pollution Control/Petroleum/Explosive/Fire rules of Govt. of India.
- 5.01.01 The unloading capacity shall be suitable to unload at a time a maximum of 50 nos. BTPN nos. wagons for each of HFO & LDO/ HSD system.
- 5.01.02 Buffer to buffer dimension of HFO & LDO/ HSD wagons is 12.42 M. Therefore, a net railway track length of minimum 625 metres paved with RCC shall be

provided for oil unloading and shall be used for unloading both HFO and LDO/ HSD.

- 5.01.03 ~~Unloading manifold (both HFO & LDO/ HSD) shall be suitable for connecting 76 nos. wagons. However, 80 nos. hoses shall be provided in the manifold.~~

Oil from wagons shall be unloaded to unloading manifold through flexible hoses.

For ease of maneuvering hose size of 80 NB is proposed.

- 5.01.04 ~~In case of HFO, tanker wagons shall be fitted with steam heating coils so that oil may be heated to reduce its viscosity. Steam from boiler is taken and after reducing its pressure to 6 Kg/cm²(g) is used for HFO wagon heating.~~

Steam header in unloading area to be sized for HFO unloading header tracing only.

- 5.01.05 When the unloading header and the piping at the individual pump suction is filled up with oil and steady oil supply is ensured, the unloading pumps shall be started.

- 5.01.06 ~~The capacity of each unloading pump shall not exceed 125 Cu.M/hr. Total number of pumps in each HFO & LDO system shall be so selected that they are capable of unloading 76 nos. of wagons (Max. Volume in each wagon for HFO & LDO are 23 Cu.M (excl. heating time) within 5 hours of operation (excluding heating time) at a rate of 125 Cu.M/hr. (maximum) each pump. Additionally, two (2) nos. pumps for each system shall also be installed for unloading oil from start of unloading and also during finishing so as avoiding malfunction of pumps due to air entrapment in the oil.~~

- 5.02.00 Oil Storage System

While assessing the HFO and LDO/ HSD storage volume, following aspects have to be taken into consideration with the assumption that fresh supply of oil wagons shall be available at site within a month of its requisition.

- 5.02.01 HFO Storage Capacity : 4000 CUM EFFECTIVE CAPACITY
(As per GA drawing attached)

~~One (1) HFO storage tank of adequate capacity to be provided to store oil from one full rake (each rake having 76 nos. of wagon each of capacity 23 Cu.M) and also to meet the sum total of the following additional requirements for a month:~~

- a) One boiler is under coal firing with oil support (oil burners at 10% BMCR) for about 8 hours a day

- b) One of the boilers is under operation with oil only at 30% BMCR for approximately 40 hours a month

Size of tank shall however, be not less than 2000 Cu.M.

5.02.02 LDO Storage Capacity : 1000 CUM EFFECTIVE CAPACITY
(AS PER GA DRAWING ATTACHED)

There shall be one (1) LDO storage tank of adequate capacity to meet one month's requirements for any one of the following events :

- a) Cold Start up of one boiler with all the LU burners operating at their maximum capacity at 10% BMCR for about six (6) hours per day.
- b) Steam Blowing Operation of any one of the boilers with all the LU burners operating at maximum capacity for about twelve (12) hours per day.
- c) TG rolling, Dry out Leading to Synchronisation of any one of the units with all the LU burners operating at maximum capacity round the clock. However, tank size shall not be less than 500 Cu.M.

5.03.00 HFO Transferring System

5.03.01 Transfer pumps :

- a) Design flow capacity, each : To be decided by Bidder
- b) Normal inlet temperature : 60 Deg.C within ± 5 Deg.C

5.04.00 HFO Day Tank Capacity : 500 Cu.M (minimum)

5.05.00 LDO/ HSD Transferring System

5.05.01 Transfer Pumps :

- a) Design flow capacity each : To be decided by Bidder
- b) Normal inlet temp : 8 - 45 Deg.C

5.05.02 LDO/ HSD Day Tank Capacity : 200 Cu.M (minimum)

5.06.00 Pipe, Fittings & Specialities

5.06.01 Determination of diameters of various pipes in the F.O. Handling system shall be done based on the velocity indicated in Annexure-III of Sec. IIIA of Vol-IIB and the flow rates established by the system designer/ bidder.

5.06.02 Thickness calculation of the pipes shall be done based on the allowable stress of the pipe material (material for various pipe lines indicated in Annexure-III of Sec. IIIA of Vol-IIB) at design temperature and the pressure determined by the system designer/bidder.

- 5.06.03 Piping system should withstand the maximum operating temperature and pressure. The forces & moments at terminal/equipment due to thermal expansion should be kept under permissible limit. Piping system shall meet other requirements of the relevant codes & standards.
- 5.06.04 All valves shall function smoothly without sticking rubbing vibrating etc. during operation.
- 5.06.05 Drain pipe size shall be 25mm NB as minimum.

6.00.00 **DESIGN & CONSTRUCTION**

6.01.00 **Pumps**

- 6.01.01 Refer Cl. No. 6.01.00 in Sec. IIIA of Vol-II B.

6.02.00 **HFO and LDO/ HSD Storage & ~~Day~~ Tanks (Steel Tanks)**

The tanks shall be constructed to IS-803 and API-650 as applicable. The oil tanks shall be vertical cylindrical type, installed outdoors; site fabricated and welded construction type with butt-welded bottom plate. Steel shall conform to IS-2062. Oil shall be stored at atmospheric pressure. The tank foundation shall be high enough to reduce idle storage volume of tanks. The fuel oil tanks shall be located adjacent to the fuel oil pressurizing pump house in a common dyke.

- 6.02.01 Since the tanks are for storage of inflammable liquids they shall be in accordance with the requirement specified in Indian Petroleum and Explosive rules. Before commencing the erection/construction, the relevant drawings/ documents shall be got approved by Directorate of Explosive, Govt. of India.
- 6.02.02 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature.
- 6.02.03 Vessel seams shall be so positioned that they do not pass through vessel connections. For cylindrical vessels consisting of more than two sections, longitudinal seams shall be offset.
- 6.02.04 Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer.
- 6.02.05 Proper means shall be provided against the chance of over-turning effect of wind on an empty vertical cylindrical tank having a shell height greater than the diameter. Anchorage of tanks shall be done when 'C', a dimensionless figure exceeds 0.66 where :

$$C = \frac{2M}{dw}, \quad \text{for vertical cylindrical tank}$$

where, M = Overturning moment due to wind, kilogram - metre.

d = Diameter of shell, metre

w = Weight of Shell and portion of roof supported by shell, kilograms.

6.02.06 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks. Data for wind load and earthquake shall be taken as indicated in Vol-IIA. Maximum allowable stresses for design loadings combined with wind or earthquake shall not exceed 133% of stress permitted for the design loading condition but in no case shall exceed 80% of specified minimum yield strength of the material.

6.02.07 For tanks of diameter 4.75 M and thickness less than 6 mm or of diameter larger than 4.75 M added structural supports in the form of rafters shall be provided.

6.02.08 Reinforcement pads in tank connections shall be provided as per applicable code & the reinforced connection shall be completely pre-assembled into a shell plate. The completed assembly including the connection shall be thermally stress-relieved as per API Standard 620.

6.02.09 The joint efficiency factor to be adopted for design calculation shall be in accordance with the applicable standard.

6.02.10 All welding shall be done as per IS:816, latest revision. All welds are to be continuous welds.

6.02.11 Sufficient air space is to be provided in the tank. Temperature expansion of oil shall be taken into account.

6.02.12 The supply and return pipes shall be extended well inside the tank and wear plates shall be provided.

6.02.13 **Tank Connections**

Tanks shall be provided with necessary connections like-oil inlet and outlet, steam inlet & condensate outlet (in case of HFO tank only), different drains, vents and return oil lines water draw off etc. as indicated in drawing

6.02.14 **Tank Accessories**

The tanks shall be provided with necessary accessories. All the accessories shall conform to relevant Indian Standard and as specified. The following broad guidelines are given for some of the accessories.

a) **Heating Coils/Floor Heater**

As specified, heating coils in one or more tiers shall be provided at the bottom of the HFO Storage tanks to maintain oil within the tank at specified temperature with steam as the heating medium.

The tubes shall be seamless steel as per indicated standard. Arrangement for supporting the coil within the tank shall be made. Connections for steam inlet and condensate outlet shall be provided.

The floor heater shall be installed inside the tank such that oil is uniformly heated without possibility of local overheating and over-straining the tank body. All connection flanges shall be outside the tank. The coils shall be guaranteed to be submerged under sufficient level of oil to avoid flashing of oil.

The Bidder shall furnish with his proposal the design calculations for arriving at steam consumption, coil heat transfer area etc. The Bidder shall also indicate the maximum time required to liquefy the stored material and bring it to the storing temperature under the extreme condition when the heating coil is turned on after prolonged shutdown with material stored in the tank, at the lowest ambient temperature.

Refer Annexure II.

b) Suction Heater

As specified, suction heater of duty conditions as indicated in Annexure shall be furnished on the outlet of HFO day tank.

The heater shall be shell and tube construction. Material of shell and tube shall be as specified Annexure. Heaters shall be designed as per TEMA or equivalent code.

The heater shall be mounted on the sidewall of the tank and properly supported. The design shall be such as to allow inspection and/or maintenance of the heater with the tank completely filled.

All heaters shall have oil in the shell side and steam in the tube side.

Refer Annexure II.

c) Steam Trap

Steam trap shall be provided for floor coil heaters and suction heaters at the condensate outlet lines.

d) Flame Arrestor

Each vent connection on tanks shall be provided with a flame arrestor design of which shall meet the approval of the Inspector of Explosives. The Bidder shall furnish the materials of construction and detail cross-sectional drawing along with his proposal.

e) Conservation Vent Valve

Where continuous venting to atmosphere directly is not permitted for the stored liquid, a conservation vent valve or a breather of approved make and design shall be provided on each of the vent/ overflow connections of the tanks as specified. The conservation vent valves where provided, shall be designed to relieve the pressure or vacuum corresponding to plus or minus 65mm water gauge in the space above

liquid in the tank. Detail cross-sectional drawing indicating materials of construction shall be submitted along with the proposal.

f) Instrumentations

Instrumentations as shown in P&I diagram shall be provided.

g) Level Transmitter

Each tank shall be provided with a radar type level transmitter to ensure safe and reliable operation.

h) Each tank shall be provided with spiral stairway with handrail and an internal vertical ladder.

i) Each tank shall have one roof manhole and one shell manhole of not less than 600mm diameter.

j) All other accessories, fittings and tank connections including level switches, etc. as required for sound engineering practice shall be provided.

6.02.15 Installation of HFO & LDO/ HSD Storage & Day Tanks

When installation of tank is specified, the recommendation regarding installation in IS:803 shall be followed in general. In addition to those recommendations, the following shall also be taken care of.

a) All fabricated part, before assembly, shall be transported by the Contractor by his own arrangement to the tank installation site. All preliminary work and fabrication in part or full shall be done at the Contractor's fabrication yard or shop as much as possible to suit his transportation arrangement subject to Purchaser's approval.

b) All material before final installation over the foundation at the respective locality shall be inspected and repaired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Owner. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates. Irregularities and dirt, which would prevent metal-to-metal contact at the jointing faces, shall be removed.

c) The sloping factor shall be taken as 1 : 36 for the Cylindrical tank head. Sufficient number of plugged holes shall be provided in the bottom plate of the vertical tanks for bottom testing as specified in IS:803.

d) Welding

Welding sequence shall be adopted in such a way so as to minimize the distortion due to weld shrinkage. Bidder shall indicate in his drawing the sequence of welding proposed by him which should meet prior approval of Purchaser.

- e) During construction period, the tanks and the sections shall be suitably anchored and tied by guy-wires etc. to avoid blowing/ toppling/Sliding due to gusty wind.

6.02.16 **Surface preparation and painting**

Primer for internal surface shall be double boiled Linseed oil and that for external shall be synthetic red lead. Finish coat for both internal and external surface shall be of synthetic enamel. For bottom surface protection, one coat of bituminastic paint shall be applied.

6.03.00 **Pipes, Fittings, Valves and Specialities**

6.03.01 Refer Cl. No. 6.02.00 of Sec. IIIA of Vol-II B.

7.00.00 **CONTROL & INSTRUMENTATION**

7.01.00 Volume-VI of this specification shall be referred for detailed Control & Instrumentation requirements.

8.00.00 **INSPECTION AND TESTING**

The manufacturer shall conduct all tests required to ensure that the equipment furnished shall conform to the requirements of this section of specification in compliance with requirements of applicable codes. In addition to the testing requirements spelt in Vol. IIA, for material, piping systems, pumps etc. the following tests are also to be done.

8.01.00 **Fuel Oil Pump Performance Test**

8.01.01 Each pump shall have to be tested to determine the performance curves of the pumps. These tests are to be conducted in presence of Purchaser/Consultant's representative as per the requirements of the Hydraulic Institute Standards.

8.01.02 Test shall be conducted with actual drive motors being furnished.

8.01.03 After installation, pumps offered may be subjected to testing at field also by Purchaser. If the performance at field is found not to meet the requirement, then the equipment shall be rectified by the supplier without any extra cost.

8.02.00 **Fuel Oil Storage & ~~Day~~ Tanks**

8.02.01 The supplier shall provide inspection to establish and maintain quality of workmanship to ensure the mechanical accuracy of components, compliance with drawings, identity and acceptability of all materials supplied by him.

8.02.02 Performance Tests

- a) Vertical Cylindrical Storage Tanks shall be tested generally as per IS:803 including the following :

- i) Spot radiography.
 - ii) Bottom plate testing by air or vacuum box.
 - iii) Shell testing by filling with water or by air as applicable.
 - iv) Fixed roof testing by air.
- b) For all tanks tests shall be conducted to prevent uneven settlement of tanks on the foundation by initially filling the tanks to one third of its capacity and leaving in this condition for a period to be decided by the Purchaser. After checking for settlement another one third of the tank shall be filled up and the procedure as above shall be followed till the tank is fully filled up. After testing, the water shall be suitably drained off in the nearest drain without flooding or endangering the surrounding areas/equipment.

8.03.00 **Valves**

Gate Valves shall be subjected to shop tests in accordance with API 598 including high-pressure closure test. Globe valve shall be tested in accordance with BS:1873 and Check valve shall be tested in accordance with BS:1868. Hydraulic test, fire safe etc. for ball valve shall be done as per relevant standard and code. For the items called for steam service IBR Certificate shall be furnished for the valves as well as the counter flanges.

8.04.00 **Piping System**

Hydraulic test of pipelines shall be conducted at site after erection, at 150% design pressure. Subsequent steam blowing shall be done before commissioning.

9.00.00 **DRAWINGS, DATA AND MANUALS**

9.01.00 Technical Information and Data to be submitted by the Bidder with the Proposal as indicated herein and elsewhere in this specification.

9.01.01 Single line schematic drawing of the entire system with all instrumentations showing sizes, capacities and rating of all equipment and accessories.

9.01.02 General layout of the entire Fuel Oil transferring system with emphasis on interconnection with existing facilities.

9.01.03 General arrangement drawings relevant Manufacturer's catalogues of HFO & LDO/ HSD storage & day tanks, pumps, strainers, different valves etc.

9.01.04 Calculations for capacity selection of HFO & LDO/ HSD pumps, tanks, mat coil and suction heaters of HFO storage & day tanks.

9.01.05 Characteristic curves of all pumps and motors.

- 9.02.00 Technical Data and Information to be submitted after award of Contract in addition to the requirements said in Vol.II-A
- 9.02.01 Final version of all schematic, layout, general arrangement and cross-sectional drawings and data enclosed with the proposal and as asked for against clause no.: 9.01.00 above.
- 9.02.02 Detail drawings of important units, assemblies, parts, etc. as deemed necessary.
- 9.02.03 Design calculations of pipe sizing, control valve sizing etc.

ANNEXURE-I

HFO TANK HEATERS - DESIGN PARAMETERS

1. FLOOR COIL HEATER IN HFO STORAGE & ~~DAY~~ TANKS

Design Data

- | | | | |
|------|--|---|---|
| a) | Heating medium at the inlet of control valve | : | Steam from Auxiliary steam pipe |
| b) | Capacity of the floor coil heater shall be determined for following conditions : | | |
| i) | Maximum capacity | : | To raise the temperature of full tank capacity of HFO oil from 5°C to 50°C in not more than 72 hours. |
| ii) | Normal capacity | : | To compensate heat loss from the unlagged tank completely filled with oil at 50°C. |
| iii) | Wind Speed | : | Refer Design data |
| iv) | Margin to be provided on calculated surface area of floor coil | : | 10 % |
| c) | Tube side design pressure (Kg./Sq.cm) & temperature (Deg.C) | : | Bidder to indicate Pressure, 250°C |
| d) | Material Heating element | : | Seamless steel tubes to ASTM, A 106, Group B or equivalent |

2. SUCTION HEATER IN HFO STORAGE & DAY TANKS

The heavy fuel oil day storage & day tanks shall be fitted with shell and tube type suction oil heaters for supplying oil at the pump suction. "U" type steel seamless tubes shall be used for the tube bundle.

The suction heaters shall be designed to the following parameters :

- | | | | |
|----|---------------------------------------|---|---------------------------------|
| a) | Oil flow rate for each suction heater | : | Shall be to two pump capacity |
| b) | Heating medium | : | Steam from Auxiliary Steam Pipe |

- c) Initial temperature of oil : $50 \pm 5^{\circ}\text{C}$
- d) Final temperature of oil : $60 \pm 5^{\circ}\text{C}$
- e) Maximum range of temperature rise : 20°C
- f) For establishing the area required for heat transfer, a fouling resistance of :

$$0.005 \frac{(\text{hr.}) (\text{Deg.F}) (\text{Sq.ft})}{\text{BTU}}$$

shall be assumed on the outside surface of heater tubes.

- g) Following material of construction shall be used :

- i) Shell : MS Plate to IS:2062
- ii) Shell head and tube sheets : Steel plates of IS-2002 Grade 2A
- iii) Heating elements : Seamless steel tubes to ASTM, A-106, Group-B or equivalent
- iv) Nozzles : Seamless steel tubes

A. SUCTION HEATER#1
DESIGN OIL FLOW: 145 CUM/HR

B SUCTION HEATER#2
DESIGN OIL FLOW: 217 CUM/HR

ANNEXURE-III

DATA SHEET FOR FUEL OIL UNLOADING PUMPS

Sl. No.	Description	Pumps	
		HFO Unloading Pump	LDO/ HSD Unloading Pump
1.0	Service	Fuel Oil	Fuel Oil
2.0	Duty	Intermittent	Intermittent
3.0	Location	Indoor	Indoor
4.0	No. of Pumps	FIVE(5) + Two (2)	THREE (3) + Two (2)
	- Working - Standby		
5.0	Type of Oil to be Handled	Heavy Fuel Oil VISCOSITY: 50-500 CST	LDO/ HSD VISCOSITY: 2-50 CST
6.0	Characteristics of Oil	Refer Vol-IIA	Refer Vol-IIA
7.0	Site Working Condition	Refer Vol-IIA	Refer Vol-IIA
8.0	Handling temperature	50°C	7°C to 50°C
9.0	Installation	Horizontal with external bearing	Horizontal with external bearing
10.0	Type	Rotary positive Displacement type	Rotary positive Displacement type
11.0	- Design Capacity at lowest viscosity - Rated capacity at handling temperature (minimum)	Bidder to indicate 150 CUM/HR- 5 NOS 25 M ³ /Hr. - 2 nos.	Bidder to indicate 50 CUM/HR- 3 NOS 25 M ³ /Hr. - 2 nos.
12.0	- Differential Pressure corresponding to rated capacity - Pump rated TDH	Bidder to indicate Bidder to indicate	Bidder to indicate Bidder to indicate
13.0	Pump Speed (rpm max.)	1500	1500
14.0	Suction Condition	Flooded	Flooded
15.0	Accessories to be provided		

Sl. No.	Description	Pumps	
		HFO Unloading Pump	LDO/ HSD Unloading Pump
15.1	Relief valves Type	Yes Inbuilt adjustable set pressure type	Yes Inbuilt adjustable set pressure type
	Value of set pressure of relief valve	1.1 times of rated differential pressure	1.1 times of rated differential pressure
15.2	Mechanical Seal	Yes	Yes
15.3	Lubrication	External lubricated grease	External lubricated grease
15.4	Body steam jacketed	Yes	No
15.5	Timing gear	Yes	Yes
15.6	Suction & discharge pressure gauge connection	Yes	Yes
15.7	Suction temperature gauge connection	Yes	Yes
15.8	Other accessories if required for cooling/ sealing/lubrication etc.	Yes	Yes
15.9	Bearing	Yes	Yes
15.10	Base plate	Yes	Yes
15.11	Lifting lug/eye bolts etc.	Yes	Yes
15.12	Tools & tackle and spare parts	Yes	Yes
15.13	Shop Painting	Yes	Yes
16.0	Material of Construction		
16.1	Casing	Cast iron	Cast iron
16.2	Casing liner	Cast iron	Cast iron
16.3	Rotor	ASTM-A-276 type 431	ASTM-A-276 type 431

Sl. No.	Description	Pumps	
		HFO Unloading Pump	LDO/ HSD Unloading Pump
16.4	Rotor housing	Mild steel	Mild steel
16.5	Shaft	EN 8	EN 8
16.6	Mechanical seal	MANUFACTURER STD	MANUFACTURER STD
16.7	Reduction gear		
	• Body	Cast iron	Cast iron
	• Gears	EN-8	EN-8
16.8	Coupling	Cast iron	Cast iron
16.9	Base plate	Mild steel	Mild steel
16.10	Relief valve body	INTEGRAL TO PUMP	INTEGRAL TO PUMP
16.11	Relief valve spring	SS	SS
16.12	Gasket	Graphite asbestos	Graphite asbestos
16.13	All fasteners	SS-304	SS-304

NOTE : All material shall conform to relevant ASTM Standard.

HYDROTEST PRESSURE: 1.5 TIMES DISCHARGE PRESSURE
DURATION: 30 MINUTES

ANNEXURE-III

PIPES, FITTINGS & VALVES : DESIGN PARAMETERS

1. For pipe sizing velocity of fluid in various pipe lines shall be considered as follows unless otherwise stated in the specification :

a) Fuel Oil Pipe	Pipe Size (mm)	Velocity (M/Sec)	
		HFO	LDO/ HSD
Pump Suctions	250 & above	0.4	0.9
	200	0.35	0.7
	150	0.30	0.6
	100	0.30	0.5
	80	0.30	0.5
	50 & below	0.28	0.4
Pump Discharge	250 & above	1.3	2.0
	200	1.1	1.7
	150	1.1	1.5
	100	1.00	1.3
	80	1.00	1.3
	50 & below	1.08	1.0
b) Steam Pipe	Below 50	15-22} For	20-30 } For Super
	50 - 150	20-33} Satu- } rated } steam	25-40 } heated } steam
c) Condensate pipe	For all sizes	2.0	
d) Compressed air pipe	For all sizes	30	

2. While calculating pressure drop, the effect of deposition of sediment in piping shall be taken into consideration.

3. Tracer Size : Bidder to indicate

4. Material of Construction

a) Fuel Oil Pipe Lines

Pipe	:	API 5 L Gr. B or ASTM 106 Gr. B Butt welded ends of pipe sizes 65 mm NB and above as per ANSI B 16.25 and socket welded ends for lower sizes as per ANSI B 16.11.
Pipe Fittings	:	ASTM A 234 Gr. WPB for 65 mm NB size and above ASTM A 105 for 50 mm NB size and lower. Butt welded ends as per ANSI B 16.9 for all sizes.

- b) Steam/Condensate Pipe : Refer Section-I of Vol-II-D.
- c) Compressed air line : Refer Section-III, Vol-II-D.
- d) Hoses
- Oil Lines : As per BS-1435 or equivalent, wire reinforced, type-S smooth bore along with quick acting coupling fitting standard Indian Railway Tanker Wagons.
- Steam/Condensate Lines : Refer Section I, Vol.II-D
- e) Gate Valve
- Gate valve shall be in accordance with API-600 for sizes 50 mm NB or above and shall be as per API-602 for sizes below 50 mm NB.
- Body and Bonnet : ASTM A-216 Gr.WCB for sizes above 50 mm NB
- : ASTM A-181 Gr. II for size 50 mm NB and below
- Seat/Trim : 11-13% Chrome steel
- Bolts for bonnets : ASTM A-193 Gr. B7
- Nuts for bonnet : ASTM A-194 Gr. 2H
- f) Globe Valve
- Globe valve shall be in accordance with BS-1873.
- Body & Bonnet : ASTM A-216 Gr. WCB for sizes above 50 mm
- : ASTM A-181 Gr.II for sizes 50 mm and below
- Bolts for bonnets : ASTM A-193 Gr.B7
- Nuts for bonnets : ASTM A-194 Gr. 2H
- Trim : Chromium Steel (Br. hardness B 250 min.) as per AISI-431
- g) Check Valves
- Check valve shall be in accordance with BS-1868. Material for body cover, bolts and nuts for bonnets shall be same as that of globe valve. The seating surface of swing check valve shall be Chromium steel (Br. hardness B-250 min) as per AISI-431.

h) Ball Valves

Ball valves shall be as per BS:5351 or approved equivalent.

Ball valve shall be teflon seated full bore. All the valves shall be of fire safe type.

Body material : ASTM A-216 Gr. WCB for sizes 65 NB and above and
ASTM A 181 Gr.II for 50 NB and below

Ball : SS, AISI-316

i) Plug valve shall conform to API-599.

Plug valve shall be of self-lubricated wrench operated. It shall also incorporate an easy visible port position indicator.

Body : ASTM A-216 WCB for sizes 65 NB and above.
ASTM A-181 Gr.II for sizes 50 NB & below.

Plug : Hardened Carbon Steel

5. Tolerances

Dimension and tolerance for fabrication shall be as given below :

- | | | | |
|----|--|---|---|
| a) | Internal Misalignment | : | 1.5 mm or less |
| b) | External Misalignment | : | 3.0 mm or less |
| c) | Length | : | ± 3 mm |
| d) | Inclination of flange face
(i.e. angle between pipe axis :
and flange face) | : | ± 1/2 Deg. (but not exceed
2 mm at flange end) |
| e) | Perpendicularity | : | 2 mm in 1000 mm |
| f) | Horizontality | : | 2 mm in 1000 mm |
| g) | Misalignment between pipe
Center and flange Center | : | ± 1.6 mm |
| h) | Rotation of flange | : | ± 1.0 mm |
| i) | Depression depth of pipe | : | 6.0 mm |
| j) | Tolerances for piping which
connects with machinery like
pumps etc. shall have accor-
dance with the requirements
of that machine. | | |

VOLUME : IID

SECTION-II

THERMAL INSULATION

1.00.00 GENERAL INFORMATION

This section of specification covers thermal insulation, cladding sheet and other auxiliary materials required for thermal insulation on piping and equipment.

1.01.01 The thermal insulation shall be applied on the outer surface of equipment, piping, valves, fittings, having skin temperature more than 60°C, to conserve the thermal energy and also to maintain the outside surface temperature of the insulation below or at 60°C.

1.01.02 Insulation thickness shall be computed on the basis of the following data :

- a) Design ambient temperature: 45 Deg.C
- b) Surface temperature of insulation jacket: 60 Deg.C. (max.)
- c) Emissivity of Aluminium sheet: 0.2
- d) Thermal conductivity of insulating material at different temperatures shall be as stipulated in IS:9842 & IS:8183 as applicable.
- e) Surface Wind velocity = 0.25 metre/sec.
- f) Pipe/Equipment wall temperature =Maximum fluid design temperature
- g) Overall heat transfer coefficient and insulation thickness shall be calculated as per ASTM C 680-89.

The minimum insulation thickness, however, shall not be less than 75 mm for Steam Generator, Turbine Generator surfaces and Electrostatic Precipitator surfaces and 25 mm for other surfaces.

1.01.03 Necessary hydrostatic pressure testing of piping, equipment shall be completed prior to the application of insulation.

1.01.04 All permanent and temporary covering necessary to protect insulation from the weather, shall be supplied and included in Bidder's scope.

1.01.05 Insulation shall not be applied over nameplates of equipment. A neat opening shall be left in the insulation and jacketting around nameplates and the opening suitably flushed to prevent the entrance of moisture.

CODES AND STANDARDS

In addition to the requirements spelt out in Vol-IIA, all items covered under this section of specification shall conform to the latest edition of the following codes and standards :

1. IS-8183 : Specification for bonded mineral wool.
2. IS-3144 : Methods of test for mineral wool thermal insulation materials.
3. IS-3346 : Methods for the determination of thermal conductivity of thermal insulation materials (two slab, guarded hot plate method).
4. IS-280 : Mild Steel wire for general engineering purposes
5. IS-6528 : Stainless Steel wire.
6. IS-3150 : Specification for hexagonal wire netting for general purposes.
7. IS-4826 : Hot-dipped galvanised coatings on round steel wires.
8. IS-737 : Specification for sheet and strip of wrought Aluminium and Aluminium Alloys (for General Engineering purposes)
9. IS-460 : Specification for test sieves.
10. IS-3677 : Specification for unbonded rock & slag wool for thermal insulation.
11. IS-9842 : Specification for Preformed Fibrous Pipe Insulation.
12. IS-5688 : Specification for Methods of test for preformed block-type and pipe covering type thermal insulation.
13. IS-14164 : Code of practice for the Industrial Application and Finishing of Thermal insulation material at temperatures above -80°C and up to 750°C.
14. ASTM B206 : Standard specification for Aluminum and Aluminum alloy sheet and plate.

3.00.00 **SCOPE OF SUPPLY**

The following materials in required quantities shall be supplied under this section:

- 3.01.00 Thermal insulating Materials - preformed bonded mineral wool sections, bonded mineral wool mattresses, loose mineral wool and lightly resin bonded glass wool shall be provided.
- 3.02.00 Hexagonal wire netting of galvanised steel/stainless steel in the form of rolls.
- 3.03.00 Binding wires, stitching wires and lacing wires of galvanised steel/stainless steel in the form of coils.
- 3.04.00 Mild steel flats, lugs etc.
- 3.05.00 Joint sealing compound of self-setting paste type for making cladding joints vapour tight.
- 3.06.00 Cladding sheets
- 3.07.00 Cadmium/zinc coated self-tapping type screws with washers for cladding sheet joints.
- 3.08.00 Heat resistant paints conforming to IS-161.
- 3.09.00 All other materials i.e. bolts, nuts, rivets, 3 mm thick mill board, aluminum pigment sealant, white glass cloth, insulating cement, neoprene washer etc.

4.00.00 **MATERIAL SPECIFICATIONS**

- 4.01.00 The insulating materials to be supplied under this specification shall be lightly resin bonded mineral wool of best grade conforming to IS:8183. Hand made mattresses is not acceptable. Material shall be rock wool only. Slag wool or slag wool inclusion shall not be accepted.
- 4.02.00 Lightly resin bonded glass wool mattress, having density 100 Kg/m³ (min.), self stitched in shop can also be accepted for temperature less than 400°C and 150 kg/m³ for above 400° C.
- 4.03.00 The bonded mineral wool shall be secured by means of galvanised steel wire (as per IS:280 or equivalent) of at least 24 SWG in the form of hexagonal netting of 10 mm to 13 mm aperture.
- 4.04.00 The Mineral wool shall :
 - a) Pass standard combustibility test both immediately after application and after subjected to maximum operating temperature for not less than 100 hrs.

- b) Not suffer permanent deterioration as a result of contact with moisture due to condensation and shall be free from objectionable odor.
- c) Not cause corrosion of the surface being insulated or of cladding on it under normal site conditions.
- d) Not suffer any quality deterioration under specified service conditions (both cold/hot face temp.) of use.

4.05.00 The mattress insulation shall be machine made, stitched at factory and should retain their form under ordinary handling conditions.

4.06.00 The Insulation mattress shall be rated incombustible when tested by the method prescribed in clause 15 of IS:3144 and shall meet the requirement of the Mercantile Marine department, Lloyd's Register of shipping, underwriter, fire hazards codes and other International standards.

4.07.00 Insulation mattress/section shall be supplied in thickness of 25, 40, 50 and 75 mm. Insulation of higher thickness shall be made up in multiple layers using mattress/slabs of thickness specified above. However, if the required thickness is such that by using above mattress/slabs the calculated thickness is not achieved, the mattress/slabs in increment of 5 mm shall be acceptable for outer layers. The min. thickness however, shall not be less than 25 mm and number of layers shall be minimum and innermost layer shall be thickest.

4.08.00 Binding and lacing wires shall be provided in line with following :

Temperature Range	Material	Thickness of wire
(a) Upto 400°C	Galvanised Steel	20 SWG
(b) Above 400°C	Stainless Steel	20 SWG

4.09.00 Sheathing material for all insulated surfaces, equipments, piping etc. confirming to ASTM B-209-1060 temper H-14 or IS:737 Gr 19000/H2, shall be provided as per following :

Bonded Mattress	With Lightly	With Preformed pipe sections
(a) For dia of insulated surfaces of 450 mm & above and for flat surfaces	1.219mm (18 SWG)	-
(b) For dia of insulated surfaces 150 mm and above upto 450 mm	0.914 mm (20 SWG)	0.914 mm (20 SWG)
(c) For dia of insulated surfaces 150 mm and below.	0.71 mm (22 SWG)	-
(c) For Steam Generator	16 SWG corrugated	-

and ESP outer casing Aluminium for SG
and plain for ESP

4.10.00 Straps and bands shall conform to materials as under :

Temperature Range	Material
a) Upto 400°C	Galvanized Steel
b) Above 400°C	Stainless Steel

Bands shall be 20 mm wide and 0.6 mm thick. For securing Aluminum sheathing material, stainless steel or anodized aluminum bends shall be used.

4.11.00 Screws shall be of galvanized steel, check headed, self-tapping type. Above 400 degree Celsius temperature, screws shall be stainless steel.

4.12.00 Hexagonal wire mesh shall be conforming to following:

Temperature Range	Material	Mesh size
(a) Upto 400°C	Galvanized Steel	10-13 mm aperture 0.71 mm diameter
(b) Above 400°C	Stainless Steel	-do-

4.13.00 All other materials, e.g. insulation supports, expansion joints, washers, etc. shall be of standard design of the contractor duly approved by the Purchaser and/or Consultant.

4.14.00 Insulating material shall be suitable for the pipe/equipment. For bonded mineral wool insulation, the bonding substance shall retain its binding property upto 600°C.

4.15.00 The insulating material whether dry or wet shall:

- a) Be fresh, incombustible, rust proof, non hygroscopic and free from asbestos.
- b) Be capable of withstanding continuously and without deterioration the maximum temperature to which they will be subjected.
- c) Not react chemically, either to itself or with other components.
- d) Not sustain any fungi, or vermin and must not pose health hazards.

5.00.00 **THERMAL INSULATION APPLICATION PROCEDURE**

Contractor shall apply thermal insulation at site. Based on Contractor's proven practice and latest design, he will follow his own recommended

thermal insulation application procedure. However, the details of method of application and finishing inclusive of all details of insulating materials and supporting arrangements shall be furnished for approval of Owner and/or Consultant.

5.01.00 General

5.01.01 All surfaces to be insulated shall be cleaned of all foreign materials such as dirt, grease, rust etc. and shall be dry before the application of insulation.

5.01.02 The insulation material shall be chemically inert, non-combustible and shall be harmless.

5.01.03 Before applying the insulation the contractor shall check that all instrument tapping, clamps, lugs and other connections on the surface to be insulated have been properly installed as per the relevant erection drawing.

5.01.04 The insulation shall be applied to all surfaces when they are at ambient temp. Ample provision shall be made for the maximum possible thermal movement and the insulation shall be applied so as to avoid breaking/telescoping due to alternate periods of expansion and contraction.

5.01.05 All cracks voids and depressions shall be filled with finishing cement, suitable for the equipment operating temp. so as to form a smooth base for the application of cladding.

5.02.00 Piping

5.02.01 Pipe insulation shall be so arranged as to allow for expansion of pipe. Insulation expansion joints shall be provided on all pipelines to allow movements and expansion of the pipe without producing random cracking of the insulation. The recommended intervals of expansion joints are:

Pipe Temperature	Spacing of Insulation Expansion Joint
Upto 200°C	5.5 M
201 - 300°C	3.5 M
301 - 400°C	3.0 M
Above 400°C	2.0 M

Before application of any insulating material, it is important to ensure that the surface to be insulated is dry and free from rust, dirt and grease and extraneous matter.

5.02.02 The mattress type insulation shall be formed to fit the pipe and applied with the mattress edges drawn together at the longitudinal joints and secured by lacing wire. Pipe section insulation shall be fitted on pipe using binding wires (tie wires).

5.02.03 Longitudinal joints of insulation mattress sections of horizontal piping shall be on the bottom or at the sides of the pipe.

- 5.02.04 Where insulation is applied in two or more layers, each layer of mattress shall be backed with hexagonal wire mesh. For the first layer of insulation and in case of single layer insulation, hexagonal wire mesh shall be provided on both the surface of the mattress. For pipe sections, the sections shall be held in place by binding wires without any wire mesh.
- 5.02.05 The insulation shall be secured to pipes by means of circumferential tie wires of 1.6 mm to 1.0 mm (16 to 19 SWG) for insulation surface with diameter up to and including 550 mm and with metal bends for insulation surfaces with diameter over 550 mm. The fastening shall be done at intervals of 250 mm except where specified otherwise. The ends of the tie wires shall be hooked and embedded in the insulation. The straps shall be mechanically stretched and fastened with metallic clamping seals of the same materials as the strap.
- 5.02.06 The ends of all wire loops shall be firmly twisted together with pliers, bent over and carefully pressed into the surface of the insulation. Any gap in the insulation shall be filled with loose mineral wool or finishing cement.
- 5.02.07 For multiple layer of insulation, the multiple layers shall be applied so that the circumferential joints on adjacent layers are staggered by at least 150 mm and longitudinal joints by at least 50 mm. At the joint of each layer of insulation, suitable packing material shall be firmly applied where necessary.
- 5.02.08 Insulation mattress/section ends shall be terminated at a sufficient distance from the flanges to facilitate removal of bolts.
- 5.02.09 The final layer of insulation shall be backed up by galvanised wire netting stitched with G.I. wire and this shall be anchored to the securing attachments by means of wire ties.
- 5.02.10 Preformed insulation on vertical or near vertical piping with a difference of elevation of 4 meters or above, must be supported in position by means of metal rings, part rings or studs at intervals not greater than 3.0 m and also immediately above each expansion break in the insulation. The support attachment may be welded or clamped to the pipe subject to approval of the Owner.
- 5.02.11 The mat insulation for vertical and near vertical piping shall also be suspended from above, and for this purpose securing attachments must be used which may be of metal rings or studs. The confining wire netting of the mattress shall be anchored to the securing attachments by means of wire ties.
- 5.02.12 Piping bends shall be insulated in the same way as the adjacent straight piping. Where preformed material is used, it should be cut lobster-back fashion and wired and strapped into position.
- 5.02.13 Insulation for application on bends and elbows shall be cut into mitred segments, sufficiently short to form a reasonably smooth internal surface. After the application of insulation material, insulating cement shall be applied as required to obtain a smooth surface.

- 5.02.14 Protrusions through insulations, which themselves do not require insulations, such as pipe clamps, supports of small pipings (except hanger rods), instrument take-offs, etc., shall be covered to the same thickness as the adjacent insulation.
- At outdoor locations and where necessary, the hanger rod protrusions shall be suitably shielded with metal flashing to deflect rain and protect the insulation from moisture while permitting the movement of the hanger rod.
- 5.02.15 All insulation shall be protected by means of an outer covering of aluminum sheathing. All insulation/cladding joints shall be sealed and made effectively weather and waterproof. All flat surfaces shall be given suitable slope to prevent collection of pools of water on the cladding surface. All sheathing shall be protected internally by the application of two coats of bitumastic paint.
- 5.02.16 Aluminium sheet jacketting on piping shall be screwed with self- tapping screws on longitudinal joints only. In case of insulating horizontal pipes, these joints shall be arranged approximately 30 Deg. below horizontal centre line to avoid water ingress. The sheets shall be overlapping by 50 mm on both longitudinal and circumferential joints.
- 5.02.17 Arrangement for securing the metal finish over the insulation shall ensure that direct metal contact between the insulating surface and outer metal cladding is reduced to minimum. All joints shall be vapour tight and shall be able to accommodate thermal movements.
- 5.02.18 All openings and joints in outdoor cladding for piping connections, supports of access shall be suitably flashed and weatherproofed. Where such flushing or weather-proofing cannot effectively control the entry of moisture, then such openings and joints shall be weather-proofed by application of aluminum pigmented sealer.
- 5.02.19 For bends, fittings etc. the cladding shall be provided in segments as to ensure a smooth finish of the cladding.
- 5.02.20 For cladding on vertical pipes/equipment, provision for load take up shall be made at every 2 to 4 meters along pipe/equipment axis.
- 5.02.21 Galvanic corrosion shall be prevented by carefully avoiding permanent contact of aluminum cladding with copper, copper alloys, tin, lead, nickel or nickel alloys including monel metal.
- 5.02.22 All joints shall be sealed with acrylic emulsion weather barrier.
- 5.02.23 Weather hoods shall be provided for insulated piping passing through floors/walls.
- 5.02.24 Upstream of all drain lines and the lines connected to steam traps, shall be insulated up to and including first isolating valve for heat conservation. Rest of such lines such as downstream of the drain valves, traps etc. and other lines such as safety valve discharges; vents, etc. shall be insulated for personnel protection.

5.03.00 Valves and Flanges

- 5.03.01 All valves fittings and specialties shall be insulated with the same type and thickness of insulation as specified for the connected piping with the special provisions and or exceptions as given below.
- 5.03.02 All valves and flanges shall be provided with removable box type of insulation covered with box fabricated from aluminum sheets of thickness same as the connected pipe cladding. Adjoining pipe insulation shall be bevelled back to permit removal bolts and nuts or bands. The portion of the valve, which cannot be covered by box type insulation, shall be filled by loose insulating material of packing density at least equal to that of the insulating material of adjoining pipe. The insulation for valves/flanges shall be applied after the finishing has been applied over the connected piping. The cladding shall be applied in such a manner that the bonnet flange can be exposed easily without disturbing the complete insulation and cladding.
- 5.03.03 Removable box type cladding for valves and flanges shall be fitted on the connected pipe cladding, with bands.
- 5.03.04 Flanges on lines having temperature up to and including 150°C shall not be insulated.
- 5.03.05 Union shall not be insulated.
- 5.03.06 Expansion joints, metallic or rubber, shall not be insulated unless otherwise specifically indicated.
- 5.03.07 Safety valves shall be insulated.
- 5.03.08 All flanged joints shall be insulated only after the final tightening and testing.

5.04.00 Equipment

- 5.04.01 Equipment insulation supports shall be welded to the vessel to support vertical insulation. The material of the supports shall be similar to the vessel, as far as practicable. The supports shall be uniformly pitched at 500 mm (approx.). A support shall be located above each vessel flange at a sufficient distance above the flange bolts to allow for easy removal. The top and bottom supports shall be slotted suitably for attachment of straps or wire.
- 5.04.02 Dished ends of the related equipment shall be insulated by welding studs or cleats to the surface at approximately 300 mm intervals. Insulation application procedure shall be otherwise similar to that for piping.
- 5.04.03 All longitudinal joints shall have a minimum overlap of 50 mm and shall be located at 45° or more below the horizontal for horizontal equipment. Joints shall be made with cheese headed self tapping galvanized steel screws at 150 mm centers.

- 5.04.04 All circumferential joints shall have a minimum overlap of 100 mm and shall be held in position by stainless steel or anodized aluminum bands, stretched and clamped.
- 5.04.05 Insulation to various areas shall be applied as under:
- | Insulation Area | Form of Insulation |
|--|--|
| a) SG and ESP surfaces, hot air and gas ducts | Mineral wool block or Mineral wool blankets. |
| b) All other surfaces (not enclosed as per (a) by boiler casing) | Calcium silicate block or above. |
- 5.04.06 For the Steam Generator furnace, if provided with skin casing and the super heater, reheater and economiser casings where water cooled walls are involved, a first covering of refractory material shall be applied to the external tube surfaces before the application of any further heat resistant insulating material.
- 5.04.07 The access doors and inspection doors in the Boiler and ESP shall be lined with refractory material. The access doors in other portions of the Steam Generator and ESP shall be insulated in a similar manner corresponding to any casing, flue-ducts or air, ducts where such openings and access doors occur.
- 5.04.08 While applying mineral wool blanket insulation :
- a) Expanded metal or hexagonal wire mesh shall be provided on both sides for single layer mattress and on first layer in case of multilayer insulation. Subsequent layers of multilayer insulation shall have only one side wire netting.
 - b) The edges of adjacent blankets shall be leased together, by appropriate lacing wire.
 - c) Any gap between joints between insulation layers shall be filled by loose mineral wool confirming to IS:3677.
 - d) All insulation shall be secured by 1.63 mm diameter wire netting over blankets with ends of wire tightly twisted, and pressed in to insulation surface.
 - (e) Impelling pins shall be placed on centers not exceeding 300 mm.
- 5.04.09 Aluminum cladding shall not come directly into contact with either the equipment surface or with the supporting arrangement on the equipment surface. To this end, adequate layers of 3 mm thick ceramic board shall be provided between the cladding and any supporting arrangement or equipment surface, and fitted with self tapping screws/metal bands, as applicable.

- 5.04.10 Weatherproof flushing shall be installed where the panels intersect with columns and at other similar joints.
- 5.04.11 Removable insulated covers shall be provided over the Separator manholes.
- 5.04.12 Cladding on top surface of Steam Generator and ductwork and equipments shall be suitably reinforced to prevent damage by personnel walking thereon.
- 5.04.13 All cladding for outdoor application shall be with neoprene washers.
- 5.04.14 Cladding shall have sufficient strength to withstand forces generated in boiler, without any rupture or damage.
- 5.04.15 Air & Flue Gas ducts with external stiffeners shall have first layer of insulation between the stiffeners and a second layer of insulation over stiffeners so that stiffeners are also insulated and a level surface is achieved.

6.00.00 **INSPECTION AND TESTING**

6.01.00 The Contractor shall furnish test certificates from any one of the independent authorities listed below or any other reputed body subject to Purchaser/Consultant's prior approval for all the tests as mentioned later.

- a) National Test House - Calcutta/Bombay
- b) Central Glass & Ceramic Research Institute, Calcutta
- c) National Metallurgical Laboratory, Jamshedpur
- d) Central Mechanical Engineering Research Institute, Durgapur
- e) National Physical Laboratory, Delhi
- f) Central Building Research Institute, Roorke, U.P.
- g) Any other Internationally reputed Test House.

6.02.00 The Contractor shall carry out all the tests according to IS:8183/3144 or according to any other internationally accepted standards. The tests shall be done on representative samples drawn from the insulating material supplied under this section of specification. All the tests mentioned in IS:3144 shall be carried out for establishing various chemical and physical properties (as mentioned below) in accordance with the procedure laid down therein. Owner shall have the right to witness any or all of the tests conducted by the contractor at the shop or laboratory.

Following shall be met by testing as per relevant clauses of IS:3144.

- | | | |
|----|--------------|--|
| a) | Shot content | 5% by weight (maxm.), size of any shot not to exceed 5 mm diameter |
| b) | Bulk density | 100 Kg/m ³ (For use upto 400°C) |

150 Kg/m³ (For use above 400°C)

- | | | |
|----|---|---|
| c) | Weight gain by moisture absorption | 2% (max.) |
| d) | Sulphur Content | Not exceeding 0.6% |
| e) | Alkalinity as percentage of Na ₂ O | Not exceeding 0.6% |
| f) | Maximum oil content | Not exceeding 0.3% by weight |
| g) | Total carbon content | Not exceeding 0.3% by weight |
| h) | Settlement | Nil (When tested as per Cl. 21.1 & 21.2 of IS:3144) |
| i) | Handability | Fully handable, without any lump formation and disintegration of material |
| k) | Loss of weight after | Not exceeding 5% by weight combustibility test |

6.03.00 The Bidder shall furnish the following test reports along with the offer:

- a) Thermal conductivity of the insulating material at various mean temperature.
- b) Retention of binder at elevated temperature
- c) All other tests as per IS:9842/8183.

6.04.00 The Contractor shall guarantee that if, on actual measurement, the specified maximum insulation surface temperatures are exceeded, the contractor shall either replace the insulation with a superior material or provide additional insulation thickness at no extra cost.

7.00.00 **DRAWINGS, DATA AND INFORMATION TO BE FURNISHED**

7.01.00 The certificates/reports for various properties of thermal insulation materials offered.

7.02.00 Manufacturer's descriptive literature and illustrative catalogues for the materials offered.

7.03.00 A comprehensive write-up on the tests to be conducted for thermal insulating, materials, inspection methods, testing facilities.

TECHNICAL SPECIFICATION FOR PRESSURE AND STORAGE VESSELS

1.00.00 INTENT OF SPECIFICATION

This specification covers the design, manufacture, shop testing, shop testing, construction, fabrication, erection, testing, inspection & commissioning of pressure and storage vessels at works & site.

2.00.00 CODES AND STANDARDS

The design, manufacture, shop testing, site fabrication and erection, testing and commissioning of the pressure vessels and atmospheric storage tanks vessels shall conform to the latest revisions of the following standards, in addition to other standards addressed elsewhere in the Bid Specification subject to any modification and requirement, as specified elsewhere:

a)	ASME Section VIII	Rules for Construction of Pressure Vessels
b)	ASTM Standards	Standards published by American Society for Testing and Materials
c)	BS EN 12285-2	Workshop fabricated steel tanks. Horizontal cylindrical single skin and double skin tanks for the aboveground storage of flammable and non-flammable water polluting liquids
d)	IS-803	Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
e)	IS-816	Code of Practice for Use of Metal Arc Welding for General Construction in Mild Steel
f)	IS-817	Code of Practice for Training and Testing of Metal Arc Welders
g)	IS-822	Code of Procedure for Inspection of Welds
h)	IS-1363 Part 1 to Part 3	Hexagon Head Bolts, Screws and Nuts of Product Grade C
i)	IS-1367 Part 1 to Part 16	Technical Supply Conditions for Threaded Steel Fasteners
j)	IS-2002	Steel Plates for Pressure Vessels for Intermediate

		and High Temperature Service including Boilers
k)	IS-2062	Hot Rolled Medium and High Tensile Structural Steel
l)	IS-2825	Code for Unfired Pressure Vessels
m)	IS-3133	Manhole and Inspection Openings for Chemical Equipment - General Requirements
n)	IS-4049 Part 1 & Part 2	Formed Ends for Tanks and Pressure Vessels
o)	IS-4682 Part 1 to Part 10	Code of Practice for Lining of Vessels and Equipment for Chemical Processes
p)	IS-4864 to IS-4870	Shell Flanges for Vessels and Equipment

3. 00.00 **GENERAL DESIGN FEATURES**

3. 01.00 Design of all pressure vessels shall conform to IS 2825 or ASME Section VIII Division-I or equivalent code / standard (subject to approval by Purchaser).

3. 02.00 Design of all vertical cylindrical atmospheric storage tanks containing water, acid, alkali and other chemicals shall conform to IS-803.

Supporting frame where required for design of Demineralized Water Storage Tanks shall be in accordance with IS-800. The tank shall be "Non-pressure" fixed roof type with atmospheric vents.

3. 03.00 Design of all horizontal cylindrical atmospheric storage tank containing decationized water, acid, alkali and other chemicals shall conform to BS EN 12285-2.

3. 04.00 Design temperature of all pressure vessels and atmospheric storage tanks shall be 10 deg. C higher than the maximum temperature that any part of the vessel / tank is likely to attain during operation.

3. 05.00 Design pressure shall be the maximum expected pressure to which the vessels may be subjected to plus 5% additional margin. Maximum expected pressure for vessels placed in the discharge line of pumps shall be based on the shut-off head of the pumps plus static head at pumps suction, if any.

3. 06.00 In case, tank is subjected to vacuum under any situation, the same shall be duly considered as one of the criteria for design of the tank.

3. 07.00 Each pressure vessel / atmospheric storage tank without inside rubber lining shall have a corrosion allowance of minimum 2.0 mm.

3. 08.00 Mill tolerance as per applicable code (minimum 0.3 mm) shall be duly considered for each shell as well as dished end.

3. 09.00 Thinning allowance of 2.0 mm (minimum) shall be considered for each dished end.

3. 10.00 Effective liquid volume for an atmospheric storage tanks tank shall be considered as the liquid volume in between the design highest operating level / design highest level switch set point and design lowest operating level / design lowest level switch set point.
3. 11.00 A liquid volume (corresponding to a minimum of 100 mm shell / liquid height in between design lowest operating level / design lowest level switch set point and top of side mounted outlet nozzle / bottom of tank) below the required effective liquid volume shall be considered & provided for satisfactory functioning of concerned level switch.
3. 12.00 Each atmospheric tank shall have sufficient free board (minimum 300 mm unless specified otherwise) above the design highest level / design highest level switch set point.
3. 13.00 The invert of overflow nozzle shall be kept at least 50 mm or 5 % of total height whichever is higher above the design highest level / design highest level switch set point for each of the atmospheric tanks, except for the Demineralized Water Storage Tanks.
3. 14.00 For Demineralized Water Storage Tanks, the invert of overflow nozzle shall be kept at least 500 mm or 5 % of total shell height whichever is higher above the design highest level / design highest level switch set point.
3. 15.00 A minimum 100 mm shell height shall be provided above the top of overflow nozzle of each atmospheric storage tank.
3. 16.00 Wall thickness of each of atmospheric tanks shall not be less than 6 mm. If higher thickness for any atmospheric storage tank is specified elsewhere in this Specification, the same shall be provided.
3. 17.00 Vessels coming under preview of IBR shall be designed accordingly.
4. 00.00 **MATERIAL OF CONSTRUCTION**
4. 01.00 The pressure vessels shall be designed as Class 3 vessels (as per IS-2825) and fabricated of steel as per IS-2062 / IS-2002 Grade 3 or SA-515 / 516 Grade 60 / 70 In case, the vessels are designed as Class 1 or Class 2 vessels (as per IS-2825), the material of construction shall conform to IS-2002 Grade 3.
4. 02.00 Atmospheric storage tanks shall be fabricated of mild steel as per IS-2062.
4. 03.00 The material of construction for various connections, for all the lined or unlined vessels/tanks shall be same as that of interconnecting piping material suitably lined wherever required. The pipe flanges, manhole/manhole covers, reinforcement pads etc. shall be fabricated out of the same material as that one used for the vessel / tank. However, screwed fittings for instrumentation, sample connection, drain connection of size 25 mm NB and less shall be of stainless steel construction (SS-316).

5. 00.00 **FABRICATION**

5. 01.00 All pressure vessels and storage tanks except the large tanks like Demineralised Water Storage Tanks should preferably be fabricated and tested completely at manufacturer's works to ensure better workmanship.
5. 02.00 The plates to be used for fabrication shall preferably have a minimum width of 1500 mm.
5. 03.00 Ends of pressure vessels shall be of dished design and constructed of forging, pressing or spinning as per IS-4049.
5. 04.00 Interior surfaces of all atmospheric storage tanks shall be clear of stiffeners and other structural supports. Tanks shall be reinforced and stiffened externally as required.
5. 05.00 Plates to be used for fabrication of atmospheric vertical storage tanks shall be accurately formed in bending rolls to the diameters called for and cold rolled through plate bending machine by several number of passes to true curvature and joined by welding.
5. 06.00 The atmospheric vertical storage tanks shall have flat bottom.
5. 07.00 Ends of atmospheric horizontal storage tanks shall be of dished design and constructed of forging, pressing or spinning as per IS-4049. Conical or Flat Ends shall not be accepted.
5. 08.00 All welding shall be as per IS-816 or equivalent code (subject to approval by Purchaser). The qualification of the welders should be as specified in IS-817 and welding electrodes shall be as per relevant Codes / Standards.
5. 09.00 Bidder shall state clearly in his proposal the make and type of welding rods necessary for fabrication / construction work.
5. 10.00 Welding sequence shall be adopted in such a way so as to minimize the distortion due to welding shrinkage. The Bidder shall indicate in drawing, the sequence of welding proposed which should meet prior approval of the Purchaser. Welding shall not be carried out when the surface of the parts to be welded are wet from any cause and during periods of rain and high winds unless the welder and work are properly shielded.
5. 11.00 All seams shall be so positioned that they do not pass through connections of vessel / tank. The connections shall be flushed with inner surface of vessel / tank and welded continuous on both sides of the vessel / tank. Sharp inside edges shall be rounded to a minimum 3 mm radius. Inside seam weld shall be ground smooth, suitable for application of corrosion resistant coating / lining.
5. 12.00 All the joints (circumferential / longitudinal) shall be double butt welded with full penetration or single butt welded without backing strip. For joints involving small thickness 6 mm or less, back chipping to metal followed by DP test and re-welding shall be done to have full penetration.
5. 13.00 All internal baffles, wear plates, pipes etc. shall be continuously welded on both sides at all contact points with full fillet welds which shall be free of voids, gaps,

craters, high spots, sharp edges, and undercutting. Sharp edges shall be ground to a 3 mm minimum radius.

- 5. 14.00 All welds on inner surface of vessel / tank shall be free of voids, gaps, craters, pits, high spots, sharp edges, abrupt ridges and valleys or undercut edges. High spots, irregularities and sharp edges shall be removed by grinding.
- 5. 15.00 Weld splatter shall be removed.
- 5. 16.00 Inspection of all welds shall be carried out in accordance with IS-822 'Code of Practice for Inspection of Welds.'

6. 00.00 **APPURTENANCES**

- 6. 01.00 Internals for pressure vessels and atmospheric storage tanks shall be provided as detailed out elsewhere in the specification and as further required.
- 6. 02.00 All the pressure vessels and atmospheric storage tanks shall be provided with drain connections along with drain valves of suitable size.
- 6. 03.00 All the pressure vessels and atmospheric storage tanks shall be provided with the vent connections. The design shall be as to offer adequate area for venting. Venting area shall be such that over pressure/vacuum is not created during maximum filling / withdrawal rate. The maximum withdrawal rate for the Demineralized Water Storage Tanks shall be intimated later at detail engineering stage to the Bidder.
- 6. 04.00 Various instrumentation and the fittings required for the pressure vessels and atmospheric storage tanks shall be provided as elaborated elsewhere in the specification.

6. 05.00 **Manholes / Hand Holes**

- 6.05.01 Manholes shall be provided for all pressure vessels and atmospheric storage tanks to provide easy access into the same. The diameter shall be minimum 500 mm and each manhole will be provided with cover plate, nuts, bolts and gaskets to ensure leak tightness at the test pressure. Manholes shall be davit type for rubber lined vessels.
- 6.05.02 Each of the pressure vessels and horizontal type storage tanks shall be provided with at least one manhole at the top.
- 6.05.03 Each of the vertical type atmospheric storage tanks with diameter 1200 mm or more shall be provided with a manhole on the top. For the Demineralized Water Storage Tanks, manholes shall be provided as per IS-803.
- 6.05.04 Each of the pressure vessels filled with ion exchange resins shall be provided with a handhold of diameter at least 150 mm at a level in the vicinity of bottom of resin bed.
- 6.05.05 The required lining / coating for the inside surface of the manhole / handhold, nozzle and cover plate of the manhole/ handhold shall be same as that of the respective vessel/tank.

6. 06.00 **Nozzle Connections**

- 6.06.01 Bidder shall furnish all materials required for nozzle connections with reference to system requirements. In addition to these, additional nozzle connections, if required by the Purchaser for the inter-connection with other systems / piping / instruments etc. shall also be provided. Such additional requirements may be intimated to the Bidder later at detail engineering stage and Bidder shall provide the same complete with necessary supports and other accessories without any sort of price implication whatsoever.
- 6.06.02 Nozzle wall thickness shall be as per relevant code for design to be followed for the vessel/tank in questions.
- 6.06.03 All flanged connections should be supplied complete with matching counter flanges, bolts, nuts and gasket materials. The flange design (thickness and drilling etc.) shall match with the interconnected piping flanges.
- 6.06.04 Bolts and nuts to be used externally to the vessels shall be of hexagonal head conforming to IS-1367. However fasteners if any within tanks shall be of SS-316 / SS-304 or Hastalloy-B as per the duty conditions / requirements.
- 6.06.05 Gaskets shall be of full face type.
6. 07.00 Sight glasses shall be provided for the tanks/vessels as specified elsewhere in the specification. The material for sight glass shall be high quality transparent PLEXIGLASS of sufficient thickness to withstand the test pressure. The sight glass shall be provided with suitable gaskets and bolts to ensure leak tightness at the test pressure.
6. 08.00 **Vessels Supports / Lifting Lugs**
- 6.08.01 Adequate supporting arrangements like legs, straps, saddles, skirt boards, pillars etc. for the pressure vessels and atmospheric storage tanks shall be provided to transfer all loads to civil foundation. All foundation bolts, inserts etc. shall also be provided.
- 6.08.02 All vessels shall be provided with lifting lugs, eye bolts etc. for effective handling during erection.
- 6.08.03 All vessels of internal, diameter of 1200 mm or greater shall be provided with minimum four (4) lifting lugs for safe and effective handling during erection. Smaller vessels shall be provided with atleast two (2) lifting lugs.
- 6.08.04 Material of construction for these vessel supports, saddles, lugs shall conform to IS-2062.
6. 09.00 **Special Accessories for Tanks**
- 6.09.01 Each of all the tanks shall be provided with over flow connection designed for the filling rate of the respective tank.
- 6.09.02 Water Seal shall be provided for the overflow line of Demineralized Water Storage Tanks. Vent line of Demineralized Water Storage Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather of proven design to prevent contamination from atmospheric air. Carbon-Di-Oxide Absorber / Breather shall preferably be located at finished floor / pavement level.

- 6.09.03 The vent and overflow lines of Acid Bulk Storage / Day / Measuring Tanks shall be provided with fume absorber using suitable packing material, such as pall rings / raschig rings.
- 6.09.04 The vent and overflow lines of Alkali Bulk Storage / Preparation / Day / Measuring Tanks shall be provided with Carbon-Di-Oxide Absorber / Breather as addressed under clause no. 6.05.02 above.
- 6.09.05 Conservation Vent Valve shall provided on each of Demineralized Water Storage Tanks to ensure minimum contact with air. The valve should normally be closed. With vacuum or pressure to the extent of 65mm water gauge into the tank, the valve shall open to relieve the vacuum or pressure.

Material of construction should be as follows:

Body & valve disc	-	Die cast aluminium.
Spindle	-	Steel
Spring	-	Phosphor Bronze
Seal	-	Rubber

7.00.00 **ERECTION**

- 7.01.00 Each of all pressure vessels and atmospheric storage tanks should be directly placed on the civil foundation when supplied in fully fabricated form.
- 7.02.00 All fabricated part, before assembly, shall be transported by the Bidder to installation at site. All preliminary work and fabrication in part or full shall be done at the Bidder's fabrication yard or shop.
- 7.03.00 All material before final installation over the foundation at the respective locality shall be inspected and faired as necessary to ensure that any damage received during transportation is corrected before erection to the satisfaction of the Purchaser. Particular attention shall be given towards removal of buckles and other form of distortion in shell and bottom plates of vertical atmospheric storage tanks. Irregularities and dirt which would prevent metal to metal contact at the jointing faces shall be removed.
- 7.04.00 The method of holding the plates in position during welding and all devices used for this purpose should be approved by the Purchaser. All lap joints shall be held in close contact during welding and the surface in contact shall be thoroughly cleaned before assembly.
- 7.05.00 Holes in plate work to assist in erection should be avoided as far as possible. The location of the holes shall be indicated in the fabrication drawing. The method of filling holes shall be approved by the Purchaser. Lugs attached by welding to the tank and required only for the purpose of erection shall be removed and any projections of weld metal shall be chipped and grounded flush with the plate surface.
- 7.06.00 In the construction of the shell, every care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.

- 7.07.00 Tanks shall be safeguarded against damage due to wind or any other external causes by providing suitable steel cable guys until completion.
- 7.08.00 All materials used by the Bidder such as electrodes, gaskets, bolts and nuts, paints and any other appurtenance shall be conforming to relevant Indian Standard Code of Practice or equivalent (subject to approval by the Purchaser). Manufacturer's test certificate for guaranteed performance shall have to be provided when called for.
- 7.09.00 The finished bottom plate of vertical atmospheric tanks shall be crowned from the outer periphery to the centre with a slope of 1:36. Sufficient number of plugged holes shall be provided in bottom plate of the tanks for bottom testing.
8. 00.00 **PROTECTIVE LINING AND PAINTING**
8. 01.00 Inside surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anticorrosive paints or rubber lining as required / specified. External surfaces of all pressure vessels and atmospheric storage tanks shall be protected by anti corrosive painting.
8. 02.00 The supply and application of Protective Lining and Painting with reference to pressure vessels and atmospheric storage tanks need to be as per **Sub Section: M7 – Technical Specification for Protective Lining and Painting**, attached herewith.
9. 00.00 **TESTS AND INSPECTION**
9. 01.00 All pressure vessels shall be hydraulically tested at 1.5 times design pressure or 2 times the maximum working pressure whichever is higher, for a period not less than one (1) hour.
9. 02.00 All atmospheric storage tanks shall be tested for leak tightness by filling up with water up to the highest level for a period not less than 8 hours.
9. 03.00 Full rubber lining is to be tested as per IS-4682 Part I for the following tests:
- (a) Adhesion tests
 - (b) Tests to check resistance to bleeding
 - (c) Measurement of lining thickness
 - (d) Shore hardness test
 - (e) Spark test at high voltages 5 KV / mm of thickness with a gap of 8 mm between the probe and lining.
9. 04.00 Thickness of painting shall be checked with dry type thickness gauge.
9. 05.00 Vessels as per IBR shall be tested accordingly.
9. 06.00 DP test after back gauging and on complete welds on atmospheric tanks and pressure vessels need to be carried out.
9. 07.00 All non-destructive tests shall be carried out as per the applicable design code / standard for all pressure vessels and atmospheric tanks.

- 9. 08.00 Butt welds if any on the dished ends shall be radio graphed after dishing and shall be stress relieved.
- 9. 09.00 All dished ends for pressure vessels shall be stress relieved after dishing.
- 9. 10.00 All weld procedure and welder qualification certificates shall be verified.
- 9. 11.00 All painting on vessels and tanks shall be checked for the thickness as per the specification mentioned elsewhere.
- 9. 12.00 All materials to be used for the pressure vessels and atmospheric tanks and accessories should be of tested quality and test certificates shall be made available to the Purchaser.

GENERAL TECHNICAL REQUIREMENTS