

**MAHARASHTRA STATE POWER GENERATION
CORPORATION LTD**

1x660 MW BHUSAWAL TPP UNIT 6

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

SPECIFICATION NO.: PE-TS-415-166-A001, Rev 01



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



TITLE FUEL OIL HANDLING SYSTEM
1X660 MW BHUSAWAL TPP # 6
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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 **1X660 MW BHUSAWAL TPP UNIT 6**.
- 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.



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SECTION: I

PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN CRITERIA

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: II
	BID SPECIFICATION NO.: DG/BSL U-6/2011/T-1	Section – 2
REV: R0	MASTER SPECIFICATIONS	Page 19 of 555
1.0 <u>INTRODUCTION</u> The proposed 1x 660 MW Bhusawal Thermal Power Project will be set up by Maharashtra State Power Generation Co. Ltd. (MAHAGENCO) in Dipnagar near Bhusawal, Maharashtra, India. The Bidder shall acquaint himself by a visit to the site, if felt necessary, with the conditions prevailing at site before submission of the bid. The information given herein under is for general guidance and shall not be contractually binding on the Owner. All relevant site data/information as may be necessary shall have to be obtained /collected by the Bidder. 2.0 <u>APPROACH TO SITE</u> Deepnagar is well connected by rail and road. By road, it is about 8 Km from Bhusawal city. Nearest railway station is at Bhusawal. The nearest Airport is at Aurangabad. The nearest sea port is at Mumbai. The site is located on the Mumbai-Nagpur Highway. 3.0 <u>LAND</u> Bhusawal Thermal Power Plant is already having 1x62.5 MW + 2x210 MW Units and Two (2) Units of 500 MW each are under execution stage. About 108.94 Hectares of land is acquired by MAHAGENCO near existing TPS. It is proposed to install 1x 660 MW unit on this land. 4.0 <u>SOURCE OF COAL</u> Indian coal would be sourced from Machaakata coal blocks in Orissa state. The Coal will be received at Plant site directly by rail. The coal from the railway wagons would be unloaded by means of wagon tipplers and will be either bunkered or stacked in the stock pile at site. 5.0 <u>SOURCE OF WATER</u> The main source of water is considered Ozerkheda Reservoir which is located at around 18 km from plant site.		

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6.0 <u>ASH DISPOSAL AREA</u> The ash generated from 1 x 660 MW unit shall be disposed off in slurry form to the existing Ash Pond located at Velhala, approx. 12 Km from the site.		
7.0 <u>PROJECT INFORMATION</u>		
7.1	Client / Owner	: Maharashtra State Power Generation Co. Ltd.
7.2	Consultant	: Procon Engineers, Navi Mumbai (Division of Nimoto Consulting Engineers Pvt. Ltd.)
7.3	Project Title	: BHUSAWAL T.P.S. UNIT – 6 : 1X660 MW
7.4	Location	: Dipnagar, Near Bhusawal, Maharashtra, India
7.5	Nearest railway station	: Bhusawal
7.6	Nearest Airport	: Aurangabad
7.7	Nearest Harbour	: Mumbai
7.8	Access Roads	: NH 6 (Mumbai-Nagpur Highway)
7.9	Elevation above MSL	: 210 M
7.10	Longitude/latitude	: 75°51'10" East /21° 02' 30" North
7.11	Seismic Zone	: Zone III as per IS:1893
7.12	<u>AMBIENT TEMPERATURE</u>	
7.12.1	Mean of daily maximum temperature	: 48.25 °C (during May)
7.12.2	Mean of daily minimum temperature	: 18 °C (during January)
7.12.3	Highest temperature recorded	: 48.7°C

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7.12.4	Lowest temperature recorded : 13°C		
7.13	Wet bulb temperature : 27°C (Maximum)		
7.14	Rainfall : 112 mm average annually		
7.15	Wind Speed : 0 to 39 m/s		
7.16	Wind direction : East North East to West South West		
	<u>ELECTRICAL</u>		
7.17	<u>MAIN POWER SOURCE FROM GRID</u>		
7.17.1	Rated Voltage : 400kV		
7.17.2	Voltage variation : ± 10 %		
7.17.3	Frequency Variation : ± 5 %		
7.17.4	Rated Short Circuit : 50 kA, Three Phase Symmetrical Level		
7.18	<u>AUXILIARY POWER SUPPLY</u>		
	Auxiliary electrical equipment shall be suitable for operation on the following supply system:		
7.18.1	Motors above 1000 kW & other Power devices : 11kV,3Ph,3wire,50Hz system		
7.18.2	Motors below 1000 kW & above 160kW & other power devices : 3.3kV, 3 ph, 3 wire 50 Hz, Non Effectively earthed		
7.18.3	Motors upto 160 kW & other power devices : 415V, 3 ph, 4 wire 50 Hz		
7.18.4	Motor Starting Methods : Direct on Line		
7.18.5	(a) Lighting fixtures, Space heaters, and single Phase motors : 240V, 1 phase, 50 Hz Supply through suitably rated transformers to limit the short circuit level to 9kA – 1 sec.		

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(b) Control & : 240V, 1 Phase, 50 Hz from UPS Instrumentation 7.18.6 Short circuit levels of 11kV, 3.3 kV and 415V system equipments The equipment shall be suitable for the following short circuit levels (a) 11kV Switchgears : 44 kA/3 sec (b) 3.3kV Switchgears : 40 kA/3sec (c) 415V PCC/ : 50 kA/1sec PMCC/ MCC (d) Lighting : 9 kA/1sec Distribution Boards & 240V A.C. supply 7.18.7 Auxiliary DC supply The auxiliary DC supply will be used for control, indication & protection, Turbine lube oil system, AVR, Emergency DC lighting of power plant and Control & Instrumentation etc. (a) Voltage : (i) 220V DC for utility purpose (ii) 24V DC for Control and Instrumentation (b) Voltage variation : + 10 %, - 15 % 7.18.8 Emergency power supply (a) Purpose : (i) Standby power to normal incomer of emergency MCC (ii) Alternate power source to Fire water Pumps (b) Rated voltage and frequency : 415 V, 3 phase, 3 wire, 50 Hz.		

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1X660 MW BHUSAWAL TPP UNIT 6

TECHNICAL SPECIFICATION
FOR
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SECTION I-A
(SPECIFIC TECHNICAL REQUIREMENT-MECHANICAL)



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



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1.0.0 SCOPE OF WORK

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.

1.1.0 SCOPE OF SUPPLY

Bidder's scope of supply shall comprise of but not necessarily be limited to the following. P&I Diagrams given with this specification should pls. be referred.

- 1) Two (2) nos (1W+1S) HFO twin screw Positive Displacement transfer pump with motor, each of capacity 125m³/hr with simplex type strainers of matching capacity at the suction of each pump. These pumps & strainer shall be steam traced/heated.
- 2) Two (2) nos (1W+1S) LDO twin screw Positive Displacement transfer pump with motor, each of capacity 125 m³/hr with simplex type strainers of matching capacity at the suction of each pump.
- 3) One (1) no. of fixed roof type M.S storage tank for storage of HFO of capacity 500 m³ duly fitted with steam heated floor coil heaters and outflow suction heater and other appurtenances, accessories, instrumentation, control and fittings etc. The HFO tank shall be insulated on shell. However, the roof will not be insulated. **(MS Plates for shell, roof and bottom shall be free issued to bidder).**
- 4) One (1) no. fixed roof type M.S storage tank for storage of LDO of capacity 500 m³ duly fitted with appurtenances, accessories, instrumentation, control and fittings etc. **(MS Plates for shell, roof and bottom shall be free issued to bidder).**
- 5) One (1) no. drain oil tank of capacity 6 m³ with heating (steam heating coils) arrangement including all its accessories in FO transfer pump house.
- 6) One (1) no vertical rotary positive displacement type drain oil pump of capacity 10 m³/hr shall be provided on drain oil tank of capacity 6 m³ to transfer the drained oil to the existing HFO storage tank.
- 7) Two Nos. (1W+1S) Vertical centrifugal sump pump motor sets of capacity 5 m³/hr with all its accessories in FO transfer Pump House. The water with oil traces shall be pumped to the existing fuel oil dyke area OWS pit.
- 8) One (1) number underground drain oil tank of capacity 10 m³ near fuel oil dyke area for emptying HFO and LDO tanks.
- 9) Two nos (1W+1S) of vertical rotary positive displacement type drain oil pump motor set of capacity 10m³/hr with all its accessories on underground drain oil tank of capacity 10 m³ for transferring oil back to HFO day tank.
- 10) One no oil water separator pit with disposal arrangement of water to nearest plant drain through two (2) nos (1W+1S) vertical centrifugal pump motor set of capacity 5m³/hr each with all its accessories & two (2) nos (1W+1S) vertical single screw recovery pump each of capacity 5 m³/hr for transferring oil to HFO day tank. This OWS shall be located near fuel oil day tank area.
- 11) Instrumentation & control System including instruments, interlocking & protection devices complete in all respects required for safe, efficient and reliable operation of the system and to be read in conjugation with the C&I portion of specification.
- 12) Pressure Reducing and Desuperheating station (PRDS) to reduce available aux. steam pressure from 16 kg/cm² (a) to 4.0 kg/ cm² (a).

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- 13) Complete Fuel oil piping, auxiliary steam piping, drain piping, vent piping, condensate piping, instrument air piping, water piping, pipe for floor coil heater of drain oil tank & HFO storage tank, valves, etc as applicable to Fuel oil transfer & storage system.
- 14) Drain and vent connection in lines along with isolation valve at every low and high point as per layout requirement of FOHS.
- 15) Complete steam tracing, Insulation and cladding material along with all accessories for HFO tank, HFO lines, pumps, strainers, etc.
- 16) One Condensate Flask Tank near fuel oil dyke area of capacity 10.0m³ and one near FO pump house of 2.0 m³ each duly insulated and cladded.
- 17) All foundation bolts/ anchor bolts required for any equipment foundation under the package.
- 18) Control valves for controlling steam flow to Floor coil heater on HFO tank, Suction heater installed on HFO tank, drain oil tank in FOPH and underground drain tank in FO dyke area.
- 19) Traps for separating condensate from steam.
- 20) All foundation bolts/ anchor bolts etc. required for any equipment/ foundation under the package.
- 21) Pipe-supporting structures over the insert plates for pedestal supported pipes and also on pipe rack supported pipe.
- 22) Pipes required for tank nozzles (HFO and LDO, Drain Oil Tank etc.), manholes, pipe support etc. shall be in bidder scope.
- 23) 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.
- 24) Platform and approach ladder to the platform for foam pourer.
- 25) Wrapping and coating of any buried MS pipes as required.
- 26) All MS structures for cross overs, valve / instruments / equipment operating & maintenance platforms, approach ladders for access to platforms, trench/pit.
- 27) Painting of equipment along with their accessories within battery limit.
- 28) Electrical scope as per enclosure elsewhere in the specification.
- 29) C&I Scope as per enclosure elsewhere in the specification.
- 30) For the scope of supply and E & C for DCS/RIO/Back-up panel/LCP/OWS/EWS, refer section-IC, TECHNICAL SPECIFICATION - C & I PORTION, However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.
- 31) Erection & commissioning spares as required for the complete system.
- 32) 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.
- 33) Mandatory spares as per enclosure elsewhere in the specification.
- 34) Initial charge of all lubricants and fluids except LDO / HFO
- 35) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- 36) Flow able 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.
- 37) Any other item covered in specification for Fuel Oil Handling System.
- 38) Relevant scope of supply as per GTR, GCC & SCC.
- 39) Valves in pit outside dyke as required as per latest OISD recommendation complying with requirement whichever is more stringent.
- 40) 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.
- 41) All mechanical items for oil water separator pit including skimmer pipe, butterfly valve, heating arrangement, rung ladder etc. for OWS.

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42) 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 MS Plates for HFO and LDO tanks 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.
- 12) Preparation of all drawings as per list enclosed under Annexure -D.
- 13) 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.
- 14) 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.



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- 15) Supply of temporary equipment and services for chemical cleaning, steam blowing, energization, testing etc. as applicable.
- 16) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- 17) 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.
- 18) Relevant requirements as per GTR, GCC, ECC & SCC.
- 19) 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 MS plates for shell, roof and bottom of HFO and LDO tanks. However, E&C of the same including supporting arrangement shall be in bidder's scope of work/supply.
- b) Civil work for fuel oil unloading & storage system including
 - i. Tank & Pump foundations
 - ii. Unloading Pump House, Oil water separator pit.
 - iii. Dyke wall and barbed fencing
 - iv. Encasing of buried pipes, providing culvert for the same, if required.
 - v. Hume Pipes, if any
 - vi. Civil works like pits, wherever required.
 - vii. Handrails other than those on the storage tanks.
 - viii. Pipe trenches, pipe pedestals, drains, sumps.
 - ix. Pipe rack/trestle (refer definition of pipe rack/ trestle elsewhere in the specification) outside pump house and dyke area.

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 fuel oil storage tanks.
- d) Air Conditioning / ventilation of Fuel Oil pump houses.
- e) Lifting equipment (electric operated hoist) for unloading pump house for maintenance purpose of these pumps. Capacity and lift of lifting equipment is mentioned in the FO pump house drawing. Bidder to confirm adequacy of the same.
- f) Exclusion as indicated in Electrical & C&I portion of technical specification
- g) 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 FO transfer pump house area:

Existing LDO tank for LDO unloading / transfer Pump suction and recirculation.

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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:

Existing HFO tanks for HFO unloading / transfer Pump suction and recirculation.

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

Aux. Steam

: Steam header at 16 kg/cm², 290 degC by BHEL at 2000 mm from FO pressurizing building / FO Dyke area.
At the TP BHEL shall supply 2 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.

Oil + Water from sump at FOPH

: Existing oil Water separator pit. (Through sump pumps, by bidder).

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

: Condensate from condensate flash tanks in FOPH area shall be terminated at existing oil water separator.



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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:

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

5.0.2 Functional Guarantees at site:

- a. 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.
- b. Noise level for safety valve to be limited to 105 dB
- c. Entire piping & support for smooth operation
- d. 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 / 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 (L_p) 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

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- 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 confirm 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 FO pump house near existing dyke area, the FGL is (-) 3.7m w.r.t. TG Hall finished floor 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.
- 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. 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.



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- 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 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 **General Technical Requirement**. 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:

- a) The Quality plans / checklist for the previous executed jobs for the equipment's / instruments are attached under **Section IA**.
- b) 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.

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- c) 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.
- d) 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.
- e) 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.

- 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



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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:

- a) Plot plan,
- b) Process & Instrumentation Diagram of LDO
- c) Process & Instrumentation Diagram of HFO
- d) Process & Instrumentation Diagram of steam & condensate
- e) FO transfer Pump House.
- f) PID of FOHS – Overall.
- g) Piping layout of existing FO dyke area.

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.

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



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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 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.



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FOR
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SECTION I-A

(SYSTEM WRITE-UP)



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



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1.0.0 Intent

1.1.0 The purpose of this document is to bring out clarity with regard to System description and Basic operation & Control Philosophy

1.2.0 Codes and standards.

The design, manufacture, inspection, testing, site calibration and installation of all equipment and items covered under this system shall conform to the latest editions of codes and standards mentioned below:

- A) API 650: Welded tanks for oil storage.
- B) IS 803: Code of Practice for Design Fabrication and Erection of Vertical Mild Steel Cylindrical Welded Oil Storage Tanks
- C) API 5L: Specification for line pipe.
- D) IS 800: General construction in steel – code of practice.
- E) API 676: Positive displacement pumps – Rotary.
- F) IS 1593: Code of Heavy fuel oil.
- G) IS 1460: Code of light diesel oil.
- H) IS 4503: Code for design and manufacture of heater.
- I) API 600: Code for design & construction of gate valve for size 50 Nb and above.
- J) API 598: Code for testing of gate valve.
- K) BS 1863: Code for design & testing of check valve.
- L) BS 5351: Code for design and testing of ball valve.
- M) API 599: Code for design and testing of plug valve.
- N) IS 8183: Specification for Bonded Mineral wools group 4.
- O) IS 7413: Code of practice for the application and finishing of thermal insulation material at temperature between 40°C and 700°C.

2.0.0 System Description

Light Diesel Oil (LDO) shall be used for initial start-up (up to 10% BMCR) while heavy Fuel Oil (HFO) shall be used (up to 30% BMCR) for flame stabilization and supporting pulverised coal up to 40% BMCR. The Fuel Oil Handling System comprises of transfer of oil from LDO & HFO existing main storage tanks to corresponding day oil tanks (Unit-6).

3.1.0 Heavy Fuel Oil System

HFO from existing storage tanks shall be pumped to 1 no. HFO Day tank (Unit-6) with the help of two (2) nos. (1W+1S) HFO transfer pumps of capacity 125 m³/hr each. The HFO transfer pumps are of rotary positive displacement, gear / screw / sliding vane type and provided with one (1) no. matching capacity heavy duty simplex type strainers at their suction with interconnecting piping and valves. The HFO transfer pumps and strainers, valves and transfer header shall be steam traced, insulated and clad.

One (1) nos. HFO Day tank having fuel oil storage capacity of 500 m³ shall be provided. HFO day tank design temperature shall be 90 Deg C and design vacuum



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pressure shall be 50 kg/m². The tank shall be provided with steam floor coil heaters to initially raise the temperature of full tank capacity of HFO oil from 18-degree centigrade temperature to the handling / tank maintenance temp of 50 °C in 36 hrs and for compensating the heat loss from the insulated tank in order to maintain the temperature as 50°C. The floor coil heater for the Fuel oil Day tank shall have adequate nos. of sections. Steam flow to the floor coil heater shall be controlled by providing pneumatically operated control valve in the common header of half segments of heater coils to maintain the desired level of temperature (50°C) and the other half sections to be used during initial heating shall be provided only with isolation valve as per flow diagram. Auto cut-off temperature shall be 51 Deg C and pick-up temperature shall be 40 Deg C.

HFO Day tank shall also be provided with one no. of suction heater with capacity suitable to meet maximum requirement of pressurizing pump for one unit (120 cum/hr). The suction heater will raise the temperature of oil by approx. 20°C to meet the pressurizing pump suction temperature requirement. Steam flow to Suction heater shall be regulated through one pneumatically operated control valve on the steam supply line to the suction heater and the same shall be actuated from heater outlet temperature.

HFO Day tank shall be insulated and cladded on the shell only. Roof will not be insulated.

Interconnecting piping, valves and instruments as required for the system shall be provided as per P & ID.

3.2.0 Light Diesel Oil System

LDO from existing storage tank shall be pumped to one (1) no. LDO Day tank (Unit-6) with the help of two (2) nos. (1W+1S) LDO transfer pumps of capacity 125m³/hr each. The LDO transfer pumps are of rotary positive displacement, gear / screw / sliding vane type and provided with one (1) no. matching capacity heavy duty simplex type strainers at their suction with interconnecting piping and valves.

One (1) no. LDO Day tank having fuel oil storage capacity of 500 m³ shall be provided.

3.3.0 Steam & Condensate System

The aux. steam pressure for tank floor coil heater, suction heater shall be 4.0 kg/cm² (a) or more as decided by FO System vendor during detail engineering based on design calculations and final tank layout drawings including the no. of coils.

A pressure reducing and de-superheating station of adequate capacity consisting of self-regulating type control valves with safety relief valve and by pass arrangement shall be provided to reduce the pressure of aux steam available at 16 kg/cm² (a) and 290 Deg.C to 4.0 kg/cm² (a) or to pressure as required from process point of view for HFO Day tank heating. Temperature shall be in the range of 140 to 160 Deg C.



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The condensate from heating coil & suction heater shall be collected in condensate header and will be taken to condensate flask tank of 6 m³ capacity (in FO dyke area) and condensate flask tank of 2 m³ capacity (in FOPH area) which shall further be connected to oil-water separator pits.

3.4.0 Drain Oil System, Sump water & Oil Water Separation

The fuel oil drains from different equipment and piping etc. in Fuel Oil Transfer pump house shall be collected by gravity in a drain oil tank of capacity 6 m³ to be located in the transfer pump house area. One (1) no rotary positive displacement type drain oil pump of capacity 10 m³/hr shall be provided to transfer the drained oil to the existing LDO and HFO storage tanks through return header. The drain oil tank shall be fitted with steam tracing arrangement to maintain the temperature inside the tank from at about 50 (°C) and shall be insulated.

All oil drain lines will have a size not less than 25 NB and HFO drain lines will be steam traced.

Two (2) No Vertical centrifugal type sump pump of 5 m³/hr capacity is also envisaged in the Fuel Oil Transfer Pump House to pump the oil water mixture to existing oil water separator pit in existing FO storage area.

One (1) number underground drain oil tank of capacity 10 m³ shall be provided near fuel oil dyke area for emptying day oil tanks. This drain oil tank shall be provided with steam coil. Two (2) number drain oil pumps, vertical single screw of capacity 10 m³/hr shall be mounted on this drain oil tank for transferring fuel oil back to HFO day oil tanks.

A single chamber gravity type oil water separator with heating arrangement and its accessories shall be provided for receiving oil spillage collected or water mixture during from the Day tanks dyke area. The separated oil collected in oil pit, through an 80 NB perforated skimmer MS pipe, shall be returned back to the HFO day tank by the help of Two(2) nos.(1W+1S) of vertical single screw recovery pumps of capacity 5 m³/hr each. The separated water shall be discharged to nearest drain through two (2) nos (1W+1S) Vertical centrifugal type pump of required capacity (other's scope). The Oil Water Separator pits shall be provided with steam coil to pass steam manually on need basis in order to heat the oil water mixture to facilitate their separation. The OWS pit will not to be designed for oil water separation during rains and water collected from dyke shall be diverted to plant drain.

Operation and Control of Fuel Oil transfer and storage system shall be from DCS based panel located in fuel oil transfer pump house.

4.0.0 Instrumentation & Control

4.1. The control of Fuel oil transfer, storage, heating system shall be DCS based. One no. DCS based panel shall be located at control room of FO transferring pump house for



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operation and monitoring of this system. One Remote I/O panel, if required, will also be provided near FO dyke area for operation of pumps and instruments located in and near FO dyke area. This DCS based panel shall be provided by BHEL. However, one Local panel for alarm and annunciation shall be provided by bidder. The LCP shall have all necessary switched, push buttons, indicators, etc to achieve the functions mentioned below.

The Control Panel is envisaged to achieve **the following functions:**

- a) Filling of the storage tanks to be started after ensuring that the inlet valve of day tanks are open. Signals from Limit switches provided at tank inlet shall be used.
- b) Stopping of transfer pumps, drain oil pumps and sump pumps.
- c) Interlocking of operation of transfer pumps, drain oil pumps and sump pumps with start / running and stop interrupts.
- d) Signals (annunciation & indication) from various instruments / transmitters as shown in flow diagram.
- e) Trip status (annunciation and indication) of transfer pumps.
- f) Low level in storage tanks will be used for annunciation purposes in the transfer pump house to alert the operator for tank inventory.
- g) Level signals from HFO/LDO day tank shall be connected to LCP via hardwired link for control of HFO/LDO transfer pumps.
- h) Connectivity for alarm and monitoring with DCS shall also be provided.

4.2 Other requirements shall be as per C&I portion of specification.

5 Electrical Requirements

Electrical Requirements shall be as per electrical portion specification.

6 Demonstration Test

- 1) Shop test report shall be considered for pump capacity and total dynamic head.
- 2) Unloading pump vibration and noise within limit.
- 3) Capacity will be ascertained by physically measuring the tank dimension. For stability, water filled test on tank will be carried out.
- 4) Entire piping and support for smooth operation: Hydro test shall be carried out for checking the weld tightness and support checking. Hydro test shall be carried out at 1.5 times of design pressure for fuel oil lines.

Above test will be demonstrated at the time of commissioning of FOHS and based on same system performance will be ascertained.

7 Equipment Design Criteria/ Data Sheet



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- 7.1.0 The design criteria / data sheet indicating major parameters/ MOC to be followed for pumps, tanks, floor coil heater, suction heater, Pressure Reducing & De-superheating Station, Strainers, Steam traps, Pipe, Fittings and Flanges and valves shall be as mentioned in this section.
- 7.2.0 Design Criteria for insulation and cladding shall generally be as per requirement indicated in customer specification.
- 7.3.0 Pipe sizing shall be as per criteria mentioned in this section.
- 7.4.0 The design criteria for valves shall be as per criteria mentioned in this section.
- 7.5.0 Electrical and C&I items shall in in line with Electrical and C&I portion specifications.



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8 Analysis fuel oil

8.1.0 HEAVY FUEL OIL (HFO) ANALYSIS

Sl no.	Characteristics	Heavy Furnace Oil
1.1	Total Sulphur.	4.5 %(Maximum)
1.2	Gross calorific value (Kcal/kg)	10,000 Approx.
1.3	Flash point (Penskey-Martens, closed)	66°C Min
1.4	Water content by volume	1.0% Max
1.5	Sediment by weight	0.25% Max
1.6	Density at 15° C	0.95 gm/ml
1.7	Kinematic viscosity in centistokes at 50°C	370 (Max)
1.8	Ash content by weight	0.1% Max.
1.9	Pour Point	50°C Max.

8.2.0 LIGHT DIESEL OIL (LDO) ANALYSIS

Sl no.	Characteristics	Light Diesel Oil (LDO)
1.1	Kinematic Viscosity in centistokes at 38° C	2.5 to 15.7
1.2	Carbon residue (Rams bottom) by weight (Max.)	1.5
1.3	Sediment percent by weight (Max.)	0.10
1.4	Total Sulphur percent by weight (Max)	1.8
1.5	Ash percentage by weight (Max)	0.02
1.6	Water Content Max, % Volume	0.25
1.7	Specific gravity at 15°C	0.85
1.8	a) Flash point (Pensky-Martens, closed), b) Pour point, Winter: c) Pour point, Summer	66°C 12°C 18°C



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9 EQUIPMENT SELECTION & DESIGN CRITERIA/ DATA SHEET

FO STORAGE AND DRAIN OIL TANKS

S.No.		HFO STORAGE TANKS	LDO STORAGE TANKS	DRAIN OIL TANK
1	Storage Medium	HFO	LDO	HFO /LDO
2	No. of Tanks	1	1	2 (one in transfer pump house and other underground tank near FO dyke area)
3	Type of Construction	Vertical Cylindrical, non-pressure type with atmospheric vents fitted with flame arrestor fixed cone roof type.		Rectangular
4	Tank Capacity (m ³)	500	500	6 & 10 (U/G)
5	Dimensions	10 m dia x 8.5 m ht	10 m dia x 8.5 m ht	1.5mx1.5mx3m 2.0mx2.5mx2.0 m (U/G).
6	Design & Construction Code	IS 803 / API650		IS-800/ standard hand book
7	Design Pressure	Atmospheric		Atmospheric
8	Corrosion allowance	Shell, Bottom & Roof :1.8 mm		
9	Material of construction	IS 2062 Gr A/B Minimum plate thickness including corrosion allowance : Bottom – 8 MM, Shell - 6 MM , Roof- 6 MM		
10	Venting Capacity	As per API 2000/ IS 803/NFPA 30.		
11	Joint efficiency	85 % on all butt welded joints		
12	Insulation	YES, (on tank shell)	NA	YES



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10. FLOOR COIL HEATER OF HFO DAY TANKS

S.No	Characteristics	Value
1	Heating medium at the inlet of control valve	Aux. Steam at 4.0kg/cm ² (a) or higher as decided by FO System vendor.
2	Capacity of the floor coil heater shall be determined for following conditions:	
a	Design capacity	To raise the temperature of full tank capacity of Heavy Fuel oil from 5 ⁰ C to storage temperature of 50 ⁰ C in 36hours.
b	Normal capacity	To compensate heat loss from the unlagged tank completely filled with oil at 50 ⁰ C.
c	Wind Speed	1.0 m/second for heat loss calculation
d	Margin to be provided on calculated surface area of floor coil	25%
3	Tube side design pressure & temperature	1.5 times the heating steam pressure, 250 Deg. C
4	Temperature of steam to be considered for thermal design	Tsat @ 4 kg/cm ² (a) or higher pressure as decided by FO system vendor.
5	Material of Heating element	Seamless steel tubes to ASTM A 106 Gr.B
6	Number of heating coil	To be decided by the vendor to ensure uniform heating, half the no. of sections will be provided with manual valve while the other half will be provided with control valve.
7	Type of Control	Through pneumatically operated modulating type control valve
8	Specific Heat of Oil to be considered for design (Kcal /kg/ ⁰ C)	0.5



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11. SUCTION HEATER FOR HFO DAY TANKS

S.No	Characteristics	Value
1	Type of heater	U-tube, shell & tube type (Oil in shell, steam in tube)
2	Design ambient temperature	As per project information
3	Heater capacity	120 m ³ /hr
4	Differential temperature	20 degC
5	Initial temperature of oil	50±5 degC
6	Final temperature of oil	70±5 degC
7	Heating medium	Aux. steam @ 4 kg/cm ² (a) or higher as decided by FO system vendor.
8	Specific heat of oil(Kcal/kg/degC)	0.5
9	Design temperature & pressure	
a	Shell side	2.5 kg/cm ² (g) , 90 degC
b	Tube side	1.5 times the heating medium pressure in kg/cm ² (g), 250 degC.
10	Corrosion allowance	1.6 mm
11	Oil properties	As per specification.
12	Temperature of steam to be considered for thermal design	Tsat @ heating medium pressure
13	Material of Construction	
13.1	Heating elements	Seamless tube as per ASTM A 106 Gr.B/ ASME SA 179 Gr.C / Equivalent
13.2	Shell	MS plate to IS:2062
13.3	Shell head and tube sheets	Steel Plates of IS-2002 Grade 2 or IS:2062 Gr. B
13.4	Nozzles	Seamless steel tubes
14	Design/construction	TEMA Class-C/ IS 2825 Class-2/ASME Sec-VIII, Div-I
15	Fouling resistance	0.005 (hr.) (Deg.F) (Sq.ft) BTU



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12. TRANSFER PUMPS, DRAIN OIL PUMPS ,RECOVERY PUMPS & SUMP PUMPS

S. No	Characteristics	HFO Transfer Pumps	LDO Transfer Pumps	Drain oil Pumps	Recovery pumps in Oil Water Separator pit	Sump Pump in Oil Water Separator pit & Sump Pumps in pump house
1	Type of Pumps	Twin Screw/Gear Positive Displacement with Steam Jacketing/ (Foot/sump heating	Twin Screw/Gear Positive Displacement	Vertical positive displacement. Single Screw	Vertical positive displacement . Single Screw	Vertical shaft centrifugal type
2	No. of Pumps	2(1W+1S)	2(1W+1S)	1W + {(1W+1S) (U/G)}	2(1W+1S)	2(1W+1S) & 2(1W+1S)
2a.	Capacity of Pumps	125 m³/hr	125 m³/hr	10 m³/hr& 10 m³/hr each (U/G)	5 m³/hr	5 m³/hr each & 5m³/hr each.
3	Type of Duty	Intermittent	Intermittent	Intermittent	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor				
5	Location	Indoor	Indoor	Indoor & Outdoor for U/G	Outdoor	Outdoor & Indoor
6	Nature of Fluid to be pumped	HFO	LDO	HFO/LDO	HFO/LDO	Water with traces of oil
7	Design Viscosity range	130-140 cST	2-20 cST	2-140 cST	130-140 cST	5-50cST
8	Sealing	Manufacturer Specific				
9	Design Code	API 676 with standard deviations as taken by approved sub vendors /HIS/VDMA as applicable.				
10	Bearings	Antifriction type		Manufacturer specific		
11	Material of Construction					
i)	Casing	Carbon Steel	Carbon Steel	Cast Iron to IS 210 Gr FG 260/ CS Fabricated/ASTM 106 Gr.B/Manufacturer Standard.		Cast Iron to IS 210 Gr FG 260/ CS Fabricated
ii)	Casing lining, if applicable	Carbon Steel	Carbon Steel	Manufacturer specific		Manufacturer Specific
iii)	Rotor/ Impeller	ASTM-A-276-type 431	ASTM A 276	13% chrome SS		Cast Iron to IS 210 Gr FG 260
iv)	Rotor housing, if applicable	MS type 431	ASTM-A-276-type 431	Manufacturer specific		Manufacturer Specific
v)	Shaft	EN 24	EN 24	13% chrome SS		BS:970 EN-8 or equivalent
vi)	Relief valve body	SS		Cast Iron to IS 210 Gr FG 260		NA
vii)	Relief valve spring	SS		Spring steel		NA
viii)	Base Plate	Fabricated from MS to IS 2062				
ix)	Coupling	Cast iron		Manufacturer Specific		Manufacturer Specific



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13. STRAINERS FOR HFO/LDO UNLOADING PUMPS & DRAIN OIL PUMPS

S.No.	Characteristics	Value
01	Type	Simplex Type
02	Fluid	LDO/HFO
03	Flow Rate	To match pump flow rate
04	Operating Pressure, maximum kg/cm ² (g)	Bidder specific
05	Operating temperature, ° C	50
06	Design Pressure , kg/cm ² (g)	1.1 times the operating pressure , min.
07	Design Temperature, ° C	65
08	Fluid Viscosity	As per Fuel Oil Characteristics
09 a)	Pressure drop in clean condition	0.1 kg/cm ²
09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm ²
10	Screen basket data	
a)	Dia of perforations	80 mesh
b)	Minimum thickness	Bidder specific
11	Steam Jacket	Applicable for HFO unloading pump suction strainer.
12	Steam pressure for steam heating	4 kg/cm ² (a) or higher based on the detail layout drawings and shall be decided by the package vendor.
13	End Connection details	
a)	Inlet & outlet size	Shall match connected upstream and downstream pipe size
b)	Type	Flanged end with counter flanges and fastners.
c)	Details / Standard	IS: 6392 /ANSI B 16.5 /Equivalent.
14	Material of Construction	
a)	Body	Fabricated from IS 2062/ Seamless pipe to ASTM A 106
b)	Cover	Fabricated from IS 2062
c)	Screen basket	The strainer shall have screen of stainless steel (AISI-316) construction with wire diameter of about 0.01 inch and open area of about 50%.



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14. STEAM TRAPS

S.No.	Characteristics	Value
	Design Features	
1	Type	IB/ TD type for Floor Coil Heater, Suction Heater & other services.
2	Strainer	Y type as per trap supplier design
3	End connection	All traps and strainers shall have socket weld ends as per ANSI B16.11 for size NB 50 mm and smaller, and butt weld ends as per B 16.25 for size NB 65 mm and above.
4	Material of construction	
a	Body	SA105 /Equivalent
b	Trims	SS conforming to AISI-316
c	Strainer	Strainer shall be Perforated metal screen of type AISI-316 stainless steel with about 0.8 mm perforation.



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15. DATASHEET FOR PRESSURE REDUCING STATION

S.No.	Characteristics	Value
1	Type	Self-actuated pilot operated
2	Steam pressure at inlet	16 kg/ cm ² (a)
3	Steam Pressure at outlet	4 kg/ cm ² (a) or more as required by FO System vendor.
4	Leakage class	Class- IV
5	Material of Construction	
a	Body	Cast Steel
b	Trim	SS
6	Configuration	1X100% Self-actuated pilot operated with isolation valve and manual by pass sized for same duty as the PRV. The complete station shall have a manual by pass sized for 100% of steam flow rate. 2 no. relief valve with 100% relieving capacity shall be provided on the common downstream header in series.



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16. PIPES, FITTINGS, FLANGES & GASKET DETAILS,

Sr. No	Size	Material Standard/ Other details	Dimension Standard
A	PIPE		
a.	FUEL OIL		
1	All Sizes	Seamless Carbon Steel Pipes to ASTM 106, Gr. B, /API 5L Gr B with type of end as available and acceptable in line with relevant standard	ASME B36.10/ IS 1978/ API 5L
2	Type of end connection (Pipe to pipe & Pipe to equipment)	Butt welded for pipe size 65 NB & above; however, near equipment, this shall be of flanged type. Socket welded for 50 NB & below; near equipment this may be either socket welded or flanged.	Socket welding – ANSI B 16.11 Butt welding – ANSI B 16.25 Flanged- ANSI B 16.5 /BS 4504 / IS 6392; Class- As per relevant standard & suitable for intended service
b.	STEAM AND CONDENSATE SERVICE		
	All Sizes	ASTM 106, Gr. B, Standard weight or Sch.-40 as available	ASME B36.10
	Type of end connection (Pipe to pipe & Pipe to equipment)	Butt welded for pipe size 65 NB & above; however, near equipment, this shall be of flanged type. Socket welded for 50 NB & below; near equipment this may be either socket welded or flanged.	Socket welding – ANSI B 16.11 Butt welding – ANSI B 16.25 Flanged- ANSI B 16.5/ BS 4504/ IS 6392; Class- As per relevant standard & suitable for intended service
c.	AIR LINE		



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	25 NB & below	Stainless Steel as per ASTM A-312 Gr. 304. Size- as per schedule 40S (Min) ANSI B36.19	ANSI B36.19
	Type of end connection (Pipe to pipe & Pipe to equipment)	Socket welded for size 50 NB and below	AS PER APPLICABLE IS-CODE
d.	BURIED PIPE, IF ANY / PIPE CARRYING BILGE WATER (WATER WITH TRACES OF OIL)		
	Up to 150 NB	M.S ERW to IS 1239 (1) Heavy Grade	AS PER IS 1239
	Type of end connection (Pipe to pipe & Pipe to equipment)	As per standard engineering practice.	
B.	FITTINGS & FLANGES		
a.	FUEL OIL		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	ASTM A 105/ Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
b.	STEAM AND CONDENSATE SERVICE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges/Blind Flanges	Material Standard	Dimension Standard
	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class



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			suitable for intended service.
c.	AIR LINE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	25 NB and below	ASTM-A-182 F304	ANSI-B-16.11
d.	Buried pipe/ Pipe carrying bilge water		
1.	Fitting - 150 NB and below	IS 1239 (II)	IS 1239 (II)
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	Fabricated from IS2062 plate	ANSI B16.5/ BS 4504/ IS 6392; Class-150 lb /Equivalent to relevant standard
C	GASKETS		
a	STEAM	Spiral wound SS316	
b	FUEL OIL	Teflon	
c	AIR LINE & BILGE WATER LINE	Grafoil	
D	Bolts / Studs	ASTM A 193 Gr. B7	
E	Nuts	ASTM A 194 Gr 2H	



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17. VALVES

S.No.	Characteristics	Value
	Design Features	
1	General Requirement for all valves	i) All valves shall be provided with hand wheels, extension spindles and floor stands or any other arrangement wherever required so that they can be operated manually with ease by a single operator from the nearest operating floors either at a lower or higher elevation as the case may be. Wherever necessary for safety purpose, locking devices shall be furnished with valves. Gear Operated valve shall be provided for valves where force applied is more than 25Kgf. In the case of those valves with extended spindles, indicators will be fitted both to the extended spindles and to the valve spindles.
2	Gate Valves	i) Gate Valves shall be used for isolation purpose for all sizes in steam and condensate lines. The gate valves shall be provided with handle wheel, position indicator and draining arrangement. ii) Gate Valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800, forged carbon steel valves with solid wedge, OS and Y rising stem and bolted bonnet, Trim shall be of 13% chrome steel. Body material shall be to ASTM A-181 Gr. II and ends shall be socket welded. STEM and Disc material shall be to ASTM A182 F6a. iii) For sizes above 40 NB/ 50 NB (As per manufacturer's standard), valves shall be of class 150/300 (depending on service), Cast Carbon Steel gate valves. Face to face dimensions shall be as per ANSI B 16.10. Body material shall be ASTM A216 Gr. WCB and ends shall be flanged to ANSI 150/300 lbs rating with raised face. iv) Gate valve shall be used in the oil lines for sizes 400NB and above. v) The valves shall conform to API-600/ API-602 and shall be tested to API 598/IS: 6157 requirements.



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3	Globe Valves	i) Globe valves shall be used for regulation purpose for all sizes in steam, condensate and oil lines, they shall be provided with hand wheel, position indicator and draining arrangement, if required. Globe valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800 forged carbon steel valves with plug disc. Trim shall be of 13% chrome steel. Body material shall be to ASTM A-181 Gr. II and ends shall be socket welded. STEM and Disc material shall be to ASTM A182 F6a. For sizes above 40 NB/50 NB (As per manufacturer's standard), valves shall be class 150/300 (depending on service) Cast Carbon steel globe valves with plug or ball type disc. Body material shall be ASTM A216 Gr. WCB and ends shall be flanged to ANSI 150/300 Ibs rating with raised face. ii) The valve shall conform to BS, 1873/BS: 2995 and shall be tested to BS: 5146 requirements.
4	Check Valves.	i) Check Valves shall be used for non-return services for all sizes in steam, condensate and oil lines. For sizes up to 40 NB/ 50 NB (As per manufacturer's standard), check valves shall be of class 800 forged Carbon Steel horizontal lift type, with bolted cover, Valves shall have 13% Chrome Steel trim and body material shall be to ASTM A-181 Gr. II and ends shall be socket welded. ii) For sizes above 50 NB, check valves shall be of class 150/300 (depending on service) Cast Carbon Steel valves of swing check type having bolted cover. Trim shall be of 13% Chromium Steel and body material to ASTM A 216 Gr. WCB. Ends shall be flanged to ANSI Class 150/300 lb rating with raised face. iii) The valves shall conform to BS: 1868 and shall be tested to BS: 5146/IS: 5312 requirements.
5	Oil Line Ball / Plug Valves	i) Ball valves shall be used for isolation purpose in oil lines. These shall have 'port' position indicators with CLOSE/OPEN indications marked on valve body.



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- ii) Ball valves shall be of class 150 full-bore type with face to face dimension as per ANSI B 16.10. Body material for plug/Ball Valves shall be **ASTM A-216 Gr WCB for sizes 65 NB and above and for sizes 50 NB and below, material shall be ASTM A181 Gr II.. The ball shall be of SS AISI 316 quality.**
- iii) Ball valves shall be of safe patter for internal (line) & external leakage. Ball valves in general shall confirm to BS: 5351/ and to BS6755 Part-2/API 607/ Equivalent for fire safe test.
- iv) Plug valves shall be of fire safe pattern for external leakage only. Plug valves in general shall confirm to API 6D/ Equivalent for design &manufacturing standard and to BS6755 Part-2/ API607/ Equivalent for fire safe test.

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

- a) Size up to 200 NB: Ball valves
- b) Size 250 NB and up to 350 NB: Plug valve
- c) Size above 350 NB: Gate valve



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18. VELOCITIES FOR SELECTING PIPING

For pipe sizing, velocity of fluid in various pipe lines shall be selected				
Sr. No	Description	Velocity (in meter/Sec.)		
A	STEAM			
1	Saturated Steam	15 - 22 m/s (Pipe size below 50mm) 20 -33 m/s (Pipe size 50 - 150mm)		
2	Super-heated Steam	20 - 30 m/s (Pipe size below 50mm) 25 - 40 m/s (Pipe size 50 - 150mm)		
B	Water			
1	Pump Suction	1.5 m/s		
2	Pump Discharge	3.0 m/s		
C	Air LINE			
	Compressed air	30 m/s for all pipe sizes		
D	Oil line			
1	LDO	Velocity at pump suction	Velocity at pump discharge	Pipe size (mm)
		1.0 m/s	2.0 m/s	250 & above
		1.0 m/s	1.7 m/s	200
		1.0 m/s	1.5 m/s	150
		0.8 m/s	1.3 m/s	100
		0.6 m/s	1.3 m/s	80
		0.4 m/s	1.0 m/s	50 & below
2	HFO	1.0 m/s	1.5 m/s	250 & above
		1.0 m/s	1.5 m/s	200
		1.0 m/s	1.5 m/s	150
		0.8 m/s	1.2 m/s	100
		0.6 m/s	1.0 m/s	80
		0.4 m/s	1.0 m/s	50 & below
E	Condensate line	2.0 m/s for all pipe sizes		

Minimum Pipe Thickness shall be as follow:

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



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VOLUME III-A
SECTION – 3
FUEL OIL SYSTEM

CONSULTANT : PROCON ENGINEERS

 MAHAGENCO Maharashtra State Power Generation Co. Ltd.	MAHARASHTRA STATE POWER GENERATION CO. LTD.	Volume: III-A
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DATA SHEET – A	FUEL OIL TRANSFER PUMPS
DATA SHEET – A	MAT COIL HEATER
DATA SHEET – A	FUEL OIL HANDLING PUMPS
DATA SHEET – A	HFO HEATERS

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1.0 GENERAL INFORMATION

1.1 HEAVY FUEL OIL SYSTEM

The fuel oil system for the plant is meant for supply of fuel oil (HFO) to the boiler up to the load of 30% rated output for support to stabilize coal firing.

1.2 LIGHT DIESEL OIL SYSTEM (LDO).

The purpose of the Light Oil supply system is to provide light oil for the start up purpose of the boiler up to 10% BMCR load.

1.3 THE FUEL OIL SYSTEM SHALL INCLUDE:

1.3.1 Fuel oil (HFO & LDO) transferring from oil tanks of existing 500MW units to HFO and LDO day tanks.

1.3.2 Fuel Oil Pressurising System for both HFO and LDO and heating of HFO is meant for supply of oil at required atomising pressure and temperature to the burners of the boiler.

1.3.3 The suction of Fuel Oil (HFO & LDO) Pressurising Unit shall be taken from outlet header of HFO/LDO day tank. Similarly HFO & LDO returns from Steam Generator and Pressurising Pumps shall be delivered to the day oil tanks through oil return headers.

1.4 For the design of the Fuel Oil system, the properties of HFO & LDO shall be considered as indicated in Volume II.

1.5 FUEL OIL SHALL BE SUPPLIED TO STEAM GENERATOR FOR THE FOLLOWING PURPOSES:

1.5.1 The HFO shall be supplied through pressurising pump & heater-sets for stabilisation of pulverised coal combustion upto 40% rated output and also for load carrying upto approximately 30% BMCR without coal firing.

1.5.2 The LDO shall be supplied for lighting up of the boiler up and for load carrying upto 10% BMCR.

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2.0 DESCRIPTION OF THE SYSTEM

- 2.1 The HFO & LDO will be transferred from the oil tanks of adjacent 500 MW units with help of HFO & LDO transferring pumps and stored in the fuel oil day tank. The oil will be supplied to boiler with the help of pressurizing pumps.
- 2.2 The suction of both HFO & LDO pressurising unit shall be taken from outlet header of HFO/LDO day tanks. Only HFO shall be heated before sending it to the Steam Generator in the heaters placed after Pressurising Pumps.
- 2.3 HFO return from Pressurising Pump and burner headers and LDO returning from Pressurising Pump shall be brought back to Day Oil Tanks.
- 2.4 The HFO lines shall be steam traced. HFO pumps and strainers shall, however be steam jacketed type.
- 2.5 HFO shall be heated in the storage tank to a suitable temperature by supplying steam through mat coil heaters for maintaining flowability of oil. Day Tanks shall also be provided with suction heaters with steam as the heating source. After pump discharge, HFO shall be further heated to a temperature of @ 110⁰ C before sending it to Boiler area. Two (2) heaters (1W+1S) shall be provided. Auxiliary steam shall be used as heating source. No such heating is required for LDO.
- 2.6 Steam lines shall be provided with necessary control stations and traps. Condensate drain from traps shall be disposed to the nearest station drain /pipe trench.
- 2.7 Suitable provision shall be provided for drainage of oil from pumps, strainers, pipings etc which shall be collected in a sump located inside Fuel Oil Pressurising Pump House. The drain line from this sump shall be terminated to the nearest drain via sump pump.
- 2.8 Suitable provision shall be made for drainage of oil pumps, strainers, piping, etc. There shall be a drain oil tank to receive the miscellaneous drains and wastes from the fuel oil transferring pump house, and this oil shall be

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returned to the Oil tanks with the help of drain oil pumps, provided the oil so collected is reasonably clean. 2.9 An oil drain header of size not less than 150 NB shall be provided to collect drain oil from Strainers, Pumps etc and return the same to the drain oil tank. The drain header shall be laid just above the ground and shall be generously pitched towards the drain tank. All oil tank lines shall have a size not less than 25 NB and shall be steam traced. The drain oil pump suction and delivery lines shall have a size not less than 25 NB and shall be steam traced. The drain oil tank shall be provided with, steam heating coil and accessories/instruments. 2.10 The drainage scheme shall be generally as per the guidelines given above. However, all additions/modifications etc as required to get the approval of the Explosive Authority and Pollution Control Board shall be done. 2.11 <u>ELECTRICAL SYSTEM</u> A complete electrical system consisting of all the required electrical equipments, XLPE cables for hoists, crane, pumps, & auxiliary loads like lighting panels, Electrical heat tracing panels, Control Panel, heat tracers etc shall be provided. All Control, Power & Special Cables, Cable Trays and support etc shall also be provided. 2.12 Power supply to Pump Motors shall be from Fuel Oil Transfer MCC located in Transfer pump house. 2.13 <u>CABLING SYSTEM</u> Cables shall be laid generally on overhead cable trays, which shall be installed along with pipe rack /sleepers. Ground floor of the building shall be cable vault and the first floor is envisaged to house LT board and Control Panel. For cable vaults, minimum 3.5 m clear height shall be maintained from finished ground floor level.		

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2.14	Cables shall be sized taking care of various factors including temperature correction, group derating, voltage drop, continuous & short circuit current requirement. <u>EARTHING SYSTEM</u> The total fuel oil system area shall be provided with independent earthing system and shall be inter-connected at minimum two (2) points with the main plant earthing system. The earthing system shall be in general covering the following: (a) Underground Earthmat of Fuel oil plant area. (b) Equipment earthing for personal safety. (c) Lightning protection for tanks & buildings. 2.15 <u>EQUIPMENT HANDLING</u> Under slung Crane in the Pump House shall be provided to handle the pumps and their components as needed for erection & maintenance. 3.0 <u>SCOPE OF SUPPLY</u> The scope of supply under this section shall include the entire Fuel Oil System for the Steam Generating unit as detailed below. 3.1 <u>HFO HANDLING SYSTEM</u> 3.1.1 HFO Transferring System 3.1.1.1 Two (2) (1W + 1S) positive displacement pumps with drives and other accessories as required and as specified in data sheets enclosed. 3.1.1.2 One (1) simplex heavy duty fuel oil pump suction strainer with isolating valves, drain valve and vent valve with pipe for each pump.	

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3.1.2 HFO Pressuring and Heating System 3.1.2.1 One (1) HFO Day oil tank with necessary accessories. 3.1.2.2 Two (2) (1W + 1S) Positive displacement type Heavy Fuel Oil (HFO) pumps with drives, base plates, support plates, grounding pads, lifting lugs, eye-bolts, anchor bolts & nuts and other accessories as required. 3.1.2.3 Two (2) (1W + 1S) Heavy fuel oil heaters (steam as heating agent) with base plates, supports, clamps and accessories. 3.1.2.4 One (1) simplex heavy duty fuel oil pump suction strainer and one (1) simplex heavy duty fuel oil pump discharge strainer with isolating valves, drain valve and vent valve with pipe for each HFO pump. 3.1.3 Instruments and Interlocks, Control & Protection System Panels. 3.1.4 Arrangement of collection of oil spillage including piping and valves. 3.1.5 Adequate supporting arrangement for all components of the system. 3.1.6 Common oil drain tank and tank mounted pump. 3.1.7 Fire Protection system shall be provided consisting of (a) Foam for HFO tanks (b) Hydrant and monitor system (c) Medium Velocity Water system for cable spreader system (d) Portable Fire extinguishers 3.2 <u>LDO HANDLING SYSTEM</u> 3.2.1 LDO Transferring System		

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3.2.1.1 Two (2) Light diesel oil (LDO) pumps (1 W + 1 S) with drives, base plates, support plates, grounding pads, lifting lugs, eye-bolts, control panels, anchor bolts & nuts and accessories. 3.2.1.2 One (1) simplex heavy duty LDO pump suction strainer with isolating valves, drain valve and vent valve with piping. 3.2.2 LDO Pressuring System 3.2.2.1 One (1) LDO Day oil tank with necessary accessories. 3.2.2.2 Two (2) (1W + 1S) Positive displacement type Light Diesel Oil (LDO) pumps with drives, base plates, support plates, grounding pads, lifting lugs, eye-bolts, anchor bolts & nuts and accessories. 3.2.2.3 One (1) simplex heavy duty LDO pump suction strainer with isolating valves, drain valve and vent valve with piping. 3.2.3 Transferring pump piping from existing oil tanks to transfer pump suction 3.2.4 Oil pump discharge piping upto day oil storage tanks 3.2.5 Instruments and Interlocks 3.2.6 Supporting arrangements for all components of the system. 3.3 One (1) Oil water separator for the Fuel Oil storage area shall be provided. 3.4 <u>TRACING OF HFO PIPE LINES</u> 3.4.1 For HFO pipelines complete steam tracing system and necessary equipment for tracing shall be provided. 3.4.2 For steam tracing necessary steam/condensate drain line, control stations and trap assembly as required shall be provided by the bidder. 3.5 One (1) drain oil tank with necessary heater (steam heated) shall be provided to receive the miscellaneous drains of HFO, LDO.		

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3.6	Two (2) recovery pumps and two (2) drain oil pumps shall be provided to re-circulate oil from oil water separator and drain oil tank respectively to HFO tanks.	
3.7	Portable hand pumps of suitable design complete with discharge spout for removal of oil from the dyke area drain sumps shall be provided.	
3.8	<u>AUXILIARY STEAM</u> Auxiliary steam required for heating of Heavy Fuel Oil shall be taken from auxiliary steam header. So, associated piping arrangement along with pressure reducing control station shall be provided.	
3.9	<u>PIPE, FITTINGS, SPECIALTIES AND VALVES</u> Pipes, fittings, specialties, traps, strainers, valves, supports/ hangers etc as per the piping system design requirement shall be as covered as per specification.	
3.10	<u>THERMAL INSULATION</u> Supply of thermal insulation along with G.I sheet, binding wire, stitching wires etc shall be provided as specified elsewhere in this specification for the following systems but not limited to the same: (a) HFO lines along with heating media (b) Auxiliary Steam lines (c) Valves, fittings & specialties as required (d) Jacketed equipment as required	
3.11	All access platforms for various valves & all pipe cross-over platforms, as required for necessary approach and crossings shall be provided.	
3.12	Anchor Bolts, Sleeves, Inserts, Foundation Plates, Lifting Lugs, Eye Bolts etc shall be supplied.	

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3.13 For details of Instrumentation & Control, refer Volume V of this specification. 3.14 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. 4.0 <u>SYSTEM DESIGN CRITERIA</u> 4.1 <u>HFO HANDLING SYSTEM</u> The basic criteria proposed to be adopted in developing the system are as follows: 4.1.1 The HFO transferring pumps shall have standby pump 4.1.2 Suitable inline strainer upstream of pump to safeguard the pumps. 4.1.3 Steam tracing of HFO lines and equipment to maintain the fluidity of HFO for transportation. 4.1.4 One (1) storage tank shall be used, capacity is 500 cubic meter. The tank size shall be calculated as per the guidelines in Petroleum Act and IS Code. 4.1.5 Fuel oil transferring pumps will be 2 x 100% of capacity such that storage tank shall be filled in 4 hour. 4.1.6 HFO Transferring Pumps The 2 X 100% pumps are proposed i.e. one working & one standby. The pump capacity is sized to transfer oil in four hour. (a) Design flow capacity, each : shall be minimum 125 m³/hr (b) Normal inlet temperature : 60⁰ C within ± 5⁰ C The pump shall be horizontal positive displacement type with casing heating arrangement.		

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4.1.7 HFO Pressurising pumps (a) Design flow capacity : 100% of the maximum Steam Generator requirement of Heavy Fuel Oil including continuous recirculation from burner header end and 10% spare capacity. One spare pump shall be supplied for the unit. (b) Normal inlet temperature : 60°C within $\pm 5^{\circ}\text{C}$ 4.1.8 HFO Heaters Design oil flow of each heater shall be matching to each pump capacity and shall maintain the outlet temperature of HFO as required at the burner header. Working Oil pressure shall be as per requirement and design oil pressure shall be 1.5 times the working pressure. Total number of heaters shall be same as the pumps. 4.2 <u>LDO HANDLING SYSTEM</u> 4.2.1 LDO Transferring Pumps The head of the pump shall be same as that of HFO system (a) Design flow capacity, each : shall be minimum 200 Cu.m/hr (b) Normal inlet temperature : 8 - 45⁰ C 4.2.2 LDO Pressurising Pumps For supplying LDO to burners of the boiler, there shall be Two (2) (1W + 1S) Pumps for the unit as follows: (a) Design flow capacity : 100% of the maximum boiler requirement of Light Diesel Oil including 10% spare capacity		

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(b) Normal inlet temp : 8 - 45°C

4.3 HFO/LDO Pressurising Pumps Recirculation Control Valves

(a) Maximum flow : Full pump discharge flow.
capacity

(b) Minimum flow : 10% of pump discharge.
capacity

4.4 PIPE, FITTINGS & SPECIALTIES

4.4.1 Determination of diameters of various pipes in the F.O. Handling system shall be done based on the flow rates established by the system designer/ Bidder. Velocity for HFO and LDO shall be considered as 2 m/s.

4.4.2 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-I, "Specification of pipes for different services" of Section-II in volume III-F) at design temperature and the pressure as determined by the system designer/Bidder.

4.4.3 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.

4.4.4 All valves shall function smoothly without sticking, rubbing, vibrating etc. during operation.

4.4.5 Drain pipe size shall be 25 NB as minimum.

5.0 CODES AND STANDARDS

5.1 In addition to the requirements spelt out in Volume II, 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:

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(a) IS-1593 : Code for Heavy Fuel Oil (HFO) (b) IS-1460 : Code for Light Diesel Oil (LDO) (c) IS-817 : Code of practice for training & testing of use of metal arc Welding (d) IS-823 : Code of procedure for manual metal arc welding of mild steel. (e) IS-816 : Code of practice for use of metal arc welding for general construction in mild steel (f) IS-4503 : Code for design & manufacture of Heater. (g) ANSI B31.1 : Design of power piping system (h) API-600 : Code for design & construction of gate valve for sizes 50 NB or above (i) API-602 : Code for design & construction of gate valve for sizes below 50 NB (j) API-598 : Code for testing of gate valve (k) BS-1863 : Code for design & testing of check valve (l) BS-5351 : Code for design & testing of ball valve (m) API-599 : Code for design & testing of plug valve (n) IS-8183 : Specification for Bonded Mineral Wools Group 4 (o) IS-9842 : Specification for Preformed Fibrous Pipe Insulation Group 3 (p) IS-277 : Specification for Galvanised Steel Sheet (q) IS-7413 : Code of practice for the Application and			

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Finishing of Thermal Insulating Materials at temperatures between 40 °C and 700 °C 5.2 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 Owner/Consultants shall accept the design only if the Owner is satisfied that sufficient experience exists with the design proposed. 5.3 In addition to the above requirements, all equipment and procedure shall comply with applicable laws regulations and requirements of the state in which the project is located. 5.4 A fuel oil dyke area shall be provided as per Petroleum Act & Rules 5.5 The complete day oil storage tank and supply system shall meet the requirements of Indian Petroleum Rules; Specific approval from Chief Contractor of Explosives shall be obtained by the CONTRACTOR. 6.0 <u>DESIGN & CONSTRUCTION</u> 6.1 <u>PUMPS</u> 6.1.1 Pumps shall be of positive displacement type with gear, screw or sliding vane rotary type or any other rotating element as per Data Sheet-A enclosed. Capacity of fuel oil pump shall be selected considering minimum expected viscosity of the fluid being pumped. 6.1.2 Bearing Bearing shall be antifriction ball or roller preferably split type or sleeve type. Bearings shall be adequately sized to absorb radial as well as axial thrust loads, if any. Bearings shall be of external type. In the latter case, provision of lubrication of the bearings by oil or grease shall be made.		

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6.1.3 Mechanical Seal Mechanical seal shall be provided at roots where the shaft extends from the casing. The seal material shall have low co-efficient of friction and shall be suitable for the fluid handled. 6.1.4 Relief Valve (a) Each pump shall have relief valve either built-in with the body or end plate, or attachable as specified elsewhere for protection against damage due to accidental closure of discharge valve & pressure build up. (b) The capacity of the relief valve shall be at least that of the pump to ensure the full discharge of liquid through the bypass line to the suction side of the pump during accidental pressure build up. (c) The relief valve body shall be stainless steel. 6.1.5 Jacketed Body HFO Transferring and pressurizing pumps and strainers at pump suction and discharge shall be of steam jacketed type. 6.1.6 Timing Gear Timing gear shall be provided to transmit torque from one rotor shaft to another and to maintain the proper angular relationship of the rotors. Proper lubricating arrangement for this shall be provided. 6.1.7 Coupling (a) Pump shall be connected to its drive by means of flexible coupling. (b) Coupling guard shall be provided.		

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6.1.8	Base plate Common base plate for the pump and motor shall be provided. The base plate shall be suitably drilled for the anchor bolts. The base plate shall have drip pan and suitable draining arrangement.	
6.1.9	Material Of Construction For material of construction for the vital parts of the pump, Data sheet-A shall be referred.	
6.1.10	Strainer (a) The simplex strainer shall have basket type straining elements permitting easy removal and replacement. (b) The open area ratio (i.e. straining area to the inlet area ratio) shall be at least 6:1. (c) The strainer shall have screen of stainless steel (AISI-304) construction with wire diameter of about 0.01 inch and open area of about 50%. Strainer screen shall be of 80 mesh. (d) Strainer body shall be made of Mild steel. No cast iron component shall be used in F.O. system. (e) Strainer shall be provided with a pair of counter flanges and associated bolts nuts and gaskets. Material of counter flanges shall be of tested quality steel conforming to IS-2062. (f) All strainers shall also be provided with oil drip plates beneath them for collection of oil. (g) Bolts and nuts shall be as per IS-1363. Gaskets shall be minimum 3 mm thick and made of compressed non asbestos fibre as per IS-2712. (h) Strainer shall be monitored for differential pressure indication and alarm.	

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6.1.11 Drive Motor

The design and construction of the drive motor shall be as specified in specification for electric motor presented in **Volume IV**.

The drive motors for Oil Handling System shall also comply with the following requirement.

- (a) Enclosure shall be sufficiently strong so as to withstand internal explosion that may occur within the motor. The enclosure shall also be provided with such devices as may be necessary to protect the motor from damage if an electrical defect such as sparking occurs accidentally due to internal fault in the apparatus like failure of insulation/fracture of conductor/loose connection.
- (b) The surface temperature of the enclosure shall be kept within such value so as not to ignite the oil vapour, under any condition of operation.
- (c) The enclosure shall be constructed complying requirements of flameproof construction: IS-2148.
- (d) Ratings of pump motor shall be selected considering maximum expected viscosity of the fluid being pumped.

6.2 HFO AND LDO DAY TANKS

The tanks shall be of M.S. Construction and shall be as per IS-803 and API-650 as applicable. The fuel oil day 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 day tanks shall be located adjacent to the fuel oil pressurizing pump house.

- 6.2.1 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

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drawings/documents shall be got approved by Directorate of Explosive, Govt of India. 6.2.2 For cylindrical tanks, the plates shall be cold rolled through plate bending machine by several number of passes to true curvature. 6.2.3 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. 6.2.4 Where possible, the inside seam weld shall be ground smooth, suitable for application of corrosion resistant primer. 6.2.5 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. 6.2.6 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks. 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. 6.2.7 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. 6.2.8 The joint efficiency factor to be adopted for design calculation shall be in accordance with the applicable standard. 6.2.9 All welding shall be done as per IS: 816, latest revision. All welds are to be continuous welds. 6.2.10 Sufficient air space shall to be provided in the tank. Temperature expansion of oil shall be taken into account.		

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(c) Flame Arrestor Each vent connection on tanks shall be provided with a flame arrestor design 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. (d) 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 65 mm 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. (e) Level Transmitter HFO & LDO tank shall be provided with a radar type level transmitter to ensure safe and reliable operation. (f) Each tank shall be provided with spiral stairway with handrail and an internal vertical ladder. (g) Each tank shall have one roof manhole and one shell manhole of not less than 600 mm diameter. (h) All other accessories, fittings and tank connections including level switches, etc, as required, for sound engineering practice shall be provided. 6.2.13 Installation of HFO & LDO 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.		

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(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 Owner'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 Engineer. 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 Owner. (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. 6.2.14 Surface preparation and painting Both internal and external surface preparation of the oil tank shall be done by sand blasting. 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 bit mastic paint shall be applied.		

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Fuel Oil Heaters

- (a) Each heater shall be located adjacent to each fuel oil pump preferably on a common structural steel base plate with suitable drip lip and plugged drain connection.
- (b) The heater shall be shell and tube type heat exchanger designed as per TEMA/IS-4503 or equivalent to meet the performance requirements as given. The heat exchanger shall be shell/straight tube single pass type having oil flow through the tubes. Care shall be taken in design and construction to prevent oil leakage into steam space.
- (c) Suitable lugs for gripping the insulation material shall be provided on the heater shell.
- (d) Each heater shall be furnished with cast steel flanged relief valves to protect the heater from excess pressure and air vents with valves in the oil and the steam compartment. Steam trap outlets and all drains shall be brought to one common point.

6.3 CONDENSATE SYSTEM

After releasing latent heat to the HFO oil in the storage tanks, heating steam shall be converted to hot condensate, which shall be brought to auxiliary flash tank from where it will be drained to WTP or area drainage. Necessary piping & accessories for efficient operation of condensate system shall be provided. Suitable trap stations shall be provided along heat tracing system.

The flash tank shall be of 1500 mm diameter and 2000 mm height.

A portion of hot condensate from transferring area shall be used to heat oil in oil water separator, and rest shall be released to atmosphere.

6.4 DYKE AREA

RCC dyke wall shall be provided around each tank. The dyke will be able to accommodate the oil from the tank during leakage.

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The width of the dyke is calculated considering 10 m clearance from tank to dyke on both sides. The out to out clearance maintained in two tanks. The enclosed dyke of 30 m long x 16 m wide of 1.25 m height shall be provided. The maximum allowable dyke height as per Petroleum Act, 2002 is 2m; the height of dyke around each tank is meeting the stipulation. 6.5 <u>DRAIN OIL TANK</u> Drain oil tank is envisaged to collect oil from HFO/LDO tanks. The drain oil pump will be used to transfer oil back to tanks. 6.6 <u>WASTE OIL COLLECTION</u> Waste oil from the dyke area shall be collected in a separation pit. Water and oil will be separated. 6.7 <u>POTABLE WATER</u> Potable water will be arranged from the plant domestic water system. Local PVC tank of 500 litre shall be provided. 6.8 <u>SERVICE WATER</u> Service water will be provided from the service water system. The service water will be provided at the following areas: (a) Fuel oil transfer pump house – ground floor – 2 nos. (b) Fuel oil transfer pump house – outdoor – 1 no. (c) Fuel oil storage area – outdoor – 1 no.		

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6.9	<u>A/C AND VENTILATION SYSTEM</u> The Control room shall be air conditioned with the help of split A/C unit. The electrical room and cable spreader room shall have pressurized system with filtered air with 16 Air changes for Electrical room& 6 air changes for cable spreader room. The pump house bay shall have exhaust vent system with 16 air changes. 6.10 <u>LAYOUT</u> The transferring pumps, suction strainers including electrical MCC & Control panel shall be located in the Fuel Oil Transfer Pump House. The storage tanks will be outdoor and necessary dyke shall be provided as per the clauses mentioned in Petroleum Act. Suitable barbed wire fence shall be provided. The dyke area shall have slope to collect drains. Dyke height shall be of 1.25 m. The oil storage tanks shall be located next to the Fuel oil pressurizing pump house. Dry chemical powder type fire extinguisher shall be placed outside the dyke area. 6.11 <u>POWER SUPPLY SYSTEM</u> (a) Power supply for fuel oil transfer pump house at 415 V level shall be obtained through two (2) feeders each 100% standby of other. The Fuel Oil Transfer pump house shall be fed from Main CHP PMCC. Power to 415 V Fuel Oil Transfer system shall be derived from the Fuel Oil Transfer MCC. LT XLPE cables (1.1 kV grade) shall be provided for power supply from the 415 V Main CHP. The cables shall be laid on cable trays inside cable vaults or through overhead cable trays and shall terminate at the 415 V LT board meant for fuel oil transfer system.	

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	(b) 415 V LT board shall comprise two (2) incomers and required number of outgoing feeders (motors + auxiliary loads). The board shall cater to all LT loads. The fault level of the board shall be 50 kA for 1 sec. Mechanical castle key interlock shall be provided between two incomers so that only one incomer can be closed at a time. Sectionalized bus shall be provided for the consideration of bus fault. The LT board may have MCCB/Fuse-switch unit as incomer. (c) Local push buttons stations shall be installed near the drive for start / stop operation. (d) A separate electrical panel room of adequate dimension shall be provided to accommodate the LT board and the local control panel. Panels shall be suitable for cable entry from bottom. Cable vault shall be provided below the electrical equipment room. Cable trenches shall be provided for laying the cables from the panels to the equipment. (e) Illumination Power supply to illumination system shall be taken from LT board and feed to the lighting panels. Separate lighting panel shall be provided for indoor & outdoor illumination. Outdoor illumination shall be controlled through photocell.	
7.0	<u>INSTRUMENTATION AND CONTROL</u>	
7.1	<u>CONTROL AND OPERATION PHILOSOPHY</u>	
7.1.1	The HFO and LDO Pressurizing Pumps shall be provided with start / stop facility from the LCP and also from Unit Control Room. The pressurizing pumps shall, however, be automatically tripped in the event of any of the followings: (a) Low level in the connected storage tanks (b) Pump suction temperature lower than 55°C (for HFO only).	

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The stand by pressurising pump shall be automatically started in the event of either low pressure in respective pump discharge header or tripping of any of the running pumps. 7.1.2 Drain oil pumps and recovery oil pumps shall have manual control/operation from the LCP. Drain oil pump shall, however, be automatically tripped in the event of low level in drain oil tank. 7.1.3 Steam flow to each HFO heater shall be independently regulated by means of automatic control valve on steam line and actuated from heater outlet oil temperature. The motorised valves on steam supply lines to HFO heaters shall have start/stop facilities from the LCP and also from the Unit Control Room. 7.1.4 Individual recirculation control valve shall be provided for each HFO and each LDO pressurising pump to maintain the pump discharge. 7.2 <u>LOCAL CONTROL PANEL</u> All logic, sequence, closed loop controls shall be configured in the programmable logic controller (PLC). The local control panel for control and monitoring of the fuel oil shall be located in the Fuel oil pump house and shall house the PLCs and all necessary start/stop push buttons, auxiliary relays, control switches, meters, indicators, status indication lamps etc. to achieve the control philosophy described above. This panel shall also include the entire annunciation described below. 7.3 <u>ANNUNCIATIONS</u> For safe and reliable operation control of the Fuel Oil System all necessary annunciations are to be provided which shall include but not be limited to the followings: (a) High level in drain oil tank (b) Low level in drain oil tank (c) High differential pressure across each strainer in HFO line at pressurising pump suction and at heater outlet.		

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(d) High differential pressure across strainer at pressurising pump suction in LDO line. (e) High pressure at discharge of each HFO pressurising pumps (f) High pressure at discharge of each LDO pressurising pumps (g) High and low pressure at discharge header of HFO heaters (h) High pressure at discharge header of LDO pressuring pumps (i) High temperature at outlet of each HFO heater (j) Low temperature at outlet of each HFO heater 7.4 In addition to the requirement spelt out above, all instruments & controls as shown in drawing no. PE-189-PF-215 and as found necessary for safe and trouble free operation of the system - shall be provided. Bidder shall refer I&C Specification Volume V. 8.0 <u>DRAWINGS, DATA AND MANUALS</u> 8.1 For Drawing, Data and Information required along with BID refer Volume VIII.		

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FUEL OIL CHARACTERISTICS

[AS PER IS 1593 WITH AMENDMENTS]

DATA SHEET-A

<u>SR. NO.</u>	<u>CHARACTERISTICS</u>	<u>HEAVY FURNACE OIL GRADE LV</u>
1.0	Total sulphur content, percent by weight	4.5% (Max.)
2.0	Gross calorific value of the order	10000 kcal/kg
3.0	Flash Point (Min.)	66 ⁰ C
4.0	Water content by Volume (Max.)	1.0%
5.0	Sediment by weight (Max.)	0.25%
6.0	Asphaltene content by weight (Max.)	2.5%
7.0	Kinematic Viscosity in Centistokes at 50 Deg.C	370 (Max.) 180
	At 98.9 Deg.C --	20 - 30
8.0	Ash Content by weight (Max.)	0.1%
9.0	Acidity (in inorganic)	Nil
10.0	Pour Point (Max.)	66 ⁰ C (Max.)
11.0	Sodium content	--
12.0	Vanadium content	25 ppm
13.0	Specific heat (kcal/kg. Deg.C)	0.5
14.0	Relative density at 15 Deg.C	0.89 (Approx.)

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LIGHT DIESEL OIL CHARACTERISTICS

[AS PER IS 1460 WITH AMENDMENTS]

DATA SHEET-A

<u>SR. NO.</u>	<u>CHARACTERISTICS</u>	<u>LIGHT DIESEL OIL</u>
1.0	Pour Point (Max.)	12 Deg.C & 21 Deg.C for Winter and Summer respectively
2.0	Kinematic viscosity in centistokes at 40 Deg.C	2.5 to 15.7
3.0	Water content, percent by volume (Max.)	0.25
4.0	Sediment percent by mass (Max.)	0.10
5.0	Total sulfur percent by mass (Max.)	1.8
6.0	Ash percent by mass (Max.)	0.02
7.0	Carbon residue (Ramsbottom) percent by wt. (Max.)	1.50
8.0	Acidity in organic	Nil
9.0	Flash point (Min.) (Pensky Martens) closed cup	66 ⁰ C
10.0	Acidity, total, mg of KOH/g (Max.)	Nil
11.0	Copper strip corrosion for 3 hours at 100 Deg.C	Not worse than No.2
12.0	Relative density at 15 ⁰ C	0.82 – 0.86

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FUEL OIL TRANSFER PUMPS

DATA SHEET-A

<u>SR.NO</u>	<u>DESCRIPTION</u>	<u>HFO TRANSFERRING PUMP</u>	<u>LDO TRANSFERRING PUMP</u>
1.0	Service	Fuel oil	Fuel oil
2.0	Duty	Intermittent	Intermittent
3.0	Location	Indoor	Indoor
4.0	No. of Pumps	Two (2)	Two (2)
	Working	1	1
	Standby	1	1
5.0	Type of Oil to be Handled	Heavy Fuel Oil	Light Diesel Oil
6.0	Handling temperature	60°C within $\pm 5^{\circ}\text{C}$	8°C to 45°C
7.0	Installation	Horizontal with external bearing	Horizontal with external bearing
8.0	Type	Rotary positive Displacement type	Rotary positive Displacement type
9.0	Design Capacity at lowest viscosity	Bidder to indicate	Bidder to indicate
10.0	Rated Capacity at handling temperature	Bidder to indicate	Bidder to indicate
11.0	Differential Pressure corresponding to rated	Bidder to indicate	Bidder to indicate

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<u>SR.NO</u>	<u>DESCRIPTION</u>	<u>HFO TRANSFERRING PUMP</u>	<u>LDO TRANSFERRING PUMP</u>
	capacity		
12.0	Pump rated TDH	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 Relief valve Type Value of set pressure of relief valve	Yes Inbuilt adjustable set pressure type 1.1 times of rated differential pressure	Yes Inbuilt adjustable set pressure type 1.1 times of rated differential pressure
16.0	Mechanical seal	Yes	Yes
17.0	Lubrication	External grease lubricated	External grease lubricated
18.0	Body steam jacketed	Yes	Yes
19.0	Timing gear	Yes	Yes
20.0	Suction & discharge pressure gauge connection	Yes	Yes
21.0	Suction temperature gauge connectio	Yes	Yes
22.0	Other accessories if required for cooling / ealing /	Yes	Yes

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<u>SR.NO</u>	<u>DESCRIPTION</u>	<u>HFO TRANSFERRING PUMP</u>	<u>LDO TRANSFERRING PUMP</u>
	lubrication etc		
23.0	Bearing	Yes	Yes
24.0	Base plate	Yes	Yes
25.0	Lifting lug/eye bolts etc	Yes	Yes
26.0	Tools & tackle and spare parts	Yes	Yes
27.0	Shop Painting	Yes	Yes
28.0	Material of Construction		
29.0	Casing	Cast iron IS;210 Gr.FG.260	Cast iron IS;210 Gr.FG.260
30.0	Casing liner	Cast iron IS;210 Gr.FG.260	Cast iron IS;210 Gr.FG.260
31.0	Rotor	ASTM-A-276	ASTM-A-276
32.0	Rotor housing	Type 431 Mild Steel	Type 431 Mild Steel
33.0	Shaft	Yes	Yes
34.0	Mechanical seal	Yes	Yes
35.0	Reduction gear Body Gears	Yes	Yes
36.0	Screw	Yes	Yes
37.0	Coupling	Yes	Yes
38.0	Base plate	Yes	Yes

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