

**TELANGANA STATE POWER GENERATION
CORPORATION LTD**

1X800 MW KOTHAGUDEM TPS

VOLUME IIB & III

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

SPECIFICATION NO. : PE-TS-410-166-A001



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

VOLUME – IIB & III

SECTION -

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SECTION-A

INTENT OF SPECIFICATION



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1.0 INTENT OF SPECIFICATION

- 1.1** The specification covers design, engineering, manufacture, supply / procurement, inspection and testing at vendor's / sub vendor's / manufacturer's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation, storage, preservation, security / safety at site, Erection & Commissioning, minor civil & structural (as applicable) works as required on FOR site basis, demonstration testing and handing over to BHEL's customer of **Fuel Oil Handling System** as per details in different sections / volumes of this specification and various pre award agreements for **1X800 MW KOTHAGUDEM TPS**.
- 1.2** The contractor shall be responsible for providing all material, equipment & services, which are required to fulfil the intent of ensuring operability, maintainability, reliability and complete safety of the complete work covered under this specification, irrespective of whether it has been specifically listed herein or not. Omission of specific reference to any component / accessory necessary for proper performance of the equipment shall not relieve the contractor of the responsibility of providing such facilities to complete the supply, erection and commissioning, demonstration testing of **Fuel Oil Handling System**
- 1.3** It is not the intent to specify herein all the details of design and manufacture. However, the equipment shall conform in all respects to highest standards of design, engineering and workmanship and shall be capable of performing the required duties in a manner acceptable to purchaser who will interpret the meaning of drawings and specifications and shall be entitled to reject any work or material which in his judgement is not in full accordance herewith.
- 1.4** The extent of supply under the contract includes all items shown in the drawings, notwithstanding the fact that such items may have been omitted from the specification or schedules. Similarly, the extent of supply also includes all items mentioned in the specification and /or schedules, notwithstanding the fact that such items may have been omitted in the drawing. Similarly, the extent of supply also includes all items required for completion of the system and not withstanding that they may have been omitted in drawings / specifications or schedules.
- 1.5** The general term and conditions, instructions to tenderers and other attachment referred to elsewhere are made part of the tender specification. The equipment materials and works covered by this specification is subject to compliance to all attachments referred to in the specification. The bidder shall be responsible for and governed by all requirements stipulated herein.
- 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



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to seek any clarification on specification requirement in the format enclosed under Vol-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 Vol – 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, Section - C shall prevail over section – D, however 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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**PROJECT INFORMATION WITH WIND AND SEISMIC DESIGN
CRITERIA**

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SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	INTRODUCTION
2.00.00	APPROACH TO SITE
3.00.00	LAND
4.00.00	SOURCE OF COAL
5.00.00	SOURCE OF WATER
6.00.00	ASH DISPOSAL AREA
7.00.00	SALIENT DESIGN DATA

VOLUME : IIA

SECTION-II

PROJECT SYNOPSIS AND GENERAL INFORMATION

1.00.00 INTRODUCTION

The proposed 1x800 MW Kothagudem Thermal Power Station (KTPS), Stage-VII, Unit-12 would be set up by Telangana State Power Corporation Ltd. (TSGENCO) at Kothagudem, Telangana. The proposed Power Plant will be installed adjacent to the existing D colony of Kothagudem Thermal Power Station, at Kothagudem.

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 here in 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.

2.00.00 APPROACH TO SITE

Site is located in the existing D Colony of Kothagudem Thermal Power Station, which is at a distance 30 km from temple town of Bhadrachalam and 300 km from Hyderabad by road. The Nearest railway station is Bhadrachalam Road (Known as Kothagudem) at a distance of 12 km. Kothagudem- Bhadrachalam National Highway branches off to the power station site near village Paloncha.

3.00.00 LAND

Land is primarily required for the main plant & auxiliaries (BTG) and balance of plant (BOP) like ash handling, coal storage, cooling tower, switchyard etc., which is available within the existing plant boundary.

The existing colony is to be dismantled, and the land of about 137 acres will be used for the main plant building, water facilities, switchyard, coal handling etc. The raw water reservoir will be located adjacent to the existing raw water reservoirs.

230 acres of land required for Ash Dyke will be procured. Land is available for staff colony, which is to be constructed by the EPC contractor.

4.00.00 SOURCE OF COAL

100% Imported and Blended coal (50% imported + 50% indigenous) will be used. Indigenous coal shall be sourced from Suliyari coal mines, Madhya Pradesh.

5.00.00 **SOURCE OF WATER**

Source of water (total quantity of water is 2192 m³/hr) is Godavari River near Burgampahad & water will be pumped through existing GRP pipe line (of length approx. 26 km).

6.00.00 **ASH DISPOSAL AREA**

Ash shall be dumped in the ash dump area which will be about 9 km from plant. The ash dyke area of 230 acres is adequate for 1x800 MW unit as per MOEF norms.

7.00.00 **SALIENT DESIGN DATA**

7.01.00 Meteorological data of site is given below:-

Elevation above MSL : 89 m

Monthly highest temperature : 44.9 °C

Monthly lowest temperature. : 12.9 °C

Rainfall

Average.: 1031 mm

Max. : 100 mm/ hr

Mean Wind speed : 44 m/sec

Relative Humidity

Max : 82%

Min : 35%

Seismic Zone : Zone-III as per IS- 1893 (Part-IV)

[Climatological data of Khammam is attached for reference].

TELANGANA STATE POWER GENERATION CORPORATION LIMITED

Office of the
Chief Engineer/Civil
Thermal, Vidyut Soudha
HYDERABAD – 500 082.

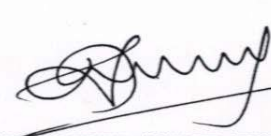
U.O to Chief Engineer/TPC.

Sub: Kothagudem Thermal Power Station Stage VII (1x800MW) – Inputs for M/s BHEL regarding Climatology and meteorology data for designing of Air Conditioning System and ventilation system - Data furnished – Reg.

The details of Climatology and meteorology data for designing of Air Conditioning System and ventilation system is as follows for KTPS Stage VII (1x800 MW).

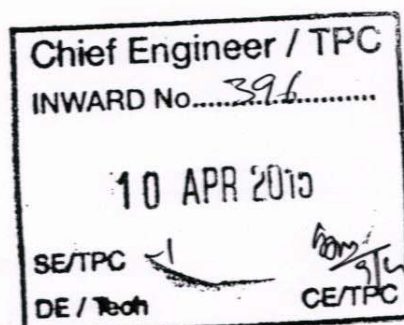
		Summer	Monsoon	Winter
Dry Bulb Temperature (°C)	I	29.0 (Min)	27.4 (Min)	22.4 (Min)
	II	37.1 (Max)	31.0 (Max)	29.1 (Max)
Wet Bulb Temperature (°C)	I	24.2 (Min)	24.9 (Min)	20.1 (Min)
	II	24.0 (Max)	25.7 (Max)	21.6 (Max)

This is furnished for taking further necessary action.


CHIEF ENGINEER/CIVIL/THERMAL

To
The Chief Engineer/TPC,
TSGENCO, Vidyut Soudha,
Hyderabad-82.

U.O.No. CE/Civil/Thermal/ KTPSD//F.KTPS Stage VII/ D.No:23 /2015-16, Dt.09-04-2015.



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TECHNICAL SPECIFICATIONS



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SPECIFIC TECHNICAL REQUIREMENT



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1.0.0 SYSTEM DESCRIPTION

Light Diesel Oil (LDO) shall be used for initial startup (upto 10% BMCR) while Heavy Fuel Oil (HFO) shall be used upto 30% BMCR and for flame stabilization. The Fuel Oil Handling System to be considered comprises unloading & storage of HFO and LDO.

This system write up is to be read in conjunction with the flow schemes enclosed.

1.1.0 Heavy Fuel Oil System

Heavy Fuel Oil (HFO) shall be delivered to power station site in one full rake consisting of 48 Nos. OF BTPN railway wagons each of approx. capacity 55-65 CUM. As per plot plan, track length of 300m corresponding to 24 nos. of BTPN wagons is available. Out of the full rake, 24 nos. of wagons will be unloaded through steel / GI augmented neoprene unloading hoses of matching size and rest of the wagons will be taken by customer in existing FO unloading area. The Fuel Oil unloading system will have 48 Nos. of unloading points (2 unloading points per wagon).

BTPN wagons are not equipped with heating facility. Hence, no heating of wagons is considered.

Fuel oil from wagons will be collected in unloading header (min. size 400 NB) laid along with track. Oil from the unloading header shall be pumped to HFO storage tank with the help of unloading pumps as indicated in the flow diagram. The Fuel Oil unloading pumps are of rotary positive displacement, twin screw type, sump heated and provided with matching capacity simplex strainers (steam heated) at their suction with interconnecting piping and valves as shown in the enclosed flow schemes.

One (1) nos. HFO storage tanks of effective capacity 2000 m³ is envisaged. The tank shall be provided with steam floor coil heaters at the bottom of the tank to raise the temperature of oil from 5°C to the handling / tank maintenance temp. of 50°C in 72 hrs. time and maintaining the temperature inside the tank at 50°C. The floor coil heater for the Fuel oil storage tanks shall have adequate nos. of sections and shall be regulated through one no. pneumatically operated modulating type control valve provided on steam supply line. This shall be actuated from tank temperature.

One no. shell and tube type suction heater is also provided on the tank to supply oil to pressurizing pump house at required temperature. Temperature will be regulated through one pneumatically operated modulating type control valve on the steam supply line. Initial and final temperature for suction heater shall be 50 deg. C and 60 deg. C respectively. However, suction heater will be designed for a temperature rise of 20 deg. C. All modulating control valves shall be of SMART type.

Interconnecting piping, valves and instruments as indicated in the Flow diagram for HFO system shall be provided. Piping, valves and other equipment shall be steam traced and insulated.

4.2.0 Light Diesel System (LDO)

Light Diesel Oil (LDO) shall be delivered to power station site in one full rake consisting of 48 Nos. OF BTPN railway wagons each of approx. capacity 55-65 CUM. As per plot plan, track length of 300m corresponding to 24 nos. of BTPN wagons is available. Out of the full rake, 24 nos. of wagons will be unloaded through steel / GI augmented neoprene unloading hoses of matching size and rest of the wagons and these wagons if the oil will be left in it will be taken by customer in existing FO



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unloading area. The Fuel Oil unloading system will have 48 Nos. of unloading points (2 unloading points per wagon).

Fuel oil from wagons will be collected in unloading header (min. size 400 NB) laid along with track. Oil from the unloading header shall be pumped to LDO storage tank with the help of unloading pumps as indicated in the flow diagram. LDO unloading pumps are of rotary positive displacement, twin screw type and provided with matching capacity simplex strainers at their suction with interconnecting piping and valves as shown in the enclosed flow schemes.

One (1) nos. LDO storage tank of effective capacity 500 m³ is envisaged.

Interconnecting piping, valves and instruments as indicated in the Flow diagram for LDO system shall be provided.

1.3.0 Steam & Condensate System

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

A condensate flash tank shall be provided by BHEL-Piping Center in the tank farm for collecting condensate from tank (floor coil heater and Suction heater) before discharging it to Oil Water Separator pit.

Condensate formed in Common unloading pump house i.e. pumps, strainers, drain oil tank shall be fed to sump in common FO unloading pump house.

1.4.0 Drain Oil System, Sump water & Oil Water Separation

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

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

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

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

Two (2) nos. vertical centrifugal type pumps of capacity 10 cum/hr. is also envisaged in FO unloading area to pump the oil water mixture to oil water separator pits in these areas.

Separated water from Oil Water Separator will be discharged to CMB by ETP supplier.

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

During rainy season, water from unloading area drain trench and from tank dyke area having very little or no trace of oil shall be diverted to nearest plant drain without letting it go to the OWS



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facility. Two valves in catch pit will be provided. Opening one valve, water inside dyke area will be routed to Oil water separator pit and from other valve it will be channeled towards plant drain (rainy season). These valves shall be provided with limit switch for monitoring.

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

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

2.0.0 Instrumentation & Control

Operation and Control of Fuel Oil unloading and storage system will be from DCS (Typ) as well as through Local Control Panel (RTU) provided near the FOHS area. Instrumentation shall be as shown in Process & Instrumentation Diagram for FOHS (Draw.no. PE-DG-410-166-A101/A102/A103).

1. 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 tanks is open. Signals from Limit switches provided at tank inlet shall be used.
- b) Operation (start / stop) of unloading pumps, recovery oil pump, sump pump.
- c) Interlocking of operation of unloading pumps, drain oil pump, recovery oil pump, 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 unloading pumps
- f) Low level in storage tanks will be used for annunciation purposes in the unloading pump house to alert the operator for tank inventory.
- g) Fuel Oil Unloading & Storage System operation and control instrumentation shall also be governed by following documents:
 - Control System for Mechanical Auxiliary Package: **PE-DM-410-145-I900**
 - Drive Control Philosophy (Station C&I): **PE-DM-410-145-I002**

2. Local control panel (without any control system) shall be provided by vendor and shall have provision for hardwired annunciation facia, push button lamps, colored mimics etc. Bidder shall connect the same up to terminal box (panel itself). Further cabling with DCS panel shall be in BHEL scope.

3.0.0 SCOPE OF WORK

Design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at site, unloading, handling & transportation at site, Erection & Commissioning, minor civil works as required, Performance and guarantee testing and handing over of Fuel Oil System shall be as per details in different sections of this specification.



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P&I Diagram and write-up for Fuel Oil Handling System (for tender purpose) is enclosed with the specification. Detailed P&I Diagrams, System write up & Control philosophy shall be furnished by the successful bidder during detail engineering & the same shall be subject to customer approval without any commercial implication.

3.1.0 SCOPE OF SUPPLY

Scope of supply by bidder shall comprise of but not necessarily limited to the following. P&I Diagrams may please be referred.

- 1) Three (3) (2W+1S) nos. LDO twin screw unloading pump motor set each of capacity 150 cum/hr. with twin simplex type strainers of matching capacity at the suction of each pump.
- 2) Two (2) (1W+1S) nos. LDO twin screw unloading pump motor set each of capacity 25 cum/hr. with twin simplex type strainers of matching capacity at the suction of each pump.
- 3) Three (3) (2W+1S) nos. HFO twin screw unloading pump motor set each of capacity 150 cum/hr. with twin simplex type strainers of matching capacity at the suction of each pump.
- 4) Two (2) (1W+1S) nos. HFO twin screw unloading pump motor set each of capacity 25 cum/hr. with twin simplex type strainers of matching capacity at the suction of each pump.
- 5) 48 Nos. 80 NB LDO and HFO unloading hoses with hose stand for. Total no. of unloading points for HFO and LDO will be 48 nos.
- 6) One nos. of fixed roof type M.S storage tanks for LDO storage of effective capacity 500 cum each along with accessories as indicated in P&ID
- 7) One nos. of fixed roof type M.S storage tanks for HFO storage of effective capacity 2000 cum each along floor coil heater and other accessories as indicated in P&ID.
- 8) One no. suction heater on HFO tank of required size.
- 9) Floor coil heater for the tank (pipe for floor coil heater of drain oil tank and main storage tank shall be in vendor scope).
- 10) Control valves for controlling steam flow to Floor coil heating and Suction heater installed on FO storage tank and Drain oil tank inside FO unloading pump house
- 11) Pressure reducing and De-Superheating station of required size (No heating of rail wagons to be considered).
- 12) Traps for separating condensate from steam.
- 13) Coriolis type mass flowmeter in HFO and LDO discharge header.
- 14) One (1) no. single chamber gravity type oil water separator pit along with its accessories.
- 15) Instrumentation & control System including instruments, interlocking & protection devices complete in all respects required for safe, efficient and reliable operation of the plant and to be read in conjunction with C&I portion of specification. Minimum instrument and control system requirement is mentioned in the P&ID.
- 16) Two (2) nos. (1W+1S) Vertical Single screw type Drain oil pump motor set of capacity 5 m3/hr. in Drain oil tank.
- 17) Two (2) nos. (1W+1S) Vertical Single screw type recovery oil pump motor set of Capacity 5 m3/hr. in Oil pit of Oil Water Separator.
- 18) Two (2) nos. (1W+1S) sump pump motor set in of capacity 10 m3/hr. in Oil unloading area.



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- 19) Two (2) nos. (1W+1S) sump pump motor set in of capacity 10 m3/hr. in Unloading Pump House.
- 20) One no. (1) Drain oil tank (20 cum) along with floor coil heater in FO unloading pump House
- 21) Complete Fuel oil piping including steam tracing, drain piping, vent piping, valves, insulation & cladding (for restricting heat loss and maintaining outside temp below 60 deg. C) etc. as applicable to Fuel oil unloading & storage system.
- 22) Drain and vent connection in lines along with isolation valve at every low and high point as per layout requirement of FOHS.
- 23) All foundation bolts/ anchor bolts required for any equipment foundation under the package. For HFO and LDO tank, minimum 24 nos. and 20 nos. anchor bolts (M33 grade) to be considered irrespective of calculation.
- 24) Pipes will be free issued to bidder. However, flanges, fasteners, gaskets with suitable hangers, supports, pipe trestle within dyke and pump house as required etc. as applicable within the terminal point will be in vendor scope.**
- 25) Pipe-supporting structures over the insert plates for pedestal supported pipes and also on pipe rack supported pipe.
- 26) 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.
- 27) Platform and approach ladder to the platform for foam pourer.
- 28) Wrapping and coating of any buried MS pipes as required.
- 29) All MS structures for cross overs, valve / instruments / equipment operating & maintenance platforms, approach ladders for access to platforms, trench/pit.
- 30) Painting of equipment along with their accessories within battery limit.
- 31) Electrical scope as per enclosure elsewhere in the specification.
- 32) C&I Scope as per enclosure elsewhere in the specification.
- 33) Erection & commissioning spares as required for the complete system.
- 34) 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.
- 35) Mandatory spares as per enclosure elsewhere in the specification.
- 36) Initial charge of all lubricants and fluids except LDO / HFO
- 37) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- 38) Flowable non- shrink grout of one grade higher than concrete used for civil work grouting below base plate for all structure/ equipment & for grouting of foundation / anchor bolts.
- 39) Any other item covered in specification for Fuel Oil Handling System
- 40) Relevant scope of supply as per GTR, GCC & SCC.
- 41) Valves in pit outside dyke as required as per latest OISD recommendation complying with requirement whichever is more stringent.
- 42) 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



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meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of supply.

3.2.0 SCOPE OF SERVICES

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

- 1) Unloading, Storage, handling and transportation at site.
- 2) Minor civil work like chipping of foundation, grouting below base plate for all structures, equipment, grouting of anchor bolts wherever these are not placed in the foundation during casting of foundation itself, excavation & filling of earth for buried MS pipes if and as required. To the extent possible, vendor shall ensure to supply all foundation bolts timely so as to facilitate placement of these bolts while casting the foundation.
- 3) Pre-Commissioning work such as flushing, hydraulic testing etc. Necessary consumables and instrumentation as required for inspection and testing at works as well as at site including pre-commissioning activities shall be arranged by the successful bidder at their own cost.
- 4) Erection & Commissioning of Fuel Oil System (including pipes free issued to bidder)
- 5) Erection of all foundation bolts/ anchor bolts etc. as required for any equipment. In case these are not erected when foundation is being cast refer point no b above.
- 6) Inspection & testing, Performance Requirements and Performance Guarantees.
- 7) Painting of tank and all other items within scope of supply.
- 8) Making Good/Repairing/replacement of and damaged done by bidder to adjacent structure, pipes etc. while erecting equipment's related to Fuel Oil system
- 9) Electrical scope as per enclosure elsewhere in the specification
- 10) Preparation of drawing showing common facilities, if any, between BHEL & Vendor supplied equipment.
- 11) Preparation of civil assignment drawings i.e. pedestals details; insert plates / embedment's plates required for supporting pipes and equipment etc. and review of civil drawing prepared by customer based on civil assignment drawing of bidder. In case any modification is required in the civil work already done based on civil inputs given by vendor, rework shall be done at the cost and risk of the vendor.
- 12) Preparation of all drawings as per list enclosed under Annexure IX.
- 13) Preparation of drawings / document / P&ID's in 3D modelling software and providing soft copy of same to BHEL.
- 14) Preparation of all necessary drawings/data/ documents for obtaining necessary Approval of statutory authorities like CCOE , IBR , Weight & Measures Department and any other agency/ competent authority related to installation of Fuel Oil Handling System on behalf of the customer. All expenses required to obtain the approval shall also be borne by the successful bidder. Successful bidder shall inform customer well in advance requirement of authority letter along with format for the same. After issuance of authority letter by customer, it will be vendor's responsibility to regularly follow up with the concerned authorities to obtain timely approval from these authorities. Any delay on account of the same, unless any specific information related to above approval to be furnished by customer is delayed by customer, shall be to vendor's account and shall not be used as a reason for extension in contract completion.



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- 15) Layout drawing to be prepared for statutory approval apart from showing the technical requirements shall necessarily show key plan showing approach to site with mile stone, Survey No., Khesra No, Plot No. etc.
- 16) Supply of temporary equipment and services for chemical cleaning, steam blowing, energization, testing etc. as applicable.
- 17) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- 18) All other facilities/ services as described in section on site services in specification and related to Fuel Oil Handling System scope of work within terminal point.
- 19) Relevant requirements as per GTR, GCC, ECC & SCC.
- 20) Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

4.0.0 EXCLUSION

- a) Supply of pipes. However, E&C of the same including supporting arrangement shall be in bidder's scope of supply:
- b) Civil work for fuel oil unloading & storage system including
 - i. Civil work in unloading area
 - ii. Tank & Pump foundations
 - iii. Unloading Pump House
 - iv. Dyke wall and barbed fencing
 - v. Encasing of buried pipes, providing culvert for the same, if required.
 - vi. Hume Pipes, if any
 - vii. Civil works like pits, wherever required.
 - viii. Handrails other than those on the storage tanks.
 - ix. Various cable & pipe trenches, pipe pedestals, drains, sumps, insert plates for pedestals for pipe supports.
 - x. 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 storage tanks,
- d) Air Conditioning / ventilation of Fuel Oil pump houses.
- e) Control/IO panel for Fuel Oil pump houses
- f) Lifting equipment (electric operated hoist) for unloading pump house for maintenance purpose of these pumps. Capacity of lifting equipment is envisaged as 2 T with lift as 4.5 m. Bidder to confirm adequacy of the same.
- g) DCS control. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.
- h) Exclusion as indicated in Electrical & C&I portion of technical specification



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- i) Relevant exclusion as per GTR, GCC, SCC & ECC.

5.0.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

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

6.0.0 TERMINAL POINT

LDO/HFO : **Towards oil unloading side:**
Outlet flange of LDO/HFO rail tanker nozzle

Towards oil unloading side:

Up to 1000 mm outside pressurizing pump house wall for suction & return lines. Piping from this TP is being done by Trichy.

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

From Return of Pressurizing Pump – From 1000 mm outside P& H pump house, Pressure – 3.0 kg/cm² (g); Elevation- Approx. 4 m above FFL.

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

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

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.



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7.0.0 ADDITIONAL LAYOUT REQUIREMENTS

- a) System layout shall conform to the requirements of the Petroleum Act 1934 & Petroleum Rules 2002, OISD 118 latest edition whichever is more stringent. The layout shall also 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) Tentative Location of items related to Fuel Oil handling System is shown in enclosed PLOT PLANS and Sketch of FOHS. 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.
- d) While selecting pipe size, velocity inside the pipe shall not overshoot the velocity criteria indicated elsewhere in the specification.
- e) 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.
- f) Where pipes are routed in a manner that it hampers man movement in that area, suitable no. of cross overs made of MS gratings shall be given across such pipes to facilitate easy man movement in such areas. 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.
- g) For all pedestal supported pipes, BHEL scope will be limited to pedestal with insert plates. Maximum height of pedestal to be provided by BHEL shall be 300 mm from FGL/FFL in the corresponding area. Structures required above these pedestals for supporting the pipes are included in the scope of the bidder. Pipe having BOP up to 2.0m from the grade level / FFL / FGL in the corresponding area shall be pedestal supported. 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.
- h) Layout shall be prepared in a way to avoid the buried piping to the maximum possible extent.
- 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) Oily water collected in storage tank area, oil unloading area will normally be collected in OWS pit by gravity either through trench (limited to a depth of 0.5 m) or through buried pipe (limited to a depth of 1.0 m) . However, in case depth of pipe between the pit and OWS pit exceeds 1 m or gravity flow is not possible due to layout constraints (which can be reviewed during detail engineering), the oily water waste shall be collected by pumping to OWS pit. Necessary pumps, valves, pipe supports, and instruments etc. for the same shall be included by bidder in their scope.
- k) Straight length required before and after flow element/ flow meters shall be provided as per latest standard/ applicable codes.



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- l) 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.
- m) 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.
- n) 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.
- o) 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.
- p) 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 tipping layout drawing to ensure correct location of the same.
- q) Requirement given under relevant clause of specification shall also be followed.

8.0.0 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 C2 – D**.
- 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.
- 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



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9.0.0 SUB-VENDOR ITEMS

Tentative list of makes of Sub-vendor items is enclosed under **Annexure-I**

10.0.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

The drawings and documents to be submitted with the bid shall strictly document mentioned in Document to be submitted with the bid in Vol-III. Any documents other than those indicated in Vol. III will not be reviewed and will not form part of contract.

11.0.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

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

12.0.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- Plot plan, **PE-DG-410-100-M001**
- Process & Instrumentation Diagram of HFO, **PE-DG-410-166-A001**
- Process & Instrumentation Diagram of LDO, **PE-DG-410-166-A002**
- Process & Instrumentation Diagram of steam & condensate, **PE-DG-410-166-A003**

The P&ID 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. The detailed P&I diagrams for FOHS in line with specification requirement shall be developed by the vendor during detail engineering for customer's approval and without any commercial implication to customer. Bidder to note that the while preparing PIDs after placement of order, successful bidder shall incorporate line numbers Instrument tag nos., KKS Numbering, equipment no, Line Spec, Line MOCs, legend / symbol chart , equipment capacity , relief valve capacity and set pressure, control valve capacity, range, fail position etc. in these drawing and same are subject to the customer approval.

13.0.0 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 w.r.t existing facility at site. Customer approval on any drawing having details of existing facility shall not be cited by the successful bidder a valid reasons 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.



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ii) Detailed 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 will necessarily address the points mentioned in the checklist.

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

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

vi) Bidder to note that the successful bidder, during detail engineering, will submit the drg. /doc through web based Document Management System in addition to hard copies to be submitted as per dwg. / document distribution schedule. Bidder would be provided access to the DMS for drg/doc approval and adequate training for the same. Detailed methodology would be finalized during the kick-off meeting. 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 to be carried out in Integrated Intelligent Engineering environment at BHEL end. The engineering platform on which BHEL is doing the project is based on Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. The engineering for packages placed in TG Hall will essentially be done using Intelligent P&ID, Intelligent Electrical, Intelligent Instrumentation and 3D modelling. For other BOPs i.e. those outside TG hall, though the same level of integration is preferable but 3D modelling is necessarily to be done and review model in compatible format is to be provided to BHEL on stages to be agreed. Hence in line with above, bidder is required to prepare PIDs, Electrical drawings and all layout drawings using intelligent software with capability for transfer of data to and from corresponding Software being used by PEM. The data of models of facilities will be made available to BHEL as per the BHEL schedule for importing into BHEL model for interface checking and raising of integrated plant model. Layout and PID/electrical drawings will be extracted from the model. Standard write up on format compatibility of the BHEL's engineering platform for this project is attached. Data/Reports other



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than listed drawings/documents will also be made available to BHEL as and when required for import into BHEL model.

Viii) Bidder to review the Electrical Load list enclosed with the tender specification and give their concurrence on the same. In case of change in any load data, bidder to brought out same in their offer. 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".

x) Site storage and preservation manual has been placed under Annexure-X. 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/ equipment's under scope of supply.



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CUSTOMER SPECIFICATIONS



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**SECTION: C-2A
TECHNICAL REQUIREMENT**

VOLUME : IIB/3

SECTION-III B

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

CONTENT

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

ATTACHMENTS

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

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

1.00.00 GENERAL INFORMATION

1.01.00 The Fuel Oil Handling System shall include:

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

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

2.00.00 CODES AND STANDARDS

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

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

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

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

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

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

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

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

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

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

3.00.00 **SHORT DESCRIPTION OF THE SYSTEM**

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

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

No heating is envisaged for HFO rail tankers

48 nos. BTPN

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

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

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

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

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

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

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

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

4.00.00 **SCOPE OF SUPPLY**

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

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

- 4.01.00 Unloading & Storage of HFO and LDO/ HSD
- 4.01.01 One (1) no. 400 mm NB (min) HFO unloading and another similar LDO/ HSD unloading manifold complete with ~~Forty Eight (48) Nos~~ 80 NB stand pipes with isolation valves and caps, ~~Forty Eight (48) Nos~~ 80 mm NB flexible hoses of sufficient length and each provided with universal type coupling and matching pieces as required for connecting to Indian Railway Oil Tanker Wagons. Tapping points on the oil headers shall be suitably located.
- 4.01.02 Six (6) nos. (2 small capacity and 4 large capacity) as specified (Steam jacketed in case of HFO only), rotary positive displacement type unloading pumps complete with flame/explosion proof electric drive motors and all other accessories as required or specified in enclosed Annexure shall be provided, -one (1) set for HFO system and another for LDO/ HSD system.
- 4.01.03 Simplex type heavy duty oil suction strainers (one for each pump) each of capacity equal to that of the pump with isolating valves, drain valves, vent valves with goose neck piping and other accessories.
- 4.01.04 One (1) no. HFO storage tank of 2000 m³ capacity (minimum) complete with mat coil heater and suction heaters, each of capacity as per the guidelines explained in with accessories as specified in the Annexure enclosed and as required. One no LDO/ HSD storage tank of 500 m³ capacity (minimum) along with necessary accessories as specified shall be provided.
- ~~4.02.00 **HFO Transferring System**~~
- ~~4.02.01 Two (2) (1 working + 1 standby) nos. positive displacement pumps with drives and other accessories as required and as specified in data sheets enclosed for transferring HFO from HFO storage tank to HFO day tank.~~
- ~~4.02.02 One (1) duplex heavy duty fuel oil pump suction strainer and one (1) duplex heavy duty fuel oil pump discharge strainer for pumps with isolating valves, drain valve and vent valve with pipe.~~
- ~~4.03.00 **LDO/ HSD Transferring System**~~
- ~~4.03.01 Two (2) nos. Light diesel oil (LDO)/ High Speed Diesel (HSD) pumps (1 working + 1 standby) with drives, base plates, support plates, grounding pads, lifting lugs, eye-bolts, anchor bolts & nuts and accessories for transferring LDO/ HSD from LDO storage LDO day tank.~~
- ~~4.03.02 One (1) duplex heavy duty LDO/ HSD pump suction strainer with isolating valves, drain valve and vent valve with piping.~~
- ~~4.04.00 One (1) no. HFO day tank of capacity suitable for one day consumption (minimum 500 m³) complete with mat coil heater and suction heaters, each of capacity as per the guidelines explained in with accessories as specified in the Annexure enclosed and as required. One (1) no. LDO/ HSD day tank of~~

~~capacity suitable for one day consumption (minimum 200 m³) along with necessary accessories as specified shall be provided.~~

4.05.00 **Tracing of HFO Pipe Lines**

4.05.01 For HFO pipelines complete steam tracing system and necessary equipment for tracing shall be provided.

4.05.02 For steam tracing necessary steam/condensate drain line, control stations and trap assembly as required shall be provided by the bidder.

4.06.00 One drain oil tank of adequate capacity (minimum 20 m³) for HFO & LDO/ HSD unloading and Transferring system with necessary heater (steam heated) shall be provided to receive the miscellaneous drains of HFO, LDO/ HSD system.

4.07.00 Two (2) nos. drain oil pumps shall be provided to recirculate oil from oil water drain oil tank to HFO tank.

4.08.00 Portable hand pumps of suitable design complete with discharge spout for removal of oil from the HFO day tank dyke area drain sumps.

4.09.00 **Pipe, Fittings, Specialties and Valves**

4.09.01 Pipes, fittings, specialties, traps, strainers, valves, supports/ hangers etc. as per the piping system design requirement for the system. For details, refer Cl. No. 4.05.00 of Sec. IIIA of Vol-IIB.

4.10.00 **Thermal Insulation**

Refer Cl. No. 4.06.00 of Sec. IIIA of Vol-IIB.

4.11.00 All access platforms for various valves & all pipe cross-over platforms, as required for necessary approach and crossings.

4.12.00 Anchor Bolts, Sleeves, Inserts, Foundation Plates, Lifting Lugs, Eye Bolts etc. shall be supplied.

4.13.00 **Control & Instrumentation**

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

5.00.00 **SYSTEM DESIGN CRITERIA**

5.01.00 Fuel oil system and its facilities shall be designed as per Pollution Control/Petroleum/Explosive/Fire rules of Govt. of India.

5.01.01 The unloading capacity shall be suitable to unload at a time a maximum of 24 nos. BTPN nos. wagons for each of HFO & LDO/ HSD system.

5.01.02 Buffer to buffer dimension of HFO & LDO/ HSD wagons is 12.42 M. Therefore, a net railway track length of minimum 300 metres paved with RCC shall be

- provided for oil unloading and shall be used for unloading both HFO and LDO/ HSD.
- 5.01.03 Unloading manifold (both HFO & LDO/ HSD) shall be suitable for connecting 24 nos. wagons. However, 80 nos. hoses shall be provided in the manifold.
- Oil from wagons shall be unloaded to unloading manifold through flexible hoses.
- For ease of maneuvering hose size of 80 NB is proposed.
- 5.01.04 In case of HFO, tanker wagons shall be fitted with steam heating coils so that oil may be heated to reduce its viscosity. Steam from boiler is taken and after reducing its pressure to 6 Kg/cm²(g) is used for HFO wagon heating.
- Steam header in unloading area to be sized for HFO unloading header tracing only.
- 5.01.05 When the unloading header and the piping at the individual pump suction is filled up with oil and steady oil supply is ensured, the unloading pumps shall be started.
- 5.01.06 The capacity of each unloading pump shall not exceed 125 Cu.M/hr. Total number of pumps in each HFO & LDO system shall be so selected that they are capable of unloading 76 nos. of wagons (Max. Volume in each wagon for HFO & LDO are 23 Cu.M (excl. heating time) within 5 hours of operation (excluding heating time) using pumps of capacity 125 Cu.M/hr. (maximum) each. Additionally, two (2) nos. pumps for each system shall also be installed for unloading oil fuel oil during start of unloading and also during finishing so as avoiding malfunction of pumps due to air entrapment in the oil.
- 5.02.00 Oil Storage System
- While assessing the HFO and LDO/ HSD storage volume, following aspects have to be taken into consideration with the assumption that fresh supply of oil wagons shall be available at site within a month of its requisition.
- 5.02.01 HFO Storage Capacity : 2000 CUM EFFECTIVE CAPACITY (BETWEEN HIGH FLUID LEVEL TO LOW FLUID LEVEL)
- One (1) HFO storage tank of adequate capacity to be provided to store oil from one full rake (each rake having 76 nos. of wagon each of capacity 23 Cu.M) and also to meet the sum total of the following additional requirements for a month:
- a) One boiler is under coal firing with oil support (oil burners at 10% BMCR) for about 8 hours a day

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

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

5.02.02

LDO Storage Capacity : 2000 CUM EFFECTIVE CAPACITY
(BETWEEN HIGH FLUID LEVEL TO
LOW FLUID LEVEL)

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

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

5.03.00 **HFO Transferring System**

5.03.01 Transfer pumps :

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

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

5.05.00 **LDO/ HSD Transferring System**

5.05.01 Transfer Pumps :

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

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

5.06.00 **Pipe, Fittings & Specialities**

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

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

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

6.00.00 DESIGN & CONSTRUCTION

6.01.00 Pumps

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

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

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

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

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

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

d = Diameter of shell, metre

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

- 6.02.06 Due consideration for wind load and/or earthquake effect shall be given by the Contractor in the design of tanks. Data for wind load and earthquake shall be taken as indicated in Vol-IIA. Maximum allowable stresses for design loadings combined with wind or earthquake shall not exceed 133% of stress permitted for the design loading condition but in no case shall exceed 80% of specified minimum yield strength of the material.
- 6.02.07 For tanks of diameter 4.75 M and thickness less than 6 mm or of diameter larger than 4.75 M added structural supports in the form of rafters shall be provided.
- 6.02.08 Reinforcement pads in tank connections shall be provided as per applicable code & the reinforced connection shall be completely pre-assembled into a shell plate. The completed assembly including the connection shall be thermally stress-relieved as per API Standard 620.
- 6.02.09 The joint efficiency factor to be adopted for design calculation shall be in accordance with the applicable standard.
- 6.02.10 All welding shall be done as per IS:816, latest revision. All welds are to be continuous welds.
- 6.02.11 Sufficient air space is to be provided in the tank. Temperature expansion of oil shall be taken into account.
- 6.02.12 The supply and return pipes shall be extended well inside the tank and wear plates shall be provided.
- 6.02.13 **Tank Connections**
- Tanks shall be provided with necessary connections like-oil inlet and outlet, steam inlet & condensate outlet (in case of HFO tank only), different drains, vents and return oil lines water draw off etc. as indicated in drawing
- 6.02.14 **Tank Accessories**
- The tanks shall be provided with necessary accessories. All the accessories shall conform to relevant Indian Standard and as specified. The following broad guidelines are given for some of the accessories.
- a) Heating Coils/Floor Heater
- As specified, heating coils in one or more tiers shall be provided at the bottom of the HFO Storage tanks to maintain oil within the tank at specified temperature with steam as the heating medium.
- The tubes shall be seamless steel as per indicated standard. Arrangement for supporting the coil within the tank shall be made. Connections for steam inlet and condensate outlet shall be provided.

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

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

Refer Annexure II.

b) Suction Heater

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

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

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

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

Refer Annexure II.

c) Steam Trap

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

d) Flame Arrestor

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

e) Conservation Vent Valve

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

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

f) Instrumentations

Instrumentations as shown in P&I diagram shall be provided. For their specification refer Volume-VI.

g) Level Transmitter

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

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

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

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

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

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

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

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

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

d) Welding

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

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

6.02.16 **Surface preparation and painting**

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

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

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

7.00.00 **CONTROL & INSTRUMENTATION**

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

8.00.00 **INSPECTION AND TESTING**

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

8.01.00 **Fuel Oil Pump Performance Test**

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

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

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

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

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

8.02.02 Performance Tests

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

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

8.03.00 Valves

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

8.04.00 Piping System

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

9.00.00 DRAWINGS, DATA AND MANUALS

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

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

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

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

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

9.01.05 Characteristic curves of all pumps and motors.

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

ANNEXURE-I

HFO TANK HEATERS - DESIGN PARAMETERS

1. FLOOR COIL HEATER IN HFO STORAGE & DAY TANKS

Design Data

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

2. SUCTION HEATER IN HFO STORAGE & DAY TANKS

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

The suction heaters shall be designed to the following parameters :

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

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

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

shall be assumed on the outside surface of heater tubes.

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

DESIGN OIL FLOW: 70 CUM/HR

ANNEXURE-III

DATA SHEET
FOR
FUEL OIL UNLOADING PUMPS

Sl. No.	Description	Pumps	
		HFO Unloading Pump	LDO/ HSD Unloading Pump
1.0	Service	Fuel Oil	Fuel Oil
2.0	Duty	Intermittent	Intermittent
3.0	Location	Indoor	Indoor
4.0	No. of Pumps	THREE + Two (2)	THREE + Two (2)
	• Working	3/2	3/2
	• Standby	--	--
5.0	Type of Oil to be Handled	Heavy Fuel Oil VISCOSITY: 50-500 CST	LDO/ HSD VISCOSITY: 2-50 CST
6.0	Characteristics of Oil	Refer Vol-IIA	Refer Vol-IIA
7.0	Site Working Condition	Refer Vol-IIA	Refer Vol-IIA
8.0	Handling temperature	50°C	7°C to 50°C
9.0	Installation	Horizontal with external bearing	Horizontal with external bearing
10.0	Type	Rotary positive Displacement type	Rotary positive Displacement type
11.0	• Design Capacity at lowest viscosity	Bidder to indicate	Bidder to indicate
	• Rated capacity at handling temperature (minimum)	150 CUM/HR- 3 NOS 25 M³/Hr. - 2 nos.	150 CUM/HR- 3 NOS 25 M³/Hr. - 2 nos.
12.0	• Differential Pressure corresponding to rated capacity	Bidder to indicate	Bidder to indicate
	• 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		

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

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

NOTE : All material shall conform to relevant ASTM Standard.

HYDROTEST PRESSURE: 1.5 TIMES DISCHARGE PRESSURE
DURATION: 30 MINUTES

ANNEXURE-III

PIPES, FITTINGS & VALVES : DESIGN PARAMETERS

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

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

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

3. Tracer Size : Bidder to indicate

4. Material of Construction

- a) Fuel Oil Pipe Lines

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

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

h) Ball Valves

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

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

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

Ball : SS, AISI-316

i) Plug valve shall conform to API-599.

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

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

Plug : Hardened Carbon Steel

5. Tolerances

Dimension and tolerance for fabrication shall be as given below :

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

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SECTION-II

THERMAL INSULATION

1.00.00 GENERAL INFORMATION

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

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

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

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

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

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

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

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

2.00.00 **CODES AND STANDARDS**

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

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

3.00.00 **SCOPE OF SUPPLY**

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

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

4.00.00 **MATERIAL SPECIFICATIONS**

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

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

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

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

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

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

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

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

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

and ESP outer casing Aluminium for SG
 and plain for ESP

4.10.00 Straps and bands shall conform to materials as under :

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

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

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

4.12.00 Hexagonal wire mesh shall be conforming to following:

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

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

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

4.15.00 The insulating material whether dry or wet shall:

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

5.00.00 **THERMAL INSULATION APPLICATION PROCEDURE**

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

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

5.01.00 General

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

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

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

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

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

5.02.00 Piping

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

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

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

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

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

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

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

5.03.00 **Valves and Flanges**

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

5.04.00 **Equipment**

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

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

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

6.00.00 **INSPECTION AND TESTING**

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

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

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

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

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

150 Kg/m³ (For use above 400°C)

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

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

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

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

7.00.00 DRAWINGS, DATA AND INFORMATION TO BE FURNISHED

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

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

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



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

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SECTION-IV

GENERAL TECHNICAL REQUIREMENTS

1.00.00 CODES AND STANDARDS

1.01.00 Except where otherwise specified, the Plant shall comply with the appropriate Indian Standard or an agreed internationally accepted Standard Specification as listed in the annexure to this Section and mentioned in detailed specifications, each incorporating the latest revisions at the time of tendering. Where no internationally accepted standard is applicable, the Bidder shall give all particulars and details as necessary; to enable the Owner to identify all of the Plant in the same detail as would be possible had there been a Standard Specification.

1.02.00 Where the Bidder proposes alternative codes or standards he shall include in his tender one copy (in English) of each Standard Specification to which materials offered shall comply. In such case, the adopted alternative standard shall be equivalent or superior to the standards mentioned in the specification.

1.03.00 The plant will be designed in compliance with applicable National and International Codes and Standards such as ASME, ASTM, DIN, BS, IEC, IEEE, IS, etc. Wherever specified or required the Plant shall conform to various statutory regulations such as Indian Boiler Regulations, Indian Explosives Act, Indian Factories Act, Indian Electricity Act, Environmental Regulations, etc. Wherever required, approval for the plant supplied under the specification from statutory authorities shall be the responsibility of the Contractor.

1.04.00 In the event of any conflict between the codes and standards referred above, and the requirements of this specification, the requirements, which are more stringent, shall govern.

1.05.00 In case of any change of code, standards and regulations between the date of purchase order and the date the Contractor proceeds with manufacturing the Owner shall have the option to incorporate the changed requirements. It shall be the responsibility of the Contractor to advise Owner of the resulting effect.

1.06.00 Successful Bidder to furnish two (2) sets of latest of national/inter-national codes and standards to owner.

2.00.00 RESPONSIBILITY FOR DESIGN

2.01.00 The Contractor shall assume full responsibility for the design of the whole and every portion of the Plant, whether or not the design work was undertaken specifically in relation to the Contract and whether or not the Contractor was directly involved in the design work.

- 2.02.00 Notwithstanding the Owner's wish to receive the benefits of new, advanced and improved technologies, a prime requirement is that all the systems and components proposed shall have been already adequately developed and shall have demonstrated good reliability under similar, or more arduous conditions elsewhere, at least for continuous 2 years in two different power station.
- 2.03.00 The successful bidder shall have to carry out surge analysis, BFP transient analysis and other transient condition studies as may be necessary and as required by the Owner as per proven engineering practice.
- 2.04.00 The Bid shall include a detailed discussion on the development status of, and the reasons for any changes made in proposed systems or components for the Plant, as compared with similar items previously supplied in other installations cited by the bidder as reference plants.
- 2.05.00 The Bidder may also make alternate offers, provided such offers are superior in his opinion in which case adequate technical information, operating feed back, etc. are to be enclosed with the offer, to enable the Owner to assess the superiority and reliability of the alternatives offered. In case of each alternative offer, its implications on the performance, guaranteed efficiency, auxiliary power consumptions, etc. shall be clearly brought out to the Owner to make an overall assessment. In any case, the base offer shall necessarily be in line with the specifications i.e. Base offer shall be as per the technical specifications and the same will be considered for techno-commercial evaluation.
- 3.00.00 **NAME PLATES (RATING PLATES)**
- 3.01.00 Instruction plates, name plates or labels shall be permanently attached to each main and auxiliary item of plant in a conspicuous position. These plates shall be engraved with the identifying name, type and manufacturers serial number, together with the loading conditions under which the item of plant has been designed to operate.
- 3.02.00 Items such as valves, etc. which are subject to hand operation, shall be provided with nameplates so constructed as to remain clearly legible throughout the life of the plant giving due consideration to the difficult climatic conditions to be encountered. Nameplates shall be securely mounted where they will not be obscured in service by insulation, cladding, actuators or other equipment. Direction of flow is also to be engraved.
- 3.03.00 All trade nameplates and labels shall be in English language. All measurements shall be in M.K.S. Units.
- 3.04.00 The size and location of nameplates shall be subject to Approval of the Engineer.
- 4.00.00 **SAFETY AND SECURITY**
- 4.01.00 The design shall incorporate every reasonable precaution and provision for the safety of all personnel and for the safety and security of all persons and

- property. The design shall comply with all appropriate statutory regulations relating to safety. All structures and equipment shall be designed and constructed to withstand every foreseeable static and dynamic loading condition, including loading under earthquake conditions, with an adequate margin of safety.
- 4.02.00 Ready and safe access with clear head room shall be provided to all parts of the plant for operation, inspection, cleaning and maintenance.
- 4.03.00 Escape routes and clear ways shall be provided to allow speedy evacuation of the plant in the event of fire or explosion, and the plant layout shall allow for ease of access to all parts of the Works by rescue and fire fighting teams. The plant layout shall be designed to localise and minimise the effects of any fire or explosion. The recommendations of NFPA, OSHA, and TAC etc. as necessary shall be followed in all respects.
- 4.04.00 The use of corrosive, explosive, toxic or otherwise hazardous materials shall be kept to a minimum during construction and the design of the plant shall minimise the requirement for such materials during operation and maintenance. Where such materials must be used, all necessary precautions shall be taken in the design, manufacture and layout of equipment to minimise the resulting hazard, and all equipment necessary for the protection and first-aid treatment of personnel in the event of accidents shall be provided. Particular attention is drawn to avoid the use of materials containing asbestos in any form.
- 5.00.00 **GUARDS**
- 5.01.00 Effective guards and fences must be provided to prevent injury to operators through accident or malpractice.
- 5.02.00 Mesh guards which allow visual inspection of equipment with the guard in place are generally preferable. The guards shall be constructed of mesh attached to a rigid framework of mild steel rod, tube, or angle and the whole galvanised to prevent loss of strength by rusting or corrosion. The guards shall be designed to facilitate removal and replacement during maintenance.
- 5.03.00 All drive belts, couplings, gears, sharp metallic edges and chains must be safely guarded. Any lubricating nipple requiring attention during normal running must be positioned where they can be reached without moving the guards.
- 5.04.00 Guards for couplings and rotating shafts shall be in accordance with BS 5304-1975 or similar approved standard. All rotating shafts and parts of shafts must be covered.
- 5.05.00 Suitable fencing shall be provided to enclose all openings or doorways used for the hoisting and lowering of machinery etc. This fencing must be securely fixed but quickly detachable when required. A secure hand hold must be provided on each side of the opening or doorway.

6.00.00 LOCATION AND LAYOUT REQUIREMENTS

The majority of plant and equipment (excluding steam generator and some other auxiliaries) shall all be of indoor installation. A broad list of buildings housing such equipment is given elsewhere in this specification. Layout should facilitate access for operation-maintenance and inspection of any one or more equipment/components at a time without disturbing the operation or installation of rest of the plant. Further, Bidder should comply with the criteria given under the various equipment and system specifications as well as those stipulated in Annexure-II attached to this section.

Enclosed General Layout and other tender layout drawings show the location of major installations and auxiliary buildings. The Bidder shall try to retain these locations as far as practicable. The layout of equipment within the power house as shown in the tender drawings is indicative. The Bidder may, subject to Owner's approval alter the same to suit the space requirement of the equipment offered.

Bidder may give as an alternative his own preferred layout clearly indicating the advantages and other implications, if any. Such alternative will not be considered for evaluating the bid, but may be considered with the successful Bidder if Owner/Engineer finds the proposal more attractive in terms of techno-economic consideration.

While developing the layout of buildings the following criteria shall be given effect :

- a) The minimum width of clear access corridors around equipment shall be 1.2 meter.
- b) Each building shall have an identified vacant space for equipment unloading and maintenance and preferably a separate bay altogether in buildings housing heavy equipment. Provision for handling equipment by monorail hoist and/or overhead crane shall be made as specified.
- c) The minimum clear height available between two consecutive floor slabs shall not be less than five (5) meters. A clear head room of 2.5m shall be maintained between the floor and any overhead piping/ cables or other obstruction. Adequate provision for natural ventilation and illumination shall be made as per good engineering practices.
- d) There shall be at least two (2) nos. main access doors, one on either side of each building, of which one shall be minimum 3 meters wide with rolling shutters for equipment entry. For multistoried buildings, at least two (2) nos. regular staircases diagonally opposite to each other shall be provided connecting all the floors and roof. These minimum requirements shall be augmented as required depending on the floor area, statutory requirements and TAC recommendations.
- e) All buildings shall have provision for toilet and associated effluent discharge system together with facility for drinking water. The criteria for ventilation, fire protection and illumination of building spaces specified

elsewhere in this specification shall be complied with.

- f) All rail/road crossings for pipe/cable racks shall be done with minimum 8 meters headroom from top of rail/road to bottom of rack. Similarly top cover over underground pipes/cables shall be minimum one (1) meter. For other detail refer to Annexure-II.
- g) Cubicle for operating personnel shall be located at safe place near the equipment.
- h) Interplant cable routing will be on overhead cable trays on pipe cum cable trestle or on cable trestle except where approved by purchaser/consultant. In exceptional case, small stretch of outdoor run of interplant cable routing may be taken through cable trench only with the Employer's prior approval.
- i) Concept of various mechanical and electrical equipment location and building dimensions (including column-row spacing) as shown in Plot Plan/Floor Plan drawing are to be adhered to. Any departure from this suggestive layout is primarily not recommended.

7.00.00 OPERATION, MAINTENANCE & AVAILABILITY CONSIDERATIONS

7.01.00 Equipment/works offered shall be designed for high availability, high reliability, low maintenance and ease of operation & maintenance. The Bidder shall specifically state the design features incorporated to achieve high degree of reliability, availability, operability and ease of maintenance. He shall also furnish details of availability records in plants stated in his experience list.

7.02.00 Ample space for ease of operation and maintenance including equipment removal, tube bundle/cartridge/rotor pulling etc. shall be provided. All valves, gates, dampers and other devices shall be located and oriented in such a way that they are accessible from operating floor levels. Where this cannot be adhered to, platforms and walkways with access ladders shall be provided to facilitate operation and maintenance.

7.03.0 Motorised lifting devices, i.e. hoists, chain pulleys, jacks, etc. shall be provided for handling and carrying out maintenance of any equipment and/or part having weight in excess of 3000 Kg. Suitable beams, hooks etc. for this purpose shall be provided in the buildings.

No lifting arrangement is necessary for part having weight less than 500 Kg. Hoist shall be well protected by environment. Suitable painting and coating covering hoist at outdoor shall be provided.

Lifting devices like lifting tackles, slings, etc. to be connected to hook of the hoist/crane shall be provided by the Bidder for lifting the equipment, accessories covered under this specification.

7.04.00 All similar parts of the equipment shall be made to gauge and shall be interchangeable with and shall be made of same material and workmanship as the corresponding parts of the equipment. Where feasible common

components shall be employed in different pieces of equipment in order to optimize the spares inventory and utilization.

8.00.00 MATERIALS

8.01.00 In selecting materials of construction of equipment, the Contractor shall pay particular attention to the atmospheric conditions existing at the Site and the nature of material/fluid handled. Wherever deviations are taken in respect of materials specified, the reasons shall be spelt out clearly in the proposal.

All materials shall be new, and shall be of the quality most suited to the proposed application.

8.02.00 In as far as is possible; materials shall be in accordance with Indian or international standard specifications and shall be used in accordance with Indian or international codes of practice. Where such standards or codes of practice are not available sufficient information shall be provided to allow the Owner to assess the suitability of the material for the particular application.

All materials used shall have performed lengthy satisfactory service in similar or more arduous conditions to those proposed by the Contractor.

8.03.00 All parts which could deteriorate or corrode under the influence of the atmospheric, meteorological or soil conditions at the Site, or under the influence of the working conditions shall be suitably and effectively protected so that such deterioration or corrosion is a minimum over the life of the plant.

9.00.00 LUBRICATION

9.01.00 Provision shall be made for suitable efficient lubrication where necessary to ensure smooth operation free from undue wear.

9.02.00 Non ferrous capillary tubing shall be used throughout.

9.03.00 Gear boxes and oil baths shall be provided with filling and drain plugs, both of adequate size. An approved means of oil indication including level switches and temperature indication shall be provided.

9.04.00 All high speed gears shall be oil bath lubricated. Low speed gears shall be lubricated by means of soft grease. Removable and accessible drip pans shall be provided to collect lubricant which may drop from operating parts.

9.05.00 All lubrication points shall be conveniently situated for maintenance purposes. It must be possible to carry out lubrication from a gangway or landing and without the removal of guarding or having to insert the hand into it. Where accessibility to a bearing for oiling purposes would be difficult a method of remote lubrication shall be fitted.

9.06.00 The Contractor shall supply grease gun equipment suitable to service each type of nipple fitted.

10.00.00 **LUBRICANTS AND CONTROL FLUIDS**

10.01.00 The Contractor shall provide a detailed and comprehensive specification for all lubricating oils, greases and control fluids required for the entire plant. A sufficient supply of these shall be provided by the Contractor for initial commissioning, first fill and till COD of the unit.

10.02.00 The Contractor shall supply a detailed schedule giving the lubricant testing, cleaning and replacement procedures. All equipment and facilities necessary for the testing, cleaning and changing of lubricants and control fluids shall be provided. The Contractor shall endeavor to reduce the varieties and grades of required lubricants and control fluids to a minimum, matching them where possible to those already in use in the generating station in order to simplify procurement and minimise storage requirements. All lubricants and control fluids shall be of internationally recognised standards and shall be easily obtainable from a large number of Indian suppliers. Bidder shall also indicate the equivalent Indian Standard for the above for easy procurement in future.

10.03.00 No lubricant or control fluid shall have toxic or other harmful effects on personnel or on the environment.

11.00.00 **OPERATION AND MAINTENANCE**

11.01.00 The plant shall be designed and constructed so that operation and maintenance manpower requirements are minimised.

The design and layout shall facilitate inspection, cleaning, maintenance and repair. The importance of continuity of operation is second only to that of safety.

11.02.00 Spare parts for equipment shall be interchangeable with the original components and, so far as possible, be of common design and manufacture.

11.03.00 All similar standard components/parts of similar standard equipment provided shall be interchangeable with one another. Further identical equipments shall be provided for similar duties so that the same are interchangeable with one another in totality and component wise.

11.04.00 All heavy parts (500 Kg and above) must be provided with a convenient arrangement for slinging and handling during erection and overhaul. Any item of plant normally stripped or lifted during periods of maintenance and weighing one tonne or above, shall be clearly marked with its weight.

11.05.00 On completion of commissioning, a complete set of tools for the maintenance of the entire plant shall be provided by the Contractor. This shall include all necessary spanners, special wrenches, extraction equipment and any special tools reasonably required by the Engineer. Tools used during erection and commissioning shall not be accepted except with the specific approval of the Engineer.

11.06.00 All equipment and major valves should be provided with adequate maintenance approach and facility.

12.00.00 **PLANT LIFE AND MODE OF OPERATION**

The complete plant including all the equipment and systems individually and collectively shall be designed for continuous operation for an economic service life of thirty (30) years under the prevailing site conditions and for the type of duty intended.

The critical components of the Steam Generator, Turbine-Generator and Auxiliary equipment, the life of which is limited by time and temperature dependent mechanisms such as thermal stress, creep and low cycle fatigue, are to be designed considering expected (hot, warm and cold) start-up, shut-down and cyclic load variations.

The allowable stresses shall be reduced so that life expectancy to minimum 2,00,000 hours of operation can be achieved. The Bidder shall discuss this aspect in his technical proposal.

The unit would be operated on base load with cyclic load variation. The load variation is expected to be as per schedule depending on power demand.

The expected start-ups should be considered as minimum
(Based on HPT metal temperature)

Cold start-up (>72 hrs. shutdown)	:	6 per year
Warm start-up (between 10 to 72 hrs. of shutdown)	:	40 per year
Hot start-up (less than 10 hrs. shutdown)	:	160 per year

13.00.00 **PACKAGING & MARKING**

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at site till the time of erection. While packing all the materials, the limitations from the point of view of availability of railway wagon sizes in India should be taken account of. The details of various wagons normally available with Indian Railways for transportation of heavy equipment shall be considered by the Bidder. The Contractor shall be responsible for all loss or damage during transportation, handling and storage due to improper packing.

As per the information available, the dimensions of OD consignment for transportation of the equipment by rail (if any equipment to be handled through rail transportation) are as below :

a)	Width of the Package (from centre-line of rails - 1.6 metres on both sides)	:	3.2 Meters
b)	Height of the package from rail top	:	4.47 Meters

The above indicates the dimensions which can be normally transported on the

wagons without infringement of the "moving gauge". This is however not indicative of the consignment which can be carried out with infringement of "moving gauge" duly authorised and approved by the Indian Railways. There may be difference between the "moving gauge" and the "fixed structure gauge" and consignments infringing the "moving gauge" can be moved after investigation regarding possible infringement with the fixed structures. As the critical fixed structures in each route are different, consignments infringing moving dimensions have to be individually investigated to select a route and also determine the restrictions under which such movement is to be carried out. Such routes selected or other mode of transport envisaged is to be clearly brought out in the proposal wherever transport of over dimensional equipment is involved.

Bidder to consider unloading of material delivered through rail transportation, at near by railway station/ site unloading siding. The subsequent transportation up to project work place shall be considered by road only. All unloading and handling equipment both at railway station siding and at project site shall be arranged by the Bidder. Necessary arrangement to be organized with the railway authority for such purpose shall also be under the scope of services of the Bidder. Bidder may consider entire material delivered up to site through rail transportation only.

The identification marking indicating the name and address of the consignee shall be clearly marked in indelible ink on two opposite sides and top of each of the packages. In addition the Contractor shall include in the marking gross and net weight, outer dimension and cubic measurement. Each package shall be accompanied by a packing note (in weather proof paper) quoting specifically the name of the Contractor, the number and date of contract and names of the office placing the contract, nomenclature of contents and Bill of Material.

For imported equipment and material, suitable port facilities may be used in which case material may be transported from the port by tractor-trailer. Bidder may consider this aspect.

14.00.00 PROTECTION

Equipment having antifriction or sleeve bearings shall be protected by weather-tight enclosures. Coated surfaces shall be protected against impact, abrasion, discoloration and other damages. Surfaces that are damaged shall be repainted.

Electrical equipment, controls and insulations shall be protected against moisture and water damages. All external gasket surfaces and flange faces, couplings, rotating equipment shafts, bearings and like items shall be thoroughly cleaned and coated with rust preventive compound as specified above and protected with suitable wood, metal or other substantial type covering to ensure their full protection. All exposed threaded parts shall be greased and protected with metallic or other substantial type protectors.

All piping, tubing and conduit connections on equipment and other equipment openings shall be closed with rough usage covers or plugs. Female threaded openings shall be closed with rough usage covers or forged steel plugs. The closures shall be taped to seal the interior of the equipment. Open ends of

piping, tubing and conduit shall be sealed and taped.

Returnable containers and special shipping devices shall be returned by the manufacturer's field representative at the Contractor's expense.

15.00.00 ENVIRONMENT PROTECTION AND NOISE LEVEL REQUIREMENT

15.01.00 Environment Protection

The plant shall be designed for installation and operation in harmony with the surrounding environment and all measures of pollution control shall be ensured by the Bidder to restrict pollution from the liquid effluent and stack emission within the limits as given below with due consideration of Environment (Protection) Rules 1986 as amended till date.

In case the Ministry of Environment & Forest stipulate any other conditions not specified hereunder while clearing the project shall be complied with the plant by the contractor.

15.01.01 For Liquid Effluent

- a) Provision laid down in schedule-I for Thermal Power Plants and also in Schedule-VI. General Standards for discharge of Environmental pollutants Part-A : Effects of Environmental (protection) Rules 1986, as amended till date.
- b) Any specific requirement of State Pollution Authorities over and above the above stipulation.

15.01.02 For Air Emission

- a) Suspended Particulate Matter i.e. dust burden at chimney outlet - Maximum 50 mg/Nm³ (with worst coal and one field out at TMCR).
- b) NO_x - 365 ppm Max. or 750 mg/Nm³ (Equivalent NO₂).
- c) SO₂ - Concentration based standard 2000 mg/Nm³. Load based standard 0.2 metric tonne /MWe/day (for first 500 MW and 0.1 metric tonne/MWe/day for rest of the capacity above 500 MW)

In absence of Indian Standard for emission from power plants as on date, for certain gaseous effluents, the internationally accepted World Bank Standard is to be followed. Indian Standard for emission of power plants are under formulation. Should this standard is published before finalisation of the contract, the bidder has to comply the more stringent of the above norm or the new Indian Standard.

The bidder shall include in his scope all necessary equipment and measuring instruments to comply with above requirements. Location and accessibility of the instruments shall be properly coordinated.

15.02.00 Noise Level Requirement

The plant will be designed, constructed and provided with suitable acoustic measures to ensure the noise level criteria as per the following stipulations.

- a) Maximum noise level shall not exceed 85 dB (A) when measured at 1.0M away from the noise emission source.
- b) Maximum noise level from its source within the premises shall not exceed 70 dB (A) as per Environment (Protection) Rules 1986, Schedule-III, 'Ambient Air Quality Standards' in respect of noise.
- c) Any statutory changes in stipulations regarding noise limitation that may occur in future according to State Pollution Control Board or Central pollution Control Board or Ministry of Environment & Forest regulation during tenure of the contract, the contractor shall comply with the requirement.

An exception will be made for the plant at startup operations and other big pressure reducing devices operating during emergency periods and for the safety valves.

16.00.00 INSPECTION AND TESTING

16.01.00 Inspection and Tests during Manufacture

16.01.01 The method and techniques to be used by the Contractor for the control of quality during manufacture of all plant and equipment shall be agreed with the Owner prior to the Award of Contract.

16.01.02 The Owner's general requirements with respect to quality control and the required shop tests are set out elsewhere in this specification.

16.01.03 Before any item of plant or equipment leaves its place of manufacture the Owner shall be given the option of witnessing inspections and tests for compliance with the specification and related standards.

16.01.04 Advance notice shall be given to the Owner as agreed in the Contract, prior to the stage of manufacture being reached, and the piece of plant must be held at this stage until the Owner has inspected the piece, or has advised in writing that inspection is waived. If having consulted the Owner and given reasonable notice in writing of the date on which the piece of plant will be available for inspection, the Owner does not attend the Contractor may proceed with manufacture having forwarded to the Owner duly certified copies of his own inspection and test results.

The Contractor shall forthwith forward to the engineer duly certified copies of the Test Certificates in six copies (one to the Purchaser and five to the Consulting Engineer) for approval. Distribution of six (6) copies of Test Certificates for approval will be two(2) copies to owner and four(4) copies to consultant. These four(4) copies will be further distributed by consultant after approval to owner, site and bidder. One copy will be retained with the

consultant for record purpose.

Further, nine (9) copies of Shop Test Certificates shall be bound with Instruction Manuals referred to elsewhere. Distribution of nine (9) copies of Shop Test Certificates for approval will be Two (2) copies to owner, Three (3) copies to site, Two (2) copies to consultant, Two (2) copies to owner's library / record.

16.01.05 Under no circumstances any repair or welding of castings be carried out without the consent of the Owner's Engineer. Proof of the effectiveness of each repair by radiographic and/or other non-destructive testing technique, shall be provided to the Engineer along with Defect Map.

16.01.06 All the individual and assembled rotating parts shall be statically and dynamically balanced in the works.

Where accurate alignment is necessary for component parts of machinery normally assembled on site, the Contractor shall allow for trial assembly prior to despatch from place of manufacture.

16.01.07 All materials used for the manufacture of equipment covered under this specification shall be of tested quality. Relevant test certificates shall be made available to the Purchaser. The certificates shall include tests for mechanical properties and chemical analysis of representative material or any other test as required by approved QAP/ Material specification.

16.01.08 All pressure parts connected to pumping main shall be subjected to hydraulic testing at a pressure of 150% of shut-off head for a period not less than one hour. Other parts shall be tested for one and half times the maximum operating pressure or as required by design code of that part, for a period not less than one hour.

16.01.09 All necessary non-destructive examinations shall be performed to meet the applicable code requirements.

16.01.10 All welding procedures adopted for performing welding work shall be qualified in accordance with the requirements of Section-IX of ASME code or IBR as applicable. All welded joints for pressure parts shall be tested by liquid penetrant examination according to the method outlined in ASME Boiler and Pressure Vessel code. Radiography, magnetic particle examination magnafux and ultrasonic testing shall be employed wherever necessary/recommended by the applicable code. At least 10% of all major butt welding joints shall be radiographed.

16.01.11 Statutory payments in respect of IBR approvals including inspection for design and manufacturer of equipment shall be made by the Bidder. All payment for erection and testing at site (i.e. under IBR jurisdiction) shall also be made by the Bidder. In such case Contractor's scope shall also be extended to preparation of all necessary documents, co-ordination and follow-up with IBR authorities for above approval.

16.02.00 **Performance Tests at Site**

- 16.02.01 The full requirements for testing the system shall be agreed between the Owner and the Bidder prior to Award of Contract. The completely erected System shall be tested by the Contractor on site under normal operating conditions. The Contractor shall also ensure the correct performance of the System under abnormal conditions, i.e. the correct working of the various emergency and safety devices, interlocks, etc.
- 16.02.02 The Bidder shall provide complete details of his normal procedures for testing, for the quality of erection and for the performance of the erected plant. These tests shall include site pressure test on all erected pipe work to demonstrate the quality of the piping and the adequacy of joints made at site.
- 16.02.03 The Contractor shall furnish the quality procedures to be adopted for assuring quality from the receipt of material at site, during storage, erection, pre-commissioning to tests on completion and commissioning of the complete system/equipment.
- 16.03.00 For details of specific tests required on individual equipment refer to respective section of this specification.

17.00.00 TRAINING OF OWNER'S PERSONNEL

The Contractor shall extend all possible assistance and co-operation to the Purchaser regarding the transfer of technology and developing expertise in the area of engineering operation and maintenance of the Plant.

Number of man-days of training as mentioned below shall be included in his Tender.

17.01.00 Training at Contractor's Premises

The Contractor shall conduct training of sixty (60) engineers of the Owner on engineering, operation and maintenance of the Plant at the Contractor's or Associates or Sub-contractor's premises where adequate training facilities are available during the design and manufacturing stage of the Contractor.

The total man-months for training of engineers shall be maximum sixty (60), having following indicative break-up :

Discipline	No. of Engineers	No. of Man-month
Operation	20 heads	20
Maintenance Boiler, Turbine, Mechanical	20 heads	20
Electrical Maintenance	8 heads	4
Control & Instrumentation	8 heads	4
Maintenance Planning	4 heads	2
	-----	-----

60 heads

60

However, the details of the training programme will be discussed and finalised with the successful Bidder.

The training may also be arranged by the Contractor in any Plant where the equipment manufactured by the Contractor or his Associates is under installation, operation or testing to enable the trainees to become familiar with the equipment being furnished by the Contractor. All expenses inherently related to the training shall be borne by the Contractor and shall include but not limited to travel expenses (international and inland fares), lodging and per diem charges as well as medical insurance, instructors fee, programme and miscellaneous cost to be incurred during the training.

The training programme shall be adequate for the trainees to acquire the necessary expertise and competence in the area of engineering, operation and maintenance and as trainers for in-house technology transfer programme of the Purchaser.

The Contractor shall be responsible for the development of the Training Module and Programme Schedule which shall be submitted to the Purchaser for approval.

The components of the training modules shall include but not be limited to the training procedures/methodology, instructional materials such as audio visual materials, CDs and slides and manuals for each trainee.

Three (3) sets of the materials included in the training modules shall be handed over to the Purchaser upon completion of the training. An evaluation shall be jointly undertaken by the Contractor and the Purchaser's representative on the adequacy, appropriateness and relevance of the training and the programme effectiveness after the training. The training material shall be in English language only.

The content of the training programme shall include but not be limited to:

1. Coal fired thermal plant principles in management and practice for operators, technicians and maintenance personnel.
2. Plant operation and systems training for operators including simulator training as applicable.
3. Maintenance training programme covering electrical, mechanical and instrumentation and control.

Said training programme shall be submitted to the Purchaser for approval.

The timing of the training should be such that the participants will be conversant with sufficient know-how to participate in the pre-commissioning and commissioning tests of the Plant.

The Contractor shall provide qualified English speaking instructors and training

coordinator(s) during the tenure of the training programme.

17.02.00 Operation and Maintenance Training at Site

The Contractor shall provide a comprehensive training programme related to design application, plant management, operation and maintenance, including trouble shooting, of the Contractor's supplied system and equipment at the Site starting from Start of Commissioning and thereafter up to the Final Acceptance of the first Unit.

The following instructors shall be at the Site continuously during the training :

- a) One (1) for Steam Generator and Auxiliaries ;
- b) One (1) for Turbine Generator and Auxiliaries ;
- c) One (1) for Electrical Works ;
- d) One (1) for Instrumentation and Control (Boiler and Auxiliaries) ;
- e) One (1) for Instrumentation and Control (Turbine and Auxiliaries).

17.03.00 On-the-Job Training

During the period of pre-commissioning, commissioning and trial operation, the Purchaser shall provide operation and maintenance personnel to assist the Contractor in the operation and maintenance of his supply and work under the direction of the Contractor for the purpose of on-the-job training.

The Purchaser shall have the right to send to the Site his employees later intended to operate and maintain the equipment supplied under this Contract. The Contractor shall, without additional cost, use his site staff to instruct these employees on the operation and maintenance of the equipment. All instructions shall be in the English language.

17.04.00 For detail C&I training refer to Volume-VI, Section-9.

18.00.00 DEVIATIONS

The Bidder is required to submit with his proposal in the relevant schedules a detail list of any and all deviations taken by him clearly without any ambiguity. In the absence of such a list it will be understood and agreed that the Bidder's proposal is based on strict conformance to this specification and no post-contract negotiations would be allowed in this regard.

Unless otherwise specifically indicated in the deviation list, it will be construed and agreed that details indicated in documents & drawings furnished by the Bidder along with the offer is in-line with the specification requirement.

ANNEXURE-I

LIST OF STANDARDS FOR REFERENCE

- a) International Standards Organisation (ISO).
- b) International Electro-technical Commission (IEC).
- c) American Society of Mechanical Engineers (ASME).
- d) American National Standards Institute (ANSI).
- e) American Society for Testing and Materials (ASTM).
- f) American Institute of Steel Construction (AISC).
- g) American Welding Society (AWS).
- h) Architecture Institute of Japan (AIJ).
- i) National Fire Protection Association (NFPA).
- j) National Electrical Manufacturer's Association (NEMA).
- k) Japanese Electro-technical Committee (JEC).
- l) Institute of Electrical and Electronics Engineers (IEEE).
- m) Federal Occupational Safety and Health Regulations (OSHA).
- n) Instrument Society of America (ISA).
- o) National Electric Code (NEC).
- p) Heat Exchanger Institute (HEI).
- q) Tubular Exchanger Manufacturer's Association (TEMA).
- r) Hydraulic Institute (HIS).
- s) International Electro-Technical Commission (IEC) Publications.
- t) Power Test Code for Steam Turbines (PTC).
- u) Applicable German Standards (DIN).
- v) Applicable British Standards (BS).
- w) Applicable Japanese Standards (JIS).

- x) Electric Power Research Institute (EPRI).
- y) Standards of Manufacturer's Standardization Society (MSS).
- z) Bureau of Indian Standards Institution (BIS).
- aa) Indian Electricity Rules.
- bb) Indian Boiler Regulations (IBR).
- cc) Indian Explosives Act.
- dd) Indian Factories Act.
- ee) Tariff Advisory Committee (TAC) rules.
- ff) Emission regulation of Central Pollution Control Board (CPCB).
- gg) Pollution Control regulations of Dept. of Environment, Govt. of India
- hh) Central Board of Irrigation and Power (CBIP) Publications.
- ii) The Air Prevention and Control of Pollution Act.
- jj) The Environmental Protection Act
- kk) The Public Liability Insurance Act.
- ll) The Forest Conservation Act
- mm) The Wildlife protection Act.
- nn) The EIA Notification, 1994.
- oo) IS: 14665-Specification for Electric Traction Lift
- pp) Any other statutory Codes/Standards/Regulations

ANNEXURE-II

CRITERIA FOR LAYOUT

PLOT PLAN LAYOUT REQUIREMENTS

ITEM	SPECIFICATION REQUIREMENT
A. Site conditions to be considered	
1. Prevalent wind direction	See wind-rose in plot plan. Also refer Metrological Data.
B. Layout Requirements	
1. Maximum permissible slope in	
a) Rail track	1 in 400
b) Road	1 in 30
c) Sides of unpaved embankment	1 in 2
2. Required road width	
a) Main roads	Refer VII-A, B, C.
b) Auxiliary interconnections	Refer VII-A, B, C.
c) Road to the power house unloading bay :	
• Only for entry to the unloading bay	Yes
• To pass through the unloading bay	No
3. Required minimum horizontal distance between the nearest points of	
a) Plant boundary and the boundary of residential area	(Local municipality/factory rule)
b) Electrical transformer and any other building/facility	As per the Tariff Advisory Committee/ LPA Rules
c) Fire water supply installation and any building/facility subject to fire risk.	As per the Tariff Advisory Committee/ LPA Rules
d) Inflammable liquid (fuel oil, etc.) storage & handling installation and their fencing and other buildings/facilities.	Rules of the Indian Explosive (Indian Explosives Act) and Indian Petroleum Code

ITEM	SPECIFICATION REQUIREMENT
4. Required minimum vertical clearance	
a) Under pipes/cable racks at road crossings	8.0 Metres
b) Soil coverage over underground pipes	1.0 Metre (minimum)
5. Railway Wagon clearance	Rules of the Indian Railways
6. Minimum Clearance between any road edge and building/structure/ any fixed installation.	3 Metres
7. Required level, above the local developed grade level, of	
a) top of all roads	150 mm above FGL
b) all outdoor paved areas	100 mm above FGL
c) Temporary storage areas, workshops, offices, residence etc. required at the time of erection work.	Yes
d) Green belt around power plant area	As per environmental guidelines of MOEF, Govt. of India.

BUILDING/ EQUIPMENT LAYOUT REQUIREMENTS

- A. Minimum clear space required at all working and walking areas for operating & maintenance personnel
1. Horizontal, in all directions
 - a) Adjacent to any electrical equipment, electrical cables, running (rotating/reciprocating) equipment, safety valve or vent/drain pipe outlet, pipe/ equipment of surface temperature exceeding 60°C. 1200 mm
 - b) Adjacent to any other plant facilities (including walls/structures) 1000 mm
 2. Vertical (head-room clearance)
 - a) Under any pipe/equipment surface of temperature exceeding 60°C and any electrical cables or other electrical items. 2.5 Metre
 - b) Under any other plant facilities (including structures, pipes etc.) 2.5 Metre

ITEM	SPECIFICATION REQUIREMENT
3. For all areas where any equipment (including trucks, trolleys and other material handling equipment) will move or maneuver.	Minimum 500 mm clear in all direction from the outer edges of the equipment
4. Minimum clear hand space required for	
a) The application of thermal insulation	100 mm
b) Welding work	150 mm
c) Bolt tightening	150 mm
B. Floors, platforms, staircase, ladders, walls, doors & windows	
1. Statutory Requirement	As per the regulations of Tariff Advisory Committee, Indian National Building Code, Indian Factories Act, Local Municipal Rules, etc.
2. Operation & Maintenance Requirement	
a) Adequate floor space shall be kept to permit dismantling, temporary storing and in-situ maintenance of plant & equipment parts, satisfying the clear space requirements stated above. A separate unloading bay for such purpose is required.	Yes
b) Floors or fixed/portable platforms with stairs/ ladders shall be provided for easy approach to any plant item, including valves, instruments, etc. to be operated, observed and/or to be frequently (more than once a month) maintained.	Yes
3. Plinth level of all buildings, above the finished grade level	500 mm
4. Minimum access opening required (with rolling shutter) for transportation, wherever entry of truck for material handling is envisaged	3.5M wide x 4M high or, more depending upon the equipment size to be handled.

ITEM	SPECIFICATION REQUIREMENT
C. Other Maintenance Requirement	
1. Generator stator handling In case the Generator stator cannot be handled by the turbine house crane, all provisions for its overhauling, including the arrangement to slide the stator on the turbine house floor, the foundation work for stator jacking /lowering assembly, dismantling of building end walls/structures etc. shall be kept.	Yes
2. Maintenance of the internals/impellers of all important equipment, like boiler feed pumps, feed water heaters, Surface Condenser, fans of the boiler draft plant, Intake and circulating water pumps, cooling water pumps, coal mills, compressors, blowers, heat exchangers, fuel oil pumps, filters etc.	Shall be possible without disconnecting or dismantling any piping/ducting.
3. Overhauling and handling of the casings for the above items	Shall be possible without disturbing/dismantling any piping/ducting not directly connected to them.
4. Crane Approach Wherever required the unobstructed approach of the crane hook/other hoisting equipment hook to various plant & equipment shall be possible.	Yes
D. Central Control Room	
All electronic equipment other than those directly associated with control, operation or presentation of displays shall be mounted external to the control room in air conditioned control equipment room.	Yes
The bidder shall describe in his bid the proposed layout philosophy of the Central Control Room and Control Equipment Room and the arrangement of equipment best suited for the system offered by him and as per good ergonomically consideration. However, as a guide line, following features are given :	
a) False ceiling and false flooring shall be provided.	
b) Uniform height, colouring schemes for cabinets etc. shall be available.	

ITEM	SPECIFICATION REQUIREMENT
c) The total area of floor space covered by Control Consoles/Panels in the Control Room shall not exceed 15% of floor area.	
d) No opening shall be provided from Boiler side.	
e) Two double leaf doors, suitably located for entering the Control room shall be provided with opening towards the turbine floor.	
f) Cable entry for the panels/consoles shall be from bottom and suitable openings shall be provided.	
g) The Control Room lighting shall be designed to provide a glare free uniform illumination. The level of illumination shall be minimum 400 LUX.	
h) Necessary Air Conditioning shall be provided for Central Control room, Control Equipment Room and SWAS room etc.	
i) Basic amenities like toilet, Tiffin rooms, wash basins, rest rooms etc. shall be provided near the Control Room.	
E. Toilet and drinking water facility	Required in all buildings and on all floors wherever operating personnel are to be deployed.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

VOLUME II-B

SECTION 'C2C'

REVISION 00

DATE: 24/04/2015

PAGE 1 of 2

**SECTION: C-2C
FUNCTIONAL / PERFORMANCE / DEMONSTRATION / GUARANTEE
TESTS**



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUEDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

VOLUME II-B

SECTION 'C2C'

REVISION 00

DATE: 24/04/2015

PAGE 2 of 2

Following test to be conducted by vendor on completion of fohs for ascertaining performance of the system:

- 1) Shop test report shall be considered for pump guaranteed for capacity and total dynamic head.
- 2) Unloading pump vibration and noise within limit at site.
- 3) Drain oil pump and sump pump noise and vibration under limit at site.
- 4) Water filled test on tank and other test as indicated in IS803 / API650 for tank leakage etc. will be carried out for tank stability.
- 5) Tank temperature and suction heater outlet temperature measurement.
- 6) Entire piping and support for smooth operation: Hydro test shall be carried out for checking the weld tightness and support checking.
- 7) Operation of the complete system as per Control philosophy.

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



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001	
VOLUME II-B	SECTION 'C2D'
REVISION 00	DATE: 24/04/2015
PAGE 1 of 1	

**SECTION: C-2D
QUALITY ASSURANCE**

STANDARD CHECL LIST FOR :Insulation & Cladding
PACKAGE-FULE OIL SYSTEM
PROJECT-
CHECL LIST NO.:PE-QP-XXX-166-A801



REV.NO. 0

DATE: 31/03/2012

SL. No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY				REMARKS
				M	C	N	D	
1.0	Review of Manufacturer's TC for Mineral wool	Sampling as per IS:8183	Appd.Data Sheet/ IS:8183	P	V	V	√	Ref, Note 1
2.0	Review of Material TC for Aluminium sheet	One/Lot	Appd.Data Sheet/ IS:737	P	V	V	√	Ref. Note 2
2.1	Dimensional Check	At random (10%)	-do-	P	V	V	√	
3.0	Packing & Marking	100%	IS:8183/Mfr's Std.	P	V	V	√	

Legend:

Records identified with "√" shall be essentially included by contractor in QA documentation

M= Manufacturer, C= Main Vendor

N= BHEL/Customer

P= Perform, W= Witness, V= Verification

Note:1.MTC Will comprise the tests in line with IS:8183

2. MTC will Comprise of chemical & mechanical properties.

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD CHECK LIST FOR: PRESSURE REDUCING VALVE

PACKAGE-FULE OIL SYSTEM

PROJECT-

CHECK LIST NO.:PE-QP-XXX-166-A802

REV.NO. 0

DATE: 31/03/2012

SL.	TESTS/CHECKS	QUANTUM OF	REFERENCE DOC./	AGENCY				REMARKS
No.		CHECKS	ACCEPTANCE NORMS	M	C	N	D	
1	Review of Material TC for body & diaphragm	One/Lot	Appd.Data Sheet/ Relevant Std.	P	V	V	✓	
2	Hydro test of body	100%	Appd.Data Sheet	P	W	V	✓	
3	End Connection	100%	-do-	P	W	V	✓	
4	Check for IBR TC	100%	-do-	P	V	V	✓	

Legend:

Records identified with ' ✓ shall be essentially included by contractor in QA documentation

M= Manufacturer, C= Main vendor/Sub vendor

N= BHEL/Customer,

P= Perform, W= Witness, V= Verification

Note: 1.For IBR Valves, no physical inspection is carried out by contractor/customer.Material will be accepted based on review of IBR Test Certificates.

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR

STRUCTURAL STEEL

PEM MAUX

QUALITY PLAN NO.:PE-QP-XXX-166-A803

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0 DATE: 31/03/2012

SHEET 1 OF 1

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.0	Structural	a) Chemical Composition	M	Chemical Analysis	Sample	IS:2062/ Spec./Drg.	IS:2062/ Spec./Drg.	Mfr's TC	✓	P	V*	V	
		b) Mechanical test	M	Mechanical Properties	-do-	-do-	-do-	Mfr's TC	✓	P	V*	V	
		c) Dimensional conformity	M	Measurement	100%	-	-	Mfr's TC	✓	P	W**	V	
* In case material is procured from dealer, and co-related TCs are not available, check test on identified sample will be carried out at recognised testing laboratory.													
** In case material is despatched directly from SAIL/IISCO plant to project site, the witnessing required is waived and material will be accepted on challan & MTC of SAIL/IISCO													

LEGEND:

RECORDS IDENTIFIED WITH "✓" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

M - MANUFACTURER

C - MAIN VENDOR

CU - BHEL/CUSTOMER/NOMINATED INSPECTION AGENCY

"P" PERFORM, "W" WITNESS AND V VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)REVIEWING AGENCY
(SIGN WITH DATE & STAMP)APPROVING AGENCY
(SIGN WITH DATE & STAMP)



PEM MAUX

STANDARD QUALITY PLAN FOR STEEL PLATE

QUALITY PLAN NO.:PE-QP-XXX-166-A804

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0 DATE: 31/03/2012

SHEET 1 OF 1

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS CHECKED	CATEGORY	TYP/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY			REMARKS
									P	W	V	
1.0	Steel Plate	a) Chemical Composition	MA	Chemical Analysis	Sample	IS:2062/ Spec./Drg.	IS:2062/ Spec./Drg.	Mfr's TC	3		2*,1	
		b) Mechanical test	MA	Mechanical Properties	-do-	-do-	-do-	Mfr's TC	3		2*,1	
		c) Dimensional conformity	MA	Measurement	100%	-	-	Mfr's TC	3	2**	1	

* In case material is procured from dealer, and co-related TCs are not available, check test on identified sample will be carried out at testing laboratory.

** In case material is despatched directly from SAIL/TISCO plant/Stock yard to project site, the witnessing required is waived and material will be accepted on MTC of SAIL/TISCO

LEGEND

CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

P - Agency Performing the Test.
W - Agency Witnessing the Test.
V - Agency Verifying the Test.

1 - BHEL 4-CUSTOMER
2 - Vendor
3 - Sub-vendor

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

STANDARD CHECK LIST FOR: :Safety Relief Valve
 PACKAGE-FULE OIL SYSTEM
 PROJECT-
 CHECK LIST NO.:PE-QP-XXX-166-A805
 REV.NO.0
 DATE:31/03/2012



SL. No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY				REMARKS
				M	C	CU	D	
1	Review of Material TC for body & stem	One/Lot	Appd.Data Sheet/ Relevant Std.	P	V	V	✓	
2	Hydro test of body	100%	Appd.Data Sheet	P	W	V	✓	
3	Set pressure	100%	-do-	P	W	V	✓	
4	Check for IBR TC	100%	-do-	P	V	V	✓	

Legend:

Records identified with ' ✓ shall be essentially included by contractor in QA documentation

M= Manufacturer, C= Main vendor

CU=BHEL/Customer

P= Perform, W= Witness, V= Verification

For IBR Valves, no physical inspection carried out by contractor/customer.Material will be accepted based on review of IBR test certificates.

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

			STANDARD QUALITY PLAN FOR SUMP PUMP				QUALITY PLAN NO.:PE-QP-XXX-166-A807 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 2 DATE: 31/03/2012						
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	M	C	CU	D	11
1.0	<u>RAW MATERIAL</u>												
1.1	CASING/ROTOR(IMPELLER) HOUSING	i) SURFACE DEFECTS ii) DIMENSIONAL CONFORMITY iii) MECHANICAL & CHEMICAL TEST iv) HARDNESS TEST	MAJOR	VISUAL MEASUREMENT PHYSICAL PROPERTIES/ CHEM. ANALYSIS MEASUREMENT	100% 100% 1/HEAT 100%	APPD.DATA SHEET/ DRG./ MFR's DRG./IS:210 Gr. FG 200/RELEVANT STD.	APPD.DATA SHEET/ DRG./ MFR's DRG./IS:210 Gr. FG 200/RELEVANT STD.	IR & TC	P	V	-		
1.2	IMPELLER	i) SURFACE DEFECTS ii) DIMENSIONAL CONFORMITY ii) MECHANICAL & CHEMICAL TEST iv) HARDNESS v) DY PENETRATION TEST (AFTER MACHINING)	MAJOR	VISUAL MEASUREMENT PHYSICAL PROPERTIES/ CHEM. ANALYSIS MEASUREMENT DYEPENETRATION TEST	100% 100% 1/HEAT 100% 100%	APPD.DATA SHEET/DRG. MFR's DRG./ RELEVANT STD.	APPD.DATA SHEET/DRG. MFR's DRG./ RELEVANT STD.	IR & TC	P	V	-		
1.3	SHAFT	i) DIMENSIONAL CONFORMITY ii) MECHANICAL & CHEMICAL TEST iii) UT DIA > 50MM **	MAJOR	MEASUREMENT PHYSICAL PROPERTIES/ CHEM. ANALYSIS UT	100% 1/HEAT 100%	MFR's DRG./ APPD. DATA SHEET/ MFR's CATALOGUE ASTM A388	MFR's DRG./ MFR's CATALOGUE/ RELEVANT STD. ASTM A388	IR & TC	P	V	-		
1.4	SHAFT SLEEVE	i) CHEMICAL ANALYSIS ii) HARDNESS	MAJOR	CHEMICAL MEASUREMENT	1/HEAT 100%	MFR's STD./MFR's CATALOGUE	RELEVANT STANDARD/ IS	IR & TC	P	V	-		
1.5	WEARING RINGS	i) MECHANICAL & CHEMICAL TEST ii) HARDNESS	MAJOR	PHYSICAL PROPERTIES/ CHEM. PROPERTIES MEASUREMENT	1/HEAT 100%	MFR's STD./MFR's CATALOGUE	RELEVANT STANDARD/ IS	IR & TC	P	V	-		
LEGEND: RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND V VERIFICATION IR - INSPECTION REPORT, MTC - MTRL./MFR'S TEST CERTIFICATES													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					

		STANDARD QUALITY PLAN FOR SUMP PUMP					QUALITY PLAN NO.:PE-QP-XXX-166-A807 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 2 OF 2				DATE: 31/03/2012		
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	M	C	CU	D	11
2.0	INTERNAL TEST												
2.1	CASING	SOUNDNESS OF CASTING	MAJOR	HYDROSTATIC TEST	100%	HYDROSTATIC TEST AT 200% OF PUMP RATED HEAD OR 150% SHUT OFF HEAD WHICHEVER IS HIGHER FOR 30 MTS.	NO LEAKAGE	IR & TC	P	V	V	✓	
2.2	SHAFT	DP ON SHAFT	MAJOR	DPT	100%	ASME E165	NO LINEAR DEFECTS	IR & TC	P	V	V	✓	
2.3	IMPELLER	RESIDUAL UNBALANCE	MAJOR	DYNAMIC/STATIC BALANCING	100%	ISO 1940 GR.6.3	ISO 1940 GR.6.3	IR & TC	P	V	V	✓	
3.0	FINAL INSPECTION												
3.1	OVERALL DIMENSION	DIMENSIONAL	MAJOR	MEASUREMENT	100%	APPD. DRAWING/ MFR's DRAWING	APPD. DRAWING/ MFR's DRAWING	IR & TC	P	W	W	✓	
3.2	PERFORMANCE TEST WITH LAB MOTOR	i) Q V/s HEAD ii) Q V/s POWER iii) Q V/s EFFICIENCY iv) NOISE LEVEL & VIBRATION	CRITICAL	MEASUREMENT	100%	APPD.DRG./MFR's DRG./APPROVED. DATASHEET/HIS	APPD.DRG./MFR's DRG./APPROVED. DATASHEET/HIS	IR & TC	P	W	W	✓	
3.3	STRIP TEST	STRIP TEST	CRITICAL	VISUAL (WEAR & TEAR)		**	85 dBA MAX. AT 1Mtr, & 75 MICRON MAX. NO UNDUW WEAR	IR & TC	P	W	W	✓	
3.4	REVIEW OF DOCUMENTATIONS					APPD. QAP	APPD. QAP		V	V	V	✓	
3.5	PAINTING	VISUAL	MINOR	VISUAL	100%	SPECIFICATION/ PAINTING SCH-EDULE/Mfr's Std.	SPECIFICATION/ PAINTING SCH-EDULE/Mfr's Std.	IR	P	V	-		** STRIP DOWN TEST ON 100% BASIS SHALL BE DONE INCASE ABNORMAL PERFORMANCE OTHERWISE SAME SHALL BE RESTRICTED TO BEARING INSPECTION ONLY
NOTE: ALL MATERIAL OF CONSTRUCTION SHALL BE AS PER APPROVED DATA SHEET/DRAWING													
LEGEND: RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER INDICATE "P" PERFORM "W" WITNESS AND V VERIFICATION IR - INSPECTION REPORT, MTC - MTRL/MFR'S TEST CERTIFICATES MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP) REVIEWING AGENCY (SIGN WITH DATE & STAMP) APPROVING AGENCY (SIGN WITH DATE & STAMP)													



STANDARD QUALITY PLAN FOR
BALL VALVE

QUALITY PLAN NO.:PE-QP-XXX-166-A808
PACKAGE-FULE OIL SYSTEM
PROJECT-

REV.NO. 0
SHEET 1 OF 3

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9				10	
1.0	MATERIALS: 1.1 BODY & END PIECE	CHEMICAL COMPOSITION	CRITICAL	CHEM. TEST	ONE/ HEAT	APPD.DRG./ DATA SHEET	APPD.DRG./ DATA SHEET/ RELEVANT STD.	MATRL. TC/ MFR'S TC	✓	P	V	V	
		MECHANICAL PROPERTIES	- DO -	MECH. TEST	ONE/HEAT/ HEAT TREAT- MENT BATCH	- DO -	- DO -	- DO -	✓	P	V	V	
		HEAT TREATMENT	- DO -	REVIEW OF HT CHART	100%	- DO -	- DO -	- DO -/HT CHART	✓	P	V	V	
		IDENTIFICATION & CORRELATION	MAJOR	VISUAL	100%	- DO -	- DO -	INTERNAL RECORD		P	V	-	
		SURFACE DEFECTS	- DO -	- DO -	100%	MSS-SP-55	FREE FROM DEFECTS	- DO -	✓	P	V	-	
		DIMENSIONAL	- DO -	MEASU- REMENT	100%	APPD. DRG./ RELEVANT STD.	APPD. DRG./ RELEVANT STD.	LOG BOOK		P	V	-	

LEGEND:

RECORDS, IDENTIFIED WITH ✓ ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

M: MANUFACTURER .

C:MAIN VENDOR, CU: BHEL/CUSTOMER

INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR
BALL VALVE

QUALITY PLAN NO.:PE-QP-XXX-166-A808
PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0
SHEET 2 OF 3

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9	10				11
1.2	BALL, SPINDLE, GLAND, LEVER FASTENERS	CHEMICAL COMPOSITION	CRITICAL	CHEM. TEST	ONE/ HEAT	APPD.DRG./ DATA SHEET	APPD.DRG./ DATA SHEET/ RELEVANT STD.	TEST CERT.	✓	P	V	V	
		MECHANICAL PROPERTIES	- DO -	MECH. TEST	ONE/HEAT/ HEAT TREATMENT BATCH	- DO -	- DO -	- DO -	✓	P	V	V	
		HEAT TREATMENT (as applicable)	- DO -	REVIEW OF HT CHART	100%	- DO -	- DO -	- DO -/ HT CHART	✓	P	V	V	
		SURFACE DEFECTS	MAJOR	- DO -	100%	MSS-SP-55	FREE FROM DEFECTS	- DO -	✓	P	V	-	
		DIMENSIONS	- DO -	MEASUREMENT	100%	APPD. DRG./ RELEVANT STD.	- DO -	LOG BOOK		P	V	-	
1.3	BODY SEAL, STEM SEAL, GLAND PACKING	DIMENSIONS	- DO -	- DO -	100%	- DO -	- DO -	INTERNAL RECORD		P	V	-	
		TEMPERATURE RESISTANCE	- DO -	TEMP. CHECK	100%	PTFE /RELEVANT STD.	RELEVANT STD.	TEST CERTIFICATE	✓	P	V	V	
2.0	IN-PROCESS INSPECTION:												
2.1	MACHINING OF BODY END-PIECE GLAND BALL, SPINDLE	DIMENSIONS	-DO-	MEASUREMENT	100%	MFG. DRG.	MFG. DRG.	LOG BOOK		P	V	-	
		SURFACE FINISH	- DO -	VISUAL	100%	- DO -	MFG. DRG./MFG. STD.	- DO -		P	V	-	
2.2	BALL, SPINDLE	HARDNESS	-DO -	HARDNESS TEST	100%	APPD. DRG./ DATA SHEET/ TECH.SPEC.	APPD. DRG./ DATA SHEET/ TECH.SPEC./MFG. STD.	TEST CERT.	✓	P	V	V	
		SURFACE DEFECTS	CRITICAL	DPT	100%	ASTM-E-165	NO LINEAR INDICATION	INTERNAL RECORD	✓	P	V	-	

LEGEND:

RECORDS, IDENTIFIED WITH ✓ SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

M: MANUFACTURER .

C: MAIN VENDOR, CU: BHEL/CUSTOMER

INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR
BALL VALVE

QUALITY PLAN NO.:PE-QP-XXX-166-A808

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO.
SHEET

0
3 OF 3

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9	10				11
2.3	BALL & SEAT	BLUE MATCH	CRITICAL	BLUE MATCHING	100%	THE SURFACE WILL BE SMOOTH & WILL HAVE UNIFORM METAL TO METAL CONTACT	SAME AS COL.7	LOG BOOK	✓	P	V	V	
3.0	<u>ASSEMBLY</u>	DIMENSIONS	MAJOR	MEASUREMENT	*AS PER NOTE-1 BELOW	APPD. DRG./ RELEVANT STD.	APPD. DRG./ RELEVANT STD.	INTERNAL RECORD	✓	P	W	W	
4.0	<u>TESTING:</u>	OPENING & CLOSING	- DO -	OPERATION	- DO -	SMOOTH OPERATION OF VALVE	- DO -	- DO -	✓	P	W	W	
4.1	<u>SHELL</u>	LEAKAGE	CRITICAL	HYDRO-STATIC	*AS PER NOTE-1 BELOW	APPD. DRG./ DATA SHEET	NO LEAKAGE	TEST CERTIFICATE	✓	P	W	W	
4.2	SEAT	- DO -	- DO -	- DO -	- DO -	- DO -	- DO -	- DO -	✓	P	W	W	
4.3	SEAT	- DO -	- DO -	AIR	- DO -	- DO -	- DO -	- DO -	✓	P	W	W	
4.4	FIRE SAFE TEST REPORT WITNESSED BY LLOYD/BV SHALL BE FURNISHED FOR REVIEW								✓	P	V	V	
4.5	REVIEW OF QA DOCUMENTATION AS PER APPD. QP								✓	P	V	V	
5.0	<u>PAINTING :</u>	QUALITY & THICKNESS OF PAINT	MAJOR	VISUAL & MEASUREMENT	100%	TECH. SPEC./ DATA SHEET/ MFG. STD.	SAME AS COL.7	INTERNAL RECORD		P	V	-	
6.0	<u>PACKING:</u>		MAJOR	VISUAL	100%			INTERNAL RECORD		P	-	-	

NOTE-1:

100% BY MANUFACTURER

10% BY TECHNO

For Actuator operating valves - Actuator test certificate shall be furnished to BHEL for review.

For Fire safe valves - valves are to be accepted based on fire test certificates

LEGEND:

RECORDS, IDENTIFIED WITH / ' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

M: MANUFACTURER .

C: MAIN VENDOR, CU: BHEL/CUSTOMER

INDICATE "P" PERFORM, "W" WITNESS AND "V" VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR
CS PIPE -ERW

QUALITY PLAN NO.:PE-QP-XXX-166-A809
PACKAGE-FULE OIL SYSTEM
PROJECT-
REV.NO. 0
SHEET 1 OF 1

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			CU	REMARKS
									D	M	C		
1	2	3	4	5	6	7	8	9			10		11
1.0	ERW PIPE	a) Physical & Chemical test	M	Physical & Chemical Properties	Sample	IS:1239 Pt.1/ API 5L Gr. B/ Appd. Data sheet	IS:1239 Pt.1/ API 5L Gr. B/ Appd. Data sheet	MTC/ Mfr's TC	✓	P	V	V	Refer Note-1
		b) Dimensional conformity	M	Measurement	At random	-do-	-do-	MTC/ Mfr's TC	✓	P	V	V	
		c) Hydro test	M	Leak test	100%	-do-	-do-	MTC/ Mfr's TC	✓	P	V	V	
Note-1: In case material is procured from dealer, and co-related Mfr's TCs are not available, check test on identified sample will be carried out at testing laboratory and hydro test at pressure 1.5 times of design pressure on10% of total quantity will be witnessed by BHEL.													

LEGEND:

RECORDS IDENTIFIED WITH ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

M - MANUFACTURER

C - MAIN VENDOR

CU - BHEL/CUSTOMER

"P" PERFORM, "W" WITNESS AND V VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR
CCS /CFS GATE,GLOBE & CHECK VALVE
(UP TO 50 NB-FCS #800 & 1 NO. 50 NB GLOBE
VALVE #600) (65 NB & ABOVE CCS # 150)

QUALITY PLAN NO.:PE-QP-XXX-166-A810
PACKAGE-FULE OIL SYSTEM
PROJECT-
REV.NO. 0
SHEET 1 OF 2

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	N	
1	2	3	4	5	6	7	8	9	10				11
1	Raw Material:												Body will carry the heat mark for co-relation with CMT
	Body, bonet, gld., Flange, Disc, / wedge	Chem. & mech. Test Dimensions Surface quality	CR MR MR	Chem.& mech.Test Measurement Visual	Per Heat 100% 100%	Appd.Drg./ Mfg. Drg./ Data Sheet Mfg. Drg./ Data Sheet	Relevant Standard Mfg. Drg./ Data Sheet Defect Free	MTC IR IR	✓ ✓ ✓	P P P	V V V	V V V	
	1.1 Stem,body seat ring,gland.	Chem. & mech. Test	CR	Chem.& mech.Test	Per Heat	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	MTC	✓	P	V	V	
	1.2 Fasteners	Chem. & mech. Test	MR	Chem.& mech.Test	Per Heat	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	IR	✓	P	V	V	
1.3	Gasket & gland packing	Compliance to PO	MR	Measurement	100%	Appd.Drg./Relevant Std.	Appd.Drg./Relevant Std.	IR	✓	P	V	V	
2.0 In Process Inspection													
2.1	Machining of valves components	Surface quality Dimension	MR	Visual	100%	Mfg. Drg.	Mfg. Drg.	IR	✓	P	V	V	
			MR	Measurement	100%	Mfg. Drg.	Mfg. Drg.	IR	✓	P	V	V	
2.2	Spindle	Surface finish	MR	Measurement	100%	Mfg. Drg.	Mfg. Drg.	IR	✓	P	V	V	
2.3	Wedge / disc , seatriing, stem & back seat	Lapping	MR	Blue Matching	100%	100% metal to metal contact	100% metal to metal contact	IR	✓	P	V	V	

LEGEND:
 RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

M MANUFACTURER/SUB-CONTRACTOR
 C CONTRACTOR/NOMINATED INSPECTION AGENCY,
 N CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND
 V VERIFICATION AS APPROPRIATE CHP
 SHALL IDENTIFIED IN COLUMN "N"
 IR - INSPECTION REPORT, CMT-CERTIFICATE OF MATERIAL & TEST

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



STANDARD QUALITY PLAN FOR
CCS /CFS GATE,GLOBE & CHECK VALVE
(UP TO 50 NB-FCS #800
(65 NB & ABOVE CCS # 150)

QUALITY PLAN NO.:PE-QP-XXX-166-A810
PACKAGE-FULE OIL SYSTEM
PROJECT-
REV.NO. 0
SHEET 2 OF 2

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	N	
1	2	3	4	5	6	7	8	9			10		11
3.0	Testing & Final Inspection												
3.1	Performance	Operation	CR	Manual	100%	Appd. Drg./Data Sheet	Should be smooth	IR	✓	P	W	W*	
3.2	Shell &Sheet / backseat	Pr. Testing	CR	Hyd. Testing	100%	Appd. Drg./Data Sheet	Relevant Standard / Data Sheet	CMT	✓	P	W	W*	
3.3	Seat	Pr. Testing	CR	Pneumatic Testing	100%	Appd. Drg./Data Sheet	Relevant Standard / Data Sheet	CMT	✓	P	W	W*	Not Applicable for Check Valve
3.4	Valve Assembly	1. Chk. For completeness/ Visual Inspection	MR	Visual	100%	Appd. Drg. / Tech. Spec./ Data Sheet	Appd. Drg./Data Sheet	IR	✓	P	W	W*	
		2. Dimention	MR	Measurement	10%	Appd. Drg./Data Sheet	Appd. Drg./Data Sheet	IR	✓	P	W	W*	
		3. Wear Travel / valve lift	MR	Manual	100%	Appd. Drg.	Appd. Drg.	IR	✓	P	W	W*	*RANDOM 10% BY CUSTOMER
4.0	Painting & Packaging												
		1. Painting & Packaging	MR	Manual	100%	Appd. Drg. / Tech. Spec.	Appd. Drg. / Tech. Spec.	IR		P	V		
		2. Tagging	MR	Manual	100%	Appd. Drg. / Tech. Spec.	Appd. Drg. / Tech. Spec.	PS / RS		P	V		

LEGEND:

RECORDS INDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

M MANUFACTURER/SUB-CONTRACTOR

C CONTRACTOR/NOMINATED INSPECTION AGENCY,

N CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND

V VERIFICATION AS APPROPRIATE CHP

SHALL INDENTIFIED IN COLUMN "N"

IR - INSPECTION REPORT, CMT-CERTIFICATE OF MATERIAL &TEST

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)



**STANDARD QUALITY PLAN FOR
OIL STRAINER**

**QUALITY PLAN NO.:PE-QP-XXX-166-A811
PACKAGE-FULE OIL SYSTEM**

PROJECT-

REV.NO. 0 DATE: 31/03/2012
SHEET 1 OF 2

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9	10				11
1.0	Raw Material												
1.1	Body, flange, dished end	Physical & Chemical Properties	MA	Physical & Chemical Test	1/Sample	Appd. Drg.	Appd. Drg./ Mfg.Std.	Mtrl.TC	✓	P	V	V	
1.2	Screen	1. Chem. composition	MA	Chem. Test	1/Sheet	- do -	- do -	- do -	✓	P	V	V	
		2. Dimension, Mesh Size	MA	Meas.	100%	- do -	- do -	log book		P	V	V	
2.0	In Process												
2.1	Welding Procedure Specification	Parameter	MA	Verification	100%	ASME-IX	ASME-IX	QW-482	✓	P	V	V	BHEL approved WPS & PQR Shall be furnished for review.
2.2	Procedure Qualification Record & Welder Qualification	Weld Soundness/ Qualification	MA	Qualification test RT	100%	ASME-IX	ASME-IX	QW-483/484	✓	P	V	V	
3.0	Weld fit up	Dimension alignment orientation	MA	Meas./ Visual	100%	Appd. WPS	Appd. WPS	log book		P	V	V	
4.0	Weldments - Final Run (all welds)	Surface Defect	MA	Penetration Test	10%	ASTME-165	No defects	- do -	✓	P	V	V	
4.1	Root run (butt welds & back gauged welds)	-do-	MA	-do-	100%	-do-	-do-	-do-	✓	P	V	V	

LEGEND:
RECORDS IDENTIFIED WITH "✓" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

"M" MANUFACTURER
"C" MAIN VENDOR
CU - BHEL/CUSTOMER
INDICATE "P" PERFORM "W" WITNESS AND"
V" VERIFICATION

**MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)**

**REVIEWING AGENCY
(SIGN WITH DATE & STAMP)**

**APPROVING AGENCY
(SIGN WITH DATE & STAMP)**



**STANDARD QUALITY PLAN FOR
OIL STRAINER**

QUALITY PLAN NO.: PE-QP-XXX-166-A811
PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0 **DATE:** 31/03/2012

SHEET 2 OF 2

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	CU	
1	2	3	4	5	6	7	8	9	10				11
5.0	Assembly of Internal Fittings Basket placement	Orientation Location of Tapping Points & fitting of Internals	MA	Visual & Meas.	100%	Appd. Drg.	Appd. Drg./ Mfg.Std.	log book		P	V	V	
6.0	<u>Final Assembly</u>												
6.1	Final Inspection	Completeness Cleanliness Dimension	MA	Visual & Meas.	100%	- do -	Appd. Drg./ Data Sheet	Inspection Report		P	W	W	
		Leak tightness	CR	Hyd. Test at 1.5 times of design pr. for 30 min.	100%	- do -	No leakage	Test Record	✓	P	W	W	
7.0	Review of QA Documents as per QP												

LEGEND:
RECORDS IDENTIFIED WITH "✓" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

"M" MANUFACTURER
"C" MAIN VENDOR
CU - BHEL/CUSTOMER
INDICATE "P" PERFORM "W" WITNESS AND
V" VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

		STANDARD QUALITY PLAN FOR POSITIVE DISPLACEMENT PUMP (SINGLE/TWIN SCREW PUMP)						QUALITY PLAN NO.:PE-QP-XXX-166-A812 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 2 DATE: 31/03/2012					
SL. NO. 1	COMPONENT & OPERATIONS 2	CHARACTERISTICS 3	CLASS 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENT 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	AGENCY				REMARKS 11
									D	M	C	CU	
1.0	Raw Material & Bought Out Items												
1.1	Casing, stuffing box & end cover	i) Chemical test	MA	Chemical Analysis	Sample/ heat	Appd. Data Sheet/ Appd. Drg./ IS:210 FG260	Same as Cl.7	Material TC	✓	P	V	V	
		ii) Physical test	MA	Physical Properties	Sample/ heat	- do -	Same as Cl.7	Material TC	✓	P	V	V	
		iii) Hardness	MA	Meas.	At random	As per Appd. Data Sheet	- do -	Material TC	✓	P	V	V	
1.2	Shaft, Rotor, Step-up gear, Timing gear	i) Chemical test	MA	Chemical Analysis	Sample/ heat	As per Appd. Data Sheet/ Drg.	Same as Cl.7	Material TC	✓	P	V	V	
		ii) Physical test	MA	Physical Properties	- do -	- do -	Same as Cl.7	Material TC	✓	P	V	V	
		iii) Heat treatment	MA	Heat treatment	100%	- do -	- do -	HT Chart	✓	P	V	V	
		iv) Hardness	MA	Meas.	- do -	- do -	- do -	- do -	✓	P	V	V	
1.3	Bearing	Make, size & bearing No.	MA	Visual	100%	Mfg. Drawing/ Mfg. Catalogue	- do -	Log Book		P	-	-	
2.0	In Process Control												
2.1	Machining of all Components	i) Dimension	MA	Meas.	100%	- do -	- do -	- do -		P	V	V	
		ii) Surface finish	MA	Visual	100%	- do -	- do -	- do -		P	-	-	
2.2	Casing	Pressure test	MA	Hyd. Test with water	100%	1.5 x max. discharge pr. for 15 minutes.	No leakage/Seepage	Test Report	✓	P	V	V	
2.3	Shaft, Rotor/Screw, Step-up gear, timing gear	1. Internal Defects	CR	UT(after skin - machining)	100%	ASTM A388	Refer Note.1 (page2)	Test Report	✓	P	V	V	
		2. Surface Defects	CR	DPT(after - final machining)	100%	ASTM E:165	No linear indication >1.6mm	Test Report	✓	P	V	V	
		3. Case Hardness of timing gear	CR	Hardness	100%	EN-36 to BS970/ As per data sheet	After case carburising, hardened & tempered to have tooth hardness of 56 to 59 HRC	H T report	✓	P	V	V	NA
2.4	Balancing of Rotor Assly.	Static & Dynamic	CR	Balancing	100%	VDI 2060 Cl. 6.3/ ISO 1940 Gr.6.3	ISO 1940 Gr.6.3	Test Report	✓	P	V	V	only in case of Twin Screw Pump
LEGEND: RECORDS IDENTIFIED WITH ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER "C" MAIN VENDOR "CU" BHEL/CUSTOMER.. "P" PERFORM "W" WITNESS AND "V" VERIFICATION													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					



**STANDARD QUALITY PLAN FOR
POSITIVE DISPLACEMENT PUMP
(SINGLE/TWIN SCREW PUMP)**

QUALITY PLAN NO.:PE-QP-XXX-166-A812

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0
SHEET 2 OF 2

DATE: 31/03/2012

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D	AGENCY			REMARKS
										M	C	CU	
1	2	3	4	5	6	7	8	9	D	10	11	12	11
3.0	Assembly Control Final Inspection & Testing:												
3.1	Pump Assembly	i) Completeness, correctness, overall dimension	MA	Visual & Meas.	100%	Appd. Drg.	Same as Cl.7	Log Book	✓	P	W	W	
3.2	Performance Test - with test bed motor	1.Performance for capacity, head,power consp., speed, efficiency.	CR	Performance Test	100%	VDMA/ HIS/Appd. Data sheet	Appd. Data sheet/curves/ VDMA/HIS	Test Report	✓	P	W	W	
		2. NPSHR for twin Screw pump	CR	- do -	10%	-do-	Appd. Data sheet/curves Appd. Document	- do -	✓	P	W	W	
		3. Vibration/Noise	CR	- do -	100%	Appd. Data Sheet/ Value given in Cl.8	75 micron at bearings 85 dbA measured at a distance of 1 mtr.	- do -	✓	P	W	W	Noise & vibration value measured at shop is for reference only.
		4. Relief valve set pr.	CR	- do -	100%	Appd. Data Sheet	Same as Cl.7	- do -	✓	P	W	W	
3.3	Review of QA Documentation as per approved QP			-	-	-	-	-		V	V	V	
3.4	Painting	Surface Preparation & shade of painting	MA	Visual	100%	As per Mfg. Std.	Same as Cl.7	-		P	V	-	
Note: 1. Defect giving echo height more than 20% on total CRT Screen height shall be treated as unacceptable.. Defect causing reduction in backwall echo less than 80% of Screen height shall be treated as unacceptable. Frequency 2 MHz min. 2. In case of mismatch in material in QP with Data Sheet, the material indicated in approved data sheet will be final.													
LEGEND: RECORDS IDENTIFIED WITH ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER "C" MAIN VENDOR "CU" BHEL/CUSTOMER.. "P" PERFORM "W" WITNESS AND "V" VERIFICATION													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					

STANDARD QUALITY PLAN FOR CS PIPE -SEAMLESS									QUALITY PLAN NO.:PE-QP-XXX-166-A813 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 DATE: 31/03/2012 SHEET 1 OF 1				
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	D	M	C	CU	11
1.0	SEAMLESS PIPE	a) Physical & Chemical test	M	Physical & Chemical Properties	Sample	ASTM A106 Gr.B/ Appd. Data sheet	ASTM A106 Gr.B/ Appd. Data sheet/ Relevant Std.	MTC/ Mfr's TC	✓	P	V	V	} Refer Note-1
		b) Dimensional conformity	M	Measurement	100%	-do-	-do-	MTC/ Mfr's TC/IR	✓	P	V	V	
		c) Hydro test	M	Leak test	100%	-do-	-do-	MTC/ Mfr's TC	✓	P	V	V	
Note-1: In case material is procured from dealer, and co-related Mfr's TCs are not available, check test on identified sample will be carried out at testing laboratory and hydro test at pressure 1.5 times of design pressure on 10% of total quantity will be witnessed by BHEL													
LEGEND: RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. M - MANUFACTURER C - MAIN VENDOR CU - BHEL/CUSTOMER "P" PERFORM, "W" WITNESS AND V VERIFICATION													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					



STANDARD QUALITY PLAN FOR

IB TYPE & TD TYPE STEAM TRAP 25NB & 15NB

QUALITY PLAN NO.:PE-QP-XXX-166-A814

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0

DATE: 31/03/2012

SHEET 1 OF 1

SL. NO. 1	COMPONENT & OPERATIONS 2	CHARACTERISTICS 3	CLASS 4	TYPE OF CHECK 5	QUANTUM OF CHECK 6	REFERENCE DOCUMENT 7	ACCEPTANCE NORMS 8	FORMAT OF RECORD 9	AGENCY				REMARKS 11
									D	M	C	CU	
1	<u>Raw Material</u> Body, Filter cap, Disc, Cover & Filter screen	i) Chemical Composition	Major	Chemical Analysis	Sample Check	As per Appd. Drg./ Data Sheet	As per Appd. Drg./ Data Sheet	MTC	✓	P	V	V	
		ii) Mechanical Test	Major	Physical properties	- do -	- do -	- do -	- do -		P	V	V	
2	<u>Final Inspection</u>	i) Visual	Major	Visual Inspn.	100%	As per Appd. Drg.	As per Appd. Drg.	Inspn. Report		P	W	V	
		ii) Dimension	Major	Meas.	100%	- do -	- do -	- do -		P	W	V	
		iii) Hyd. Test	Major	Leak Test	100%	As per Appd. Drg./ Data sheet	As per Appd. Drg./ Data sheet	Test Report	✓	P	W	V	
3	Review of QA Documents as per approved QP									V	V	V	IBR certificate as applicable shall be furnished as part of QA documentation.

LEGEND:

RECORDS IDENTIFIED WITH " ✓ " SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.

M - MANUFACTURER

C - MAIN VENDOR

CU - BHEL/CUSTOMER.

INDICATE "P" PERFORM "W" WITNESS AND V VERIFICATION

IR - INSPECTION REPORT, MTC - MTRL./MFR'S TEST CERTIFICATES

MAIN VENDOR/SUB-VENDOR

(SIGN WITH DATE & STAMP)

REVIEWING AGENCY

(SIGN WITH DATE & STAMP)

APPROVING AGENCY

(SIGN WITH DATE & STAMP)

 STANDARD QUALITY PLAN FOR SUCTION HEATER (HEAT EXCHANGER)								QUALITY PLAN NO.:PE-QP-XXX-166-A815 PACKAGE-FULE OIL SYSTEM PROJECT- REV.NO. 0 SHEET 1 OF 1 DATE: 31/03/2012					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
									D	M	C	N	
1	2	3	4	5	6	7	8	9	10	11	12	13	14
1.	<u>Materials</u>												
	a) Shell, plates for tube sheet, & Dished end	i) Chemical Composition	Major	Chemical Analysis	Sample	Appd.Drg./ASME SEC-II	Same as Cl.7	Material Test Cert.	✓	P	V	V	
		ii) Mechanical Test	Major	Physical Properties	- do -	- do -	- do -	- do -	✓	P	V	V	
	b) Tubes	i) Chemical Composition	Major	Chemical Analysis	- do -	- do -	- do -	- do -	✓	P	V	V	
		ii) Mechanical Test	Major	Physical Properties	- do -	- do -	- do -	- do -	✓	P	V	V	
2.	<u>In Process Inspection</u>												
A.	U-Tube	i) Thinning Test on tubes	Major	By Destruction test	Sample	TEMA' C/Appd. Drg.	17% thinning	Inspn. Report	✓	P	V	V	
		ii) Mock-up Test on tube to tube sheet joint	Major	- do -	100%	- do -	- do -	- do -	✓	P	V	V	
		iii) Dimensional Check	Major	By Meas.	100%	Appd. Drg.	- do -	- do -		P	V	-	
		iv) Hydraulic Test (for tube bundle)	Major	Hydraulic	100%	Appd. Drg.	No Leakage	- do -	✓	P	V	V	
B.	Shell	a) Welding Procedure	Major	WPS	100%	ASME-Sec.IX	Same as Cl.7	QW-482	✓	P	V	V	
		b) Welder Procedure Qualification Test	Major	PQR	100%	- do -	- do -	QW-483	✓	P	V	V	WPS to be approved by BHEL/ NTPC. Qualified welders only to be employed.
LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY, "N" CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP SHALL IDENTIFIED IN COLUMN "N"													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)					REVIEWING AGENCY (SIGN WITH DATE & STAMP)					APPROVING AGENCY (SIGN WITH DATE & STAMP)			

		STANDARD QUALITY PLAN FOR SUCTION HEATER (HEAT EXCHANGER)						QUALITY PLAN NO.:PE-QP-XXX-166-A815 PACKAGE-FULE OIL SYSTEM PROJECT-REV.NO. 0 SHEET 1 OF 1 DATE: 31/03/2012					
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS
1	2	3	4	5	6	7	8	9	D	M	C	N	11
C.	Tube Sheets	c) Dimensional Check	Major	Meas.	100%	Appd. Drg.	Same as Cl.7	Inspn. Report		P	V	-	
	3. <u>Final Inspection</u> Finished Product after completion	a) Dimensional Check	Major	Meas.	100%	- do -	- do -	- do -		P	V	-	
		b) Assembly Check	Major	Visual	100%	- do -	- do -	- do -		P	V	-	
		i) Welding	Major	Visual	100%	Appd. WPS	- do -	- do -		P	V	V	
		ii) NDT for Shell fabrication	Major	DP test	100%	ASME SEC-V	- do -	- do -		P	V	V	
		iii) NDT for Dished end to Shell joint	Major	Spot Radiography	10%	- do -	- do -	Radiography Report	✓	P	V	V	
		iv) NDT for Shell to Tube sheet joint	Major	DP test	100%	- do -	- do -	Inspn. Report		P	V	V	
		v) NDT for Dish fabrication	Major	DP test on Knuckle	100%	- do -	- do -	- do -		P	V	V	
		vi) Dimensional Check	Major	Meas.	100%	Appd. Drg.	- do -	- do -	✓	P	W	W	
		vii) Hydraulic Test for Shell side and tube side	Critical	Hydrostatic	100%	Appd. Drg./ 1.5 x Design Pr.	No Leakage	- do -	✓	P	W	W	
viii) Review of QA Document as per approved QP	-	-	-	-	-	-	-	-	-	-			
ix) Painting	Major	Visual	100%	Mfg. Std.	Same as Cl.7	-		P	-	-			
LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY, "N" CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP SHALL IDENTIFIED IN COLUMN "N"													
MAIN VENDOR/SUB-VENDOR (SIGN WITH DATE & STAMP)				REVIEWING AGENCY (SIGN WITH DATE & STAMP)				APPROVING AGENCY (SIGN WITH DATE & STAMP)					



STANDARD CHECK LIST FOR OIL HOSE

CHECK LIST NO.:PE-QP-XXX-166-A816

PACKAGE-FULE OIL SYSTEM

PROJECT-

REV.NO. 0

SHEET 1 OF 1

REV.NO. 0

DATE: 31/03/2012

SL. NO.	COMPONENT & PARTS	CHARACTERISTICS	TYPE OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY			REMARKS	
							M	C	N		
							8				
1	2	3	4	5	6	7				9	
1	Material for										
1.1	Synthetic Rubber	Polymer Confirmation	Chemical Analysis	Appd.data sheet/ Relavent Code	Same as Cl.7	Lab Test Certificate	P	V	V		
1.2	Canvas	Mechanical Test	Tensile	-do-	-do-	- do -	P	V	V		
1.3	Bonding Agents	Bonding Strength	Properties	-do-	-do-	- do -	P	V	V		
1.4	End Fittings	Chem. & Mech. Test	Chem.& Mech properties	-do-	-do-	- do -	P	V	V		
2	In Process Inspection										
2.1	Compound										
	Oil Resistance	i) Oil Resistance test	Oil Resistance check	-do-	-do-	Lab Test Report	P	V	V		
		ii) Heat Resistance	Heat Resistance check	-do-	-do-	Lab Test	P	V	V		
2.2	Sheeting	i) Visual Inspection	Visual	Mfg. Drg.	Mfg. Drg.	Inspn. Report	P	-	-		
		ii) Dimension	Meas.	- do -	- do -	- do -	P	-	-		
2.3	Hose Making	i) Visual Inspection	Visual	- do -	- do -	- do -	P	-	-		
		ii) Dimensional	Meas.	- do -	- do -	- do -	P	-	-		
2.4	Wrapping	Tightening	Visual	- do -	- do -	- do -	P	-	-		
2.5	Flange	Dimension	Meas.	- do -	- do -	- do -	P	-	-		

LEGEND:

"M" MANUFACTURER/SUB-CONTRACTOR
 "C" CONTRACTOR/NOMINATED INSPECTION AGENCY,
 "N" CUSTOMER. INDICATE "P" PERFORM "W" WITNESS AND
 "V" VERIFICATION AS APPROPRIATE CHP
 SHALL IDENTIFIED IN COLUMN "N"

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

MANUFACTURERS NAME & ADDRESS				MANUFACTURING QUALITY PLAN				PROJECT:						
				ITEM : QAP FOR OIL HOSE.		PAGE 1 OF 1		PACKAGE : CONTRACT CONTRACT DOC NO. P						
SL. NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTAM OF CHECK	REFERENCE DOCUMENTS	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY				REMARKS	
1	2	3	4	5	6	7	8	9	D	M	C	N	10	11
A	RAW MATERIALS													
1.0	NEOPRENE & NITRILE	POLYMER IDENTIFICATION	MAJOR	CHEMICAL	SAMPLE	ASTM -D297	ASTM - D297	LAB CERT./ QC REPORT	P	V	V			
B.	END FITTINGS													
1.1	FLANGE	CHEMICAL COMPOSITION	MAJOR	CHEMICAL	SAMPLE	IS-2062 GR.B	IS-2062 GR.B	- DO -	P	V	V			
1.2	PIPE	PHYSICAL & CHEMICAL	MAJOR	PHYSICAL & CHEMICAL	SAMPLE	ASTM A 106 GR.B	ASTM A 106 GR.B	- DO -	P	V	V			
C.	IN PROCESS CHECKS													
1.3	RUBBER TEST SLAB	a). TENSILE STRENGTH	MAJOR	BEFORE & AFTER AGEING	SAMPLE	IS-10733/83 TYPE-2B	IS-10733/83 TYPE- 2B	- DO -	P	V	V			
		b). ELONGATION AT BREAK	MAJOR	- DO -	SAMPLE	- DO -	- DO -	- DO -	P	V	V			
		c). ADHESION TEST	MAJOR	ADHESION	SAMPLE	- DO -	- DO -	- DO -	P	V	V			
		d). OIL RESISTANCE TEST	MAJOR	OIL RESISTANCE COMPOUND	SAMPLE	- DO -	- DO -	- DO -	P	V	V			
D.	FINAL INSPECTION													
1.4	FINISHED PRODUCT	a). VISUAL & DIMENSIONAL	MAJOR	VISUAL & DIMENSIONS	100%	APP. DRG./BS-1435/75	APP. DRG./BS-1435/75	- DO -	P	W	V			10% QUANTITY
	CHECK FOR	b). HYDRAULIC TEST	MAJOR	PRESSURE TEST	100%	EN-1765/2004	- DO-	- DO -	P	W	V			MAY BE
	COMPLETENESS	c). ELONGATION CHECK	MAJOR	ELONGATION MEASURE	100%	- DO-	- DO-	- DO -	P	W	V			SELECTED AT
		d). BENDING RADIUS CHECK	MAJOR	BEND RADIUS CHECK	100%	- DO-	- DO-	- DO -	P	W	V			RANDOM FOR
		e). VACUUM TEST	MAJOR	VACUUM CHECK	100%	- DO-	- DO-	- DO -	P	W	V			WITNESS
		f). MARKING CHECK	MAJOR	VISUAL	100%	- DO-	- DO-	- DO -	P	W	V			
CLIENT		LEGEND :					FOR BHEL USE						REV.	
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY DETERMINED BY CONTRACTOR IN QA DOCUMENTATION "M" MANUFACTURER												
CONTRACTOR		C' CONTRACTOR, 'P' PERFORM, 'W' WITNESS, 'V' VERIFICATION AS APPROPRIATE CHP												
MANUFACTURE		BHEL SHALL IDENTIFIED IN COLUMN 'N' BHEL.												
SIGNATURE							REVIEWED BY		NAME & SIGN OF APPROVING AUTHORITY & SEAL					



STANDARD CHECK LIST
STANDARD CHECK LIST FOR: CS-FITTINGS (FORGED/SEAMLESS)
PACKAGE-FULE OIL SYSTEM
PROJECT-
CHECK LIST NO.:PE-QP-XXX-166-A817
REV.NO. 0
DATE: 31/03/2012 **Sheet 1 of 1**

SL. NO.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENT./ ACCEPTANCE NORMS	AGENCY				REMARKS
1	2	3	4	M	C	N	D	6
1	Visual and Dimensional Checks for each size and type	100% by Manufacturer and 10% by BHEL	Appd. Data Sheet/ Relevant Standard	P	W	W	✓	Inspn. Report shall be furnished
2	Check for Logo mark & Specification	-do-	-do-	P	V	V		
3	Check for TC of mother pipe/forgings	100%	-do-	P	V	V	✓	Manufacturer's TCs of mother pipe/forgings shall be furnished
4	Cross check for Mech/Chem properties of mother pipe/forging	One/Heat	-do-	P	V	V	✓	-do-

LEGEND:

RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.

M= MANUFACTURER/SUB-CONTRACTOR

C= CONTRACTOR/NOMINATED INSPECTION AGENCY,

N= CUSTOMER

P= PERFORM; W= WITNESS; V= VERIFICATION

MAIN VENDOR/SUB-VENDOR
(SIGN WITH DATE & STAMP)

REVIEWING AGENCY
(SIGN WITH DATE & STAMP)

APPROVING AGENCY
(SIGN WITH DATE & STAMP)

CHECK LIST

Check list for item : Dished-end for Flash Tank
 Check list No. :
 Project :
 Package : Fuel Oil Handling
 Contract No. :
 Contractor : BHEL
 Sub-Contractor :

SL. NO.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOCUMENT/ ACCEPTANCE NORMS	FORMAT OF RECORDS	AGENCY				REMARKS
					D	S	C	N	
A.	<u>RAW MATERIAL</u>								
	Plate - conforming to IS 2002 Gr.A								
	Chemical Composition & Physical Properties	1 sample/heat	IS:2002 Gr.A	Material TC	√	V	V	V	
B	<u>IN PROCESS INSPECTION</u>								
	UT on Plate	100%	ASTM A388 (Defect giving echo height more than 20% on total CRT Screen height shall be treated unacceptable. Defect causing reduction in backwall echo less than 80% of Screen height shall be treated as unacceptable)	UT Report	√	P	V	V	
C.	<u>FINAL INSPECTION</u>								
1	Visual Exam.	100%	Appd.Drg.	Inspn. Report	√	P	V	V	
2	Dimensional Check	100%	Appd.Drg.	-do-	√	P	V	V	
3	DP on Knuckle	100%	ASTM E165	-do-	√	P	V	V	

Legend

S = SUB-CONTRACTOR
 C= CONTRACTOR
 N= CUSTOMER
 P= PERFORM; W= WITNESS; V= VERIFICATION
 " √ " Marked document to be furnished along with QA Doc. Pkg.

Manufacturer's Name & Address :			QUALITY ASSURANCE PLAN Item : Plug Valve Sub-System : Fuel Oil System Page No.: 1 OF 4				Project : Contract Contractor Sub-Contractor						
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency			Remarks	
1	2	3	4	5	6	7	8	9	D	P	W	V	10
A RAW MATERIAL													
1	Castings (Body, Cover, Plug)	a) Verification	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	✓	3	3	1,2	
		b) Size/Class	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	✓	3	3	1,2	
		c) Material Id.	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	✓	3	3	1,2	
		d) Heat No.	MA	Material TC	100%	Appr. Drg. Tech. Specs.	Tech. Specs.	Material TC	✓	3	3	1,2	
		e) Surface Defect	MA	Visual	100%	MSS-SP-55	No crack acceptable	Inspection Report		3	3	1,2	
		f) Dimension	MA	Vernier scale	100%	Mfg. Drg	Mfg. drg.	Mfg. drg.		3	3	1,2	
		g) RT on body	MA	Physical	100%	NDT Report	ANSI B16.34 ANNEX-I	NDT REPORT	✓	3	3	1,2	
		h) Tensile Properties	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard			3	3	1,2	
		i) Chemical Properties	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard			3	3	1,2	
		j) Heat Treatment	MA	Verification of foundry TC	100%	Tech. Specs.	Relevant Standard			3	3	1,2	
		BHEL		LEGEND : Records identified with "✓" shall essentially be included by Contractor in QA Documents 1 - BHEL 2 - PACKAGE SUPPLIER 3 - Manufacturer CR - Critical Characteristics MA - Major Characteristics MI - Minor Characteristics IR - Inspection Report, MTC - Material/Manufacturer's Test Certificate					CLIENT NO REV. CAT. REVIEWED BY NAME & SIGNATURE OF APPROVING AUTHORITY				
		SUB-CONTRACTOR		SIGNATURE									

Manufacturer's Name & Address :			QUALITY ASSURANCE PLAN Item : Plug Valve Sub-System : Fuel Oil System Page No.: 2 of 4				Project Contract Contract Sub-Cont					
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency			Remarks
1	2	3	4	5	6	7	8	9	10	11	12	
2	Fasteners	a) Dimension	MA	Dimensional	1/Lot/Size	Appr. Drg	Appr. Drg	...	3	3	1,2	
		b) Tensile Properties	MA	Verification of Supplier TC	100%	Appr. Drg	Relevant Std	Mfg. TC	✓	3	3	
		c) Chemical Properties	MA	Verification of Supplier TC	100%	Appr. Drg	Relevant Std	Mfg. TC	✓	3	3	
		d) Heat Treatment	MA	Verification of Supplier TC	100%	Appr. Drg	Relevant Std	Mfg. TC	✓	3	3	
3	Limit Switch	a) Dimension	MA	Dimensional	1/Lot/Size	PO	Mfg. Drg	Mfg. TC	✓	3	3	
		b) Chemical properties	MA	Mfg. TC	1/Lot/Size	Relevant Std	Relevant Std	...		3	3	
4	Hand Wheel	a) Dimension		Dimensional	1/Lot/Size	PO	Mfg. Drg	GRR		3	3	
		b) Surface Defect	MA	Visual	100%	PO	Mfg. Drg	No crack acceptable		3	3	
SUB-CONTRACTOR SIGNATURE		BHEL CONTRACTOR	LEGEND : Records identified with " ✓ " shall essentially be included by Contractor in QA Documents 1 - BHEL 2 - PACKAGE SUPPLIER 3 - Manufacturer CR - Critical Characteristics MA - Major Characteristics MI - Minor Characteristics IR - Inspection Report, MTC - Material Manufacturer's Test Certificate						CLIENT NO.			
			REV. 00 CAT.									
			REVIEWED BY						NAME & SIGNATURE OF APPROVING AUTHORITY			

Manufacturer's Name & Address :			QUALITY ASSURANCE PLAN				Project : Contract : Contractor : Sub-Contractor :					
			Item : Plug Valve		Sub-System : Fuel Oil System							Page No.: 3 of 4
Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency			Remarks
1	2	3	4	5	6	7	8	9	D	10	11	
IN PROCESS INSPECTION												
1	Body / Cover	a) Mechined surface	MA	Visual	100%	Mfg. Drg.	No blow holes are acceptable	...		3	3	3
		b) Dimension	MA	Dimensional	100%	Mfg. Drg.	Mfg. Drg.	...		3	3	3
2	Plug	Mechined surface	MA	Visual	100%	Mfg. Drg.	No blow holes are acceptable	...		3	3	3
3	Component	Dimension	MA	Dimensional	100%	Mfg. Drg.	Mfg. Std.	...		3	3	3
4	Assembly	Operational Test	MA	Ful opening / closing test	100%	GA Drg	Mfg. Std.	...		3	3	3
				Min. Stem Projection	100%	...	Mfg. Drg	...		3	3	3
				Smooth operation	100%	...	Mfg. Std.	...		3	3	3
BHEL			LEGEND :				CLIENT NO. _____					
			Records identified with "√" shall essentially be included by Contractor in QA Documents									
MANUFACTURE SUB-CONTRACTOR			CONTRACTOR		1 - BHEL /DVC		P - Agency Performing the Test		REV. 00 CAT.			
					2 - PACKAGE SUPPLIER		W - Agency Witnessing the Test					
					3 - Manufacturer		V - Agency Verifying the Test					
					CR - Critical Characteristics							
					MA - Major Characteristics							
					MI - Minor Characteristics							
SIGNATURE					IR - Inspection Report, MTC - Material/Manufacturer's Test Certificate				REVIEWED BY NAME & SIGNATURE OF APPROVING AUTHORITY			

Manufacturer's Name & Address :			QUALITY ASSURANCE PLAN				Project : Contract Contractor Sub-Contractor				
			Item : Plug Valve Sub-System : Fuel Oil System		Page No.: 4 of 4						

Sl. No.	Components & Operations	Characteristic/Item	Class	Type of check	Extent of Check	Reference Document	Acceptance Norm	Format of Record	Agency			Remarks
									P	W	V	
1	2	3	4	5	6	7	8	9	10	11	12	

C FINAL INSPECTION (Before Painting)													
1	Complete valve	a) Dimension	MA	Fig. Drilling face to face	100%	Relevant Std	Relevant Std	Dimensional Report	✓	3	1, 2	1, 2	100% Inspection by Manufacturer & 10% by Inspection Agency
		b) Operational Test	MA	Full opening / closing test	100%	Relevant Std	PO	Testing Register	✓	3	1, 2	1, 2	
		c) Pressure testing	MA	i) Hydro shell	100%	Relevant Std	Relevant Std	Testing Register	✓	3	1, 2	1, 2	
				ii) Hydro seat	100%	Relevant Std	Relevant Std	Testing Register	✓	3	1, 2	1, 2	
		Fire Safe Testing	MA	Fire Safe	1/proto type	AP1607/ BS 6755 P-II	Relevant Std	Testing Register	✓	3	3	1, 2	
2	Paint & Packing	Surface	MA	Visual	Dryness	PO	PO	Testing Register		3	3	3	
				Visual	Two coats of redoxide	PO	PO	Testing Register		3	3	3	
				Visual	One coat of hammer tone dark grey	PO	PO	Testing Register		3	3	3	
				Visual	Anti rust layer at machined surface	PO	PO	Testing Register		3	3	3	
				Visual	Fixing of wooden/ plastic end protector	PO	PO	Testing Register		3	3	3	

BHEL

CONTRACTOR

SUB-CONTRACTOR

SIGNATURE

LEGEND :

Records identified with "✓" Documents

1 - BHEL	P - Agency Performing the Test
2 - PACKAGE SUPPLIER	W - Agency Witnessing the Test
3 - Manufacturer	V - Agency Verifying the Test

CR - Critical Characteristics
MA - Major Characteristics
MI - Minor Characteristics
IR - Inspection Report, MTC - Material/Manufacturer's Test Certificate

CLIENT NO.

REV. 00 CAT.

REVIEWED BY

NAME & SIGNATURE OF APPROVING AUTHORITY

		STANDARD QUALITY PLAN FOR AUXILIARY STEAM PRDS		CUSTOMER :				SPECIFICATION NUMBR			
				BIDDER/ : AS PER APPROVED VENDOR LIST		SPECIFICATION TITLE : AUXILIARY STEAM P.R.D.S					
		SHEET 1 of 2		SYSTEM ITEM : STEAM DESUPERHEATER		QUALITY PLAN NUMBR		SECTION VOLUME			
SL. NO.	COMPONENT/ OPERATION	CHARACT-ERISTIC CHECK	CAT.	TYPE METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY P W V		REMARKS
1	2	3	4	5	6	7	8	9	10	11	

1.0	Raw Materials											
1.1	Pipes	Mechanical & Chemical Prop.		Mechanical & Chemical	100%	Appd Specn./ Data Sheet/Drg.	Appd Specn./ Data Sheet/Drg.	TC	3/2	-	1	Correlation required
		Leakproofness		Hydraulic test	100%	-do-	-do-	TC	3/2	-	1	
		Dimensions		Measurement	100%	-do-	-do-	IR	3/2	-	1	
1.2	Forging	Physical & Chemical Prop.		Physical & Chemical Prop.	1/heat	Appd Specn./ Data Sheet/Drg.	Appd Specn./ Data Sheet/Drg.	TC	3/2	-	1	Correlation required
		Dimensions		Measurement	100%	-do-	-do-	IR	3/2	-	1	
		Heat Treatment		Scrutiny	100%	-do-	-do-	HT/SR Chart	3/2	-	1	Correlation required
2.0	In Process											
2.1	Forgings	Internal defects		U.T	100%	ASTMA 435	ASTMA 435	IR	3/2	-	1	
2.2	Machining Body Internals	Dimensions		Measurement	100%	Appd.Drg.	Appd.Drg.	IR	3/2	-	1	Correlation required
2.3	Body	Surface Defects		D.P. Check	100%	ASTME165	ASME-B 16.34 ,Appendix-III	TC	3/2	-	1	

PARTICULARS	CUSTOMER/CONSULTANT	BHEL	BIDDER / VENDOR	BIDDER'S/ VENDOR'S COMPANY SEALS
NAME				
SIGNATURE				
DATE				



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS
(ELECTRICAL PORTION)**

SPECIFICATION NO. PE-TS-410-166-A001	
VOLUME II-B	SECTION 'C3'
REVISION 00	DATE: 24/04/2015
PAGE 1 of 1	

**SECTION: C-3
TECHNICAL SPECIFICATION (ELECTRICAL PORTION)**

**TELANGANA STATE POWER GENERATION
CORPORATION LTD.
1 X 800 MW KOTHAGUDEM TPS**

FUEL OIL HANDLING & STORAGE SYSTEM

**TECHNICAL SPECIFICATION
(ELECTRICAL PORTION)**



TITLE:
**ELECTRICAL EQUIPMENT SPECIFICATION
FOR
FUEL OIL HANDLING & STORAGE SYSTEM
KOTHAGUDEM TPS (1 X 800MW)**

SPECIFICATION NO.

VOLUME NO. : **II-B**

SECTION: **C**

REV NO. : **00** DATE: 19/03/2015

SHEET: OF

CONTENTS

SECTION	TITLE	NO OF SHEETS
C	SPECIFIC TECHNICAL REQUIREMENTS	2
C	ELECTRICAL SCOPE BETWEEN BHEL & VENDOR	2
C	TECHNICAL SPECIFICATION FOR MOTORS/ACUATORS	21
D	MOTOR DATASHEET-C	7
D	QUALITY PLAN (FOR MOTORS BELOW 55 KW)	2
D	QUALITY PLAN (FOR MOTORS ABOVE & 55 KW)	9
D	APPROVED SUBVENDOR LIST (MOTOR)	1
D	ELECTRICAL LOAD DATA FORMAT (ANN-II)	1
D	CABLE SCHDULE FORMAT INCLUDING NOTES	3

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR FUEL OIL HANDLING & STORAGE SYSTEM KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 19/03/2015
		SHEET: OF

SPECIFIC TECHNICAL REQUIREMENTS:

1.0 EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:

The equipment and services to be provided by bidder under this specification shall be as detailed here below but shall not be limited to the following:

- Services and Equipment as per “Electrical Scope between BHEL and Vendor”.
- Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- Supply of mandatory spares as specified in the specifications of mechanical equipments.
- Electrical load requirement for Fuel Oil Handling & Storage System.
- All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- Bidder to furnish list of makes for each equipment at contract stage, which shall be subject to customer / BHEL approval without any commercial and delivery implications to BHEL.
- Various drawings including GA drg, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals, characteristic curves, wiring diagrams/schemes etc. shall be furnished as specified at contract stage. All documents shall be subject to customer / BHEL approval without any commercial implications to BHEL.
- The sub-vendor list for various electrical items is subject to BHEL/Customer approval without any commercial implications.
- Motors shall meet minimum requirement of Electric motor specification.
- Purchaser will furnish data sheets to the vendor after award of contract. Vendor shall furnish filled in data sheets meeting the specification requirements.
- Vendor to clearly indicate equipment locations and local routing lengths in their cable listing furnished to BHEL.
- Cable BOQ worked out based on routing of cable listing provided by the vendor for “both end equipment in vendor’s scope” shall be binding to the vendor with +10 % margin to take care of slight variation in routing length & wastages.

2.0 EQUIPMENT & SERVICES TO BE PROVIDED BY PURCHASER FOR ELECTRICAL & TERMINAL POINTS:
Refer “Electrical Scope between BHEL and Vendor”.

3.0 DOCUMENTS TO BE SUBMITTED ALONG WITH BID

	TITLE: ELECTRICAL EQUIPMENT SPECIFICATION FOR FUEL OIL HANDLING & STORAGE SYSTEM KOTHAGUDEM TPS (1 X 800MW)	SPECIFICATION NO.
		VOLUME NO. : II-B
		SECTION: C
		REV NO. : 00 DATE: 19/03/2015
		SHEET: OF
3.1 Bidder shall confirm total compliance to the electrical specification without any deviation from the technical / quality assurance requirements stipulated. In line with this, the bidder as technical offer shall furnish two signed and stamped copies of the following: a) A copy of this sheet "Electrical Equipment Specification for Fuel Oil Handling & Storage System and sheet "Electrical Scope between BHEL and Vendor" with bidder's signature and company stamp. b) Electrical load requirement. 3.2 No technical submittal such as copies of data sheets, drawings, write-up, quality plans, type test certificates, technical literature, etc, is required during tender stage. Any such submission even if made, shall not be considered as part of offer. 4.0 LIST OF ENCLOSURES 4.1 Electrical scope between BHEL & vendor 4.2 Technical specification – Specification for Electric Motors/Actuators 4.3 Datasheets & quality plan for motors. 4.4 Load Data Format. (Annexure –II) 4.5 BHEL Cable listing format (Annexure –III)		

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: FUEL OIL HANDLING & STORAGE SYSTEM

PROJECT: KOTHAGUDEM TPS (1 X 800MW)

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

ELECTRICAL SCOPE BETWEEN BHEL AND VENDOR

PACKAGE: FUEL OIL HANDLING & STORAGE SYSTEM

PROJECT: KOTHAGUDEM TPS (1 X 800MW)

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
9	Lighting	BHEL	BHEL	
10	Equipment grounding (including electronic earthing) & lightning protection	BHEL	BHEL	Refer note no. 4 for electronic earthing
11	Below grade grounding	BHEL	BHEL	
12	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
13	Mandatory spares	Vendor	-	Vendor to quote as per specification.
14	Recommended O & M spares	Vendor	-	As specified elsewhere in specification
15	Any other equipment/ material/ service required for completeness of system based on system offered by the vendor (to ensure trouble free and efficient operation of the system).	Vendor	Vendor	
16	a) Input cable schedules (Control & Screened Control Cables) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for Control and Instrumentation Cable and electronic earthing cable in enclosed excel format shall be submitted by vendor during detailed engineering stage.
17	Electrical Equipment & cable tray layout drawings	Vendor	-	Vendor shall prepare & submit cable tray/trench & equipment layout (both in print form as well as in AUTOCAD) of the complete Fuel oil pump house building indicating location and identification of all equipment requiring cabling for BHEL review & approval. Vendor to ensure the cable tray lay out shall confirm to NFPA (National fire prevention act)/TAC (Tariff advisory committee) applicable for hazardous area classification.
18	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.

NOTES:

1. Make of all electrical equipment/ items supplied shall be reputed make & shall be subject to approval of BHEL/customer after award of contract.
2. All QPs shall be subject to approval of BHEL/customer after award of contract without any commercial implication.
3. In case the requirement of Junction Box arises on account of Power Cable size mis-match due to vendor engineering at later stage, vendor shall supply the Junction Box for suitable termination.
4. Vendor shall indicate location of Electronic Earth pit in their Civil assignment drawing.

VOLUME: V-A

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	CODES & STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	TYPE AND RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENTS
7.00.00	ACCESSORIES
8.00.00	TESTS
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA

VOLUME: V-A

SECTION-II

**TECHNICAL SPECIFICATION
FOR
A.C. & D.C. MOTORS**

1.00.00 SCOPE

- 1.01.00 This section covers the general requirements of the drive motors for power station auxiliary equipment.
- 1.02.00 Motors shall be furnished in accordance with both this general specification and the accompanying driven equipment specification.
- 1.03.00 In case of any discrepancy, the driven equipment specification shall govern.

2.00.00 CODES & STANDARDS

- 2.01.00 All motors shall conform to the latest applicable IS, IEC and CBIP Standards/ Publications except when otherwise stated herein or in the driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed:
- i) IS-325
 - ii) IS-12615
 - iii) IEC-60034

3.00.00 SERVICE CONDITIONS

- 3.01.00 The motors will be installed in hot, humid and tropical atmosphere highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the annexure to this specification.
- 3.03.00 For motor installed outdoor and exposed to direct sunrays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 TYPE AND RATING

4.01.00 A.C. Motors

- 4.01.01 Motors shall be general purpose, constant speed, squirrel cage, three/single phase, induction type.

- 4.01.02 All motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.
- 4.01.03 LT motor & HT motor name-plate rating at 50°C shall have at least 15% margin and 10% margin respectively over the input power requirement of the driven equipment at rated duty point unless stated otherwise in driven equipment specification.
- 4.01.04 The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.
- 4.01.05 Motors efficiency class shall be IE1, IE2 as per latest version of IEC-60034.
- 4.02.00 **D.C. Motors**
- 4.02.01 D.C. motor provided for emergency service shall be shunt/compound wound type.
- 4.02.02 Motor shall be sized for operation with fixed resistance starter for maximum reliability.
- Starter panel complete with all accessories shall be included in the scope of supply.
- 5.00.00 **PERFORMANCE**
- 5.01.00 **Running Requirements**
- 5.01.01 Motor shall run continuously at rated output over the entire range of voltage and frequency variations as given in the annexure.
- 5.01.02 The motor shall be capable of operating satisfactorily at full load for 5 minutes without injurious heating with 75% rated voltage at motor terminals.
- 5.01.03 The motor shall be designed to withstand momentary overload of 60% of full load torque for 15 second without any damage.
- 5.02.00 **Starting Requirements**
- Motor shall be designed for direct online starting at full voltage. Breakaway starting current as percentage of full load current for various motor rating shall not exceed the given below-
- | | | |
|---------------------|---|---|
| Motors up to 1500kW | - | 600% subject to IS tolerance of plus 20%. |
| Motors above 1500kW | - | 450% not subject to any positive tolerance. |
- 5.02.01 The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

- 5.02.02 Motor shall start with rated load and accelerate to full speed with 80% rated voltage at motor terminals except mill motor. Mill motor shall start with rated load and accelerate to full speed at 85% of the rated voltage at the motor terminals.
- 5.02.03 a) Two hot starts in succession with motor initially at normal running temperature.
- b) Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with shaft rotating at 125% rated speed in reverse direction.
- 5.02.04 The motors shall be designed to withstand 120% of rated speed for 2 minutes without any mechanical damage.
- 5.03.00 **Stress During Bus Transfer**
- 5.03.01 The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.
- 5.03.02 The motor shall be designed to withstand any torsional and/or high current stresses, which may result, without experiencing any deterioration in the normal life and performance characteristics.
- 5.04.00 **Locked Rotor Withstand Time**
- 5.04.01 The locked rotor withstand time under hot condition at 110% rated voltage shall be more than motor starting time by at least 3 seconds for motors up to 20 seconds starting time and by 5 seconds for motor with more than 20 seconds starting time.
- 5.04.02 Starting time mentioned above is at minimum permissible voltage of 80% rated voltage.
- 5.04.03 Hot thermal withstand curve shall have a margin of at least 10% over the full load current of the motor to permit relay setting utilising motor rated capacity.
- 6.00.00 **SPECIFIC REQUIREMENTS**
- 6.01.00 **Enclosure**
- 6.01.01 All motor enclosures for outdoor, semi-outdoor & indoor application shall conform to the degree of protection IP-55 unless otherwise specified. Motor for outdoor or semi-outdoor service shall be of weather-proof construction with canopy.
- 6.01.02 For hazardous area approved type of increased safety enclosure shall be furnished.
- 6.02.00 **Cooling**
- 6.02.01 The motor shall be self ventilated type, either totally enclosed fan cooled IC 411(TEFC), totally enclosed tube ventilated IC 511(TETV) or closed air circuit air- cooled IC 611(CACA).

- 6.02.02 For large capacity motors not available with above type of cooling may be accepted with IC 81W or IC 91W, closed air circuit water cooled (CACW) subject to the approval of the owner.
- 6.03.00 **Winding and Insulation**
- 6.03.01 All insulated winding shall be of copper.
- 6.03.02 All motors shall have class F insulation but limited to class B temperature rise.
- 6.03.03 Windings shall be impregnated to make them non-hygroscopic and oil resistant.
- 6.04.00 **Tropical Protection**
- 6.04.01 All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
- 6.04.02 All fittings and hardwares shall be corrosion resistant.
- 6.05.00 **Bearings**
- 6.05.01 Motor shall be provided with antifriction bearings, unless sleeve bearings are required by the motor application. Bearings shall be rated for minimum service life of 40,000Hrs.
- 6.05.02 Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred.
- 6.05.03 Bearings shall be provided with seals to prevent leakage of lubricant or entrance of foreign matters like dirt, water etc. into the bearing area.
- 6.05.04 Sleeve bearings shall be split type, ring oiled, with permanently aligned, close running shaft sleeves.
- 6.05.05 Grease lubricated bearings shall be pre-lubricated and shall have provisions for in-service positive lubrication with drains to guard against over lubrication. LT motors 15kW and above shall be provided with external greasing arrangement.
- 6.05.06 Oiled bearing shall have an integral self cooled oil reservoir with oil ring inspection ports, oil sight glass with oil level marked for standstill and running conditions and oil fill and drain plugs.
- 6.05.07 Forced lubricated or water cooled bearing shall not be used without prior approval of Owner.
- 6.05.08 Lubricant shall not deteriorate under all service conditions. The lubricant shall be limited to normally available types with IOC equivalent.
- 6.05.09 Bearings shall be insulated as required to prevent shaft current and resultant bearing damage.
- 6.06.00 **Noise & Vibration**

- 6.06.01 All HT motors shall be provided with vibration pads for mounting of vibration detectors. Vibration monitoring devices shall be provided on DE and NDE side in x&y direction with remote DCS monitoring, alarm and tripping.
- 6.06.02 The maximum double amplitude vibrations for HT motors upto 1500 rpm shall be 25 microns and 15 microns upto 3000 rpm. For 415V motors, maximum double amplitude vibrations upto 1500 rpm shall be 40 microns and 15 microns upto 3000 rpm.
- 6.06.03 The noise level shall not exceed 85db (A) at 1.5 meters from the motor.
- 6.07.00 **Motor Terminal Box**
- 6.07.01 Motor terminal box shall be detachable type and located in accordance with Indian Standards clearing the motor base- plate/ foundation
- 6.07.02 Terminal box shall be capable of being turned 360 Deg. in steps of 180 Deg. for HT motors and 90 Deg. for LT motors unless otherwise approved.
- 6.07.03 The terminal box shall be split type with removable cover with access to connections and shall have the same degree of protection as motor.
- 6.07.04 The terminal box shall have sufficient space inside for termination/connection of XLPE insulated armoured aluminium cables.
- 6.07.05 Terminals shall be stud or lead wire type, substantially constructed and thoroughly insulated from the frame.
- 6.07.06 The terminals shall be clearly identified by phase markings, with corresponding direction of rotation marked on the non-driving end of the motor.
- 6.07.07 The terminal box shall be capable of withstanding maximum system fault current for a duration of 0.25 sec.
- 6.07.08 For 11000V and 3300V motor, the terminal box shall be phase-segregated type. The neutral leads shall be brought out in a separate terminal box (not necessarily phase segregated type) with shorting links for star connection.
- 6.07.09 Motor terminal box shall be furnished with suitable cable lugs and double compression brass glands to match with cable used.
- 6.07.10 The gland plate for single core cable shall be non-magnetic type.
- 6.07.11 Minimum clearances to be provided between phase to phase and phase to earth shall be as under-

Voltage Rating of Motor		Minimum Ph-Ph & Ph-Earth clearance
0.415 kV	:	25 mm
3.3 kV	:	65 mm
11.0 kV	:	140 mm

Note: In case it is not possible to maintain these clearances, the live parts shall be totally insulated from earth and other Phases. Adequate clearances shall be provided for cable connections.

6.08.00 Grounding

6.08.01 The frame of each motor shall be provided with two separate and distinct grounding pads complete with tapped hole, GI bolts and washer.

6.08.02 The grounding connection shall be suitable for accommodation of ground conductors as follows:

Rating		Conductor Size	
Above	Up to		
-----	5.5 kW	:	8 SWG GI Wires.
5.5 kW	22 kW	:	25mm X 4mm GS Flat.
23 kW	55 kW	:	40mm X 6mm GS Flat.
56kW	174kW	:	50mm X 8mm GS Flat.
175kW	ABOVE	:	75mm X 10mm GS Flat.

6.08.03 The cable terminal box shall have a separate grounding pad.

6.09.00 Minimum Cable Size for LT & HT Motors shall as be as follows-

a) For 415V, 3-Ph, LT Motors-

Rating		:	Cable Size
Above	Up to		
-----	5.5 kW	:	1R X 3C X 6 Sq.mm
5.5 kW	11 kW	:	1R X 3C X 10 Sq.mm
11 kW	22 kW	:	1R X 3C X 35 Sq.mm
22 kW	37.5 kW	:	1R X 3C X 70 Sq.mm.
37.5kW	55 kW	:	1R X 3C X 150 Sq.mm
55 kW	75 kW	:	1R X 3C X 300 Sq.mm
75 kW	110kW	:	2R X 3C X 150 Sq.mm
110 kW	175kW	:	2R X 3C X 300 Sq.mm

b) For 3.3kV & 11kV, 3-Ph, HT Motors-

Rating		:	Cable Size
Above	Up to		

175 kW	1000 kW	:	1R X 3C X 240 Sq.mm
1000 kW	2000 kW	:	2R X 3C X 240 Sq.mm
2000 kW	4500 kW	:	2R X 3C X 300 Sq.mm
4501 kW	10,000 kW	:	9R X 1C X 1000 Sq.mm.

Note: During detail engineering if higher cable size is required same shall be provided.

6.10.00 Rating Plate

In addition to the minimum information required by IS, the following information shall be shown on motor rating plate :

- a) Temperature rise in Deg.C under rated condition and method of measurement.
- b) Degree of protection.
- c) Bearing identification no. and recommended lubricant.
- d) Location of insulated bearings.

7.00.00 ACCESSORIES

7.01.00 General

Accessories shall be furnished, as listed below, or if otherwise required by driven equipment specification or application.

7.02.00 Space Heater

7.02.01 Motor of rating 30 kW and above shall be provided with space heaters, suitably located for easy removal or replacement.

7.02.02 The space heater shall be rated 240 V, 1 Phase, 50Hz and sized to maintain the motor internal temperature above dew point when the motor is idle.

7.02.03 Minimum Cable Size for space heater shall be as listed-

- i) For LT motors: 2.5 sq.mm, 2-Core copper cable complying with IS-1554(Part-1).
- ii) For HT motors: 6 sq.mm, 2 Core aluminium cable complying with IS-1554(Part-1).

7.03.00 Temperature Detectors

7.03.01 All 11000V and 3300V motors shall be provided with twelve (12) nos. simplex type winding temperature detectors, four (4) nos. per phase.

- 7.03.02 11000V and 3300V motor bearing shall be provided with duplex type temperature detectors.
- 7.03.03 The temperature detector mentioned above shall be resistance type, 3 wire, platinum wound, 100 Ohms at 0°C.
- 7.03.04 Leads of all simplex type motor winding RTDS and motor bearing RTDS shall be wired up to respective switchgear metering & protection compartment. From which one set of RTDS will be connected to numerical protection relay and another set shall be kept free for DDCMIS connectivity.
- 7.03.05 0.5 sq.mm annealed tinned copper conductor complying with IS-1554(Part-1). shall be used for RTD/BTD wiring.
- 7.04.00 **Indicator/Switch**
- 7.04.01 Dial type local indicator with alarm contacts shall be provided for the following:
- a) 11000 V and 3300V motor bearing temperature.
 - b) Hot and cold air temperature of the closed air circuit for CACA and CACW motor.
- 7.04.02 Flow switches shall be provided for monitoring cooling water flow of CACW motor and oil flow of forced lubrication bearing, if used. CACW motor shall be provided with water leakage detector with remote alarm and tripping.
- 7.04.03 Alarm switch contact rating shall be minimum 2.0 A at 220V D.C. and 10A at 240V A.C.
- 7.05.00 **Current Transformer for Differential Protection**
- 7.05.01 Motor 1000 kW and above shall be provided with three differential current transformers mounted over the neutral leads within the enclosure.
- 7.05.02 The arrangement shall be such as to permit easy access for C.T. testing and replacement. Current transformer characteristics shall match Owner's requirements to be intimated later.
- 7.06.00 **Accessory Terminal Box**
- 7.06.01 All accessory equipment such as space heater, temperature detector, current transformers etc., shall be wired to and terminated in terminal boxes, separate from and independent of motor (power) terminal box.
- 7.06.02 Accessory terminal box shall be complete with double compression brass glands and pressure type terminals to suit owner's cable connections.
- 7.07.00 **Drain Plug**
- Motor shall have drain plugs so located that they will drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

7.08.00 **Lifting Provisions**

Motor weighing 25 Kg. or more shall be provided with eyebolt or other adequate provision of lifting.

7.09.00 **Dowel Pins**

The motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

7.10.00 **Painting**

PL. REFER PAINTING SCHEDULE OF MECHANICAL SPECIFICATION

8.00.00 **TESTS**

Routine and Type Tests are to be conducted in presence of customer's representative as per IS:325 and in addition, any special test called for in the driven equipment specification shall be performed and required copies of test certificates are to be furnished for approval. In addition, following tests shall have to be carried out on the motors in presence of OWNER's representative on 3.3kV/11kV motors.

- a. Impulse test by 1.2 / 50 micro sec. On sample coil of Stator winding insulation as type test as per IEC-60034, part -15 test voltages as under :

Voltage rating of motor	Impulse Test Voltage
3.3 kV	18 kV peak
11 kV	49 kV peak

- b. Tan delta, charging current and dielectric loss measurements on each phase of motor stator winding as routine test.
- c. Polarization Index Test as per IS: 7816 as routine test
- d. Test for suitability of IPW– 55(Weather proof) as per IS 4691 as type test. Type test certificate for first numeral shall be acceptable in lieu to test, provided the test motor is identical to motor being supplied. Second numeral test shall be carried out on one motor of each type and rating.
- e. Fault Withstand Test for main terminal box as type test. Type test certificate shall be acceptable, if the test is conducted on exactly identical terminal box.
- f. Test for noise level as routine test.
- g. Test for vibration as routine test.

- h. Tan delta measurement on coils.
- i. Surge withstand test for inter turn insulation.
- j. Test to diagnose rotor bar failure during manufacture.
- k. Over speed test as routine test.
- l. Temperature rise test.

Temperature rise under normal condition above ambient temperature shall be limited to-

Specified Design Ambient temperature	Thermometer Method	Resistance Method
50 deg.C	60 deg.C	70 deg.C
45 deg.C	65 deg.C	75 deg.C
40 deg.C	70 deg.C	80 deg.C

Tests indicated at (h), (i), (j) shall be carried out during manufacture of the coils and shall be furnished for verification.

9.00.00 **DRAWINGS, DATA & MANUALS**

9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be Submitted with the bid**

- a) List of the motors
- b) Individual motor data sheet as per format of the proposal data sheets.
- c) Scheme & write-up on forced lubrication system, if any
- d) Type test report

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. ~~Also refer clause no. 1.19.02(u) of Section-I of Volume - V A: Technical Specifications for Electrical Equipment & Accessories.~~

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
H.V. Supply	11000 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 44 kA symm. for 1 sec.	Motors 1500 kW & above
M.V. Supply	3300 V, 3Ø, 3W, 50 Hz, Non-effectively earthed Fault level 40 kA symm. for 1 sec.	Motors 175 kW and Up to less than 1500 kW.
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz effectively earthed Fault level 50 kA symm. for 1 sec.	Motors above 0.2kW and below 175kW.
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heat- ing , A.C supply for Contr- ol & protective devices.
D.C. Supply	220V, 2W, unearthed Fault level 25* kA. for 1 sec.	D.C. alarm, control & protective devices

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

Note-

- 415V or 3.3 kV may be adopted by the bidder for the drives in the range of 160-210 kW.
- 3.3 kV AC supply for CHP conveyor motors of rating above 160 kW is to be used.
- The voltage rating of the drives indicated above is for basic guideline. Minor variations can be accepted on case to case basis based on techno-economic considerations of the various sub-systems.
- Voltage rating for special purpose motors viz, VFD and screw compressors, shall be as per manufacturer's standard. All the motors ratings on Stacker/ reclaimer shall be 415V ac supply only.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	$\pm 10\%$
Frequency	:	+3% to -5%
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242 Volt

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

CONTENT

CLAUSE NO.	DESCRIPTION
1.00.00	SCOPE
2.00.00	STANDARDS
3.00.00	SERVICE CONDITIONS
4.00.00	RATING
5.00.00	PERFORMANCE
6.00.00	SPECIFIC REQUIREMENT
7.00.00	ACCESSORIES
8.00.00	TEST
9.00.00	DRAWINGS, DATA & MANUALS

ATTACHMENT

ANNEXURE-A	DESIGN DATA

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 STANDARDS

- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS-9334
 - ii) IS-325

3.00.00 SERVICE CONDITIONS

- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 RATING

- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00 PERFORMANCE

The actuator shall meet the following performance requirements:

- 5.01.00 Open and close the valve completely and make leak-tight valve closure without jamming.
- 5.02.00 Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
- 5.03.00 Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
- 5.04.00 The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
- 5.05.00 The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.

6.00.00 SPECIFIC REQUIREMENT

6.01.00 Construction

- 6.01.01 The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
- 6.01.02 The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
- 6.01.03 All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
- 6.01.04 The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.

6.02.00 Motor

- 6.02.01 The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
- 6.02.02 The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
- 6.02.03 The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
- 6.02.04 Motor leads shall be terminated in the limit switch compartment.
- 6.02.05 Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall declutch automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. ~~Also refer clause no. 1.19.02(u) of Section I of Volume V-A: Technical Specifications for Electrical Equipment & Accessories.~~

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

Supply	Description	Consumer
L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	Motors above 0.2kW upto less than 175kW.
	Fault level 50 kA symm. for 1 sec.	
	240V, 1Ø, 2W, 50 Hz effectively earthed	Lighting, Space heat- ing , A.C supply for Contr- ol & protective devices.
D.C. Supply	220V, 2W, unearthed	D.C. alarm, control & protective devices
	Fault level 25* kA. for 1 sec.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

Voltage	:	± 10%
Frequency	:	+3% to -5%.
Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242

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LT MOTORS

A. GENERAL

1. Manufacturer & Country of origin.
(Shall be as per approved QA make)
2. Equipment driven by motor
3. Motor type
4. Quantity

B. DESIGN AND PERFORMANCE DATA

1. Frame size
2. Type of duty
3. Type of enclosure /Method of cooling/Degree of protection
4. Applicable standard to which motor generally conforms
5. Efficiency class as per IS 12615
6. (a) Whether motor is flame proof Yes/No
(b) If yes, the gas group to which it conforms as per IS:2148
7. Type of mounting
8. Direction of rotation as viewed from DE END__
9. Standard continuous rating at 40 deg.C. ambient temp. as per Indian Standard (KW)
10. Derated rating for specified normal condition i.e. 50 deg. C ambient temperature (KW)
11. Maximum continuous load demand of driven equipment in KW
12. Rated Voltage (volts)
13. Permissible variation of :

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- a. Voltage (Volts)
 - b. Frequency (Hz)
 - c. Combined voltage and frequency
14. Rated speed at rated voltage and frequency(RPM)
 15. At rated Voltage and frequency:
 - a. Full load current
 - b. No load current
 16. Power Factor at
 - a. 100% load
 - b. NO load
 - c. Starting.
 17. Efficiency at rated voltage and frequency,
 - a. 100% load
 - b. 75% load
 - c. 50% load
 18. Starting current (amps) at
 - a. 100 % voltage
 - b. 85% voltage
 - c. 80% voltage
 19. Minimum permissible starting Voltage (Volts)
 20. Starting time with minimum permissible voltage
 - a. Without driven equipment coupled
 - b. With driven equipment coupled

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21. Safe stall time with 100% and 110% of rated voltage
 - a. From hot condition
 - b. From cold condition
22. Torques :
 - a. Starting torque at min. permissible voltage(kg-mtr.)
 - b. Pull up torque at rated voltage.
 - c. Pull out torque
 - d. Min accelerating torque (kg.m) available
 - e. Rated torque (kg.m)
23. Stator winding resistance per phase (ohms at 20 Deg.C.)
24. GD^2 value of motors
25. No of permissible successive starts when motor is in hot condition
26. Locked Rotor KVA Input
27. Locked Rotor KVA/KW
28. Vibration limit :Velocity (mm/s)
29. Noise level limit (dBA)

C. CONSTRUCTIONAL FEATURES

1. Stator winding insulation
 - a. Class & Type
 - b. Winding Insulation Process
 - c. Tropicalised (Yes/No)

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- d. Temperature rise over specified maximum ambient temperature of 50 deg C
- e. Method of temperature measurement
- f. Stator winding connection
2. Main Terminal Box
 - a. Type
 - b. Location (viewed from NDE side)
 - c. Entry of cables(bottom/side)
 - d. Recommended cable size (To be matched with cable size envisaged by owner)
 - e. Fault level (MVA), Fault level duration (sec)
 - f. Cable glands & lugs details (shall be suitable for power cable)
3. Type of DE/NDE Bearing
4. Motor Paint shade
5. Weight of
 - a. Motor stator (KG)
 - b. Motor Rotor (KG)
 - c. Total weight (KG)
- D. List of accessories.**
 1. Space Heaters (Applicable for 30 KW & above motor) (Nos./Power in watts/supply voltage)
 2. Terminal Box for Space Heater (Yes/No)
 3. Speed switch (Yes/No)
No of contacts and contact ratings of speed switch

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4. Insulation of bearing (Yes/No)

5. Noise reducer(Yes/No)

6. Grounding pads

i) No and size on motor body

ii) Nos on terminal Box

7. Vibration pads

i) Nos and size

ii) Location

8. Any other fitments

E. List of curves.

1. Torque speed characteristic of the motor

2. Thermal withstand characteristic

3. Starting. current Vs. Time

4. Starting. current Vs speed

5. P.F. and Effi. Vs Load

F. Additional Data to be filled for each rating of DC Motor

1. Rated armature voltage (Volt)

2. Rated field excitation (Amp)

3. Permissible % variation in voltage

4. Minimum Permissible Starting voltage (volt)

5. At rated voltage

i) Full load Armature current.(Amp)

ii) Full load Field current (Amp)

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- iii) No load Armature current (Amp)
6. Full load Field current (Amp)
7. No load Armature current (Amp)
8. Minimum permissible field current(Amp) to avoid overspeeding at
 - i) Maximum permissible voltage
 - ii) Rated voltage
 - iii) Minimum Permissible Voltage
9. Resistance (indicative Values) in ohm
 - i) Armature winding (Arm + IP + Series) at 25 deg.C
 - ii) Field Winding at 25 deg. C
10. Inductance (indicative values)
 - i) Armature winding
 - ii) Field winding
11. Value of trimmer resistance (ohm) to be connected in series with the shunt field to obtain rated speed at
 - i) 220 V DC
 - ii) 250 V DC
 - iii) 187 V DC
12. Value of the external resistance (ohm) required to be connected in series with armature during starting only
13. Technical data sheet for external resistance box
14. GA drawing of motor
15. Starting time calculation

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16. Starter resistance design calculation
17. Electrical connection diagram of motor

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S.D.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
	2	3	4	5	6	7	8	9	10			11
0	ASSEMBLY	1.WORKMANSHIP	MA	VISUAL	100%	MANUF'S SPEC	MANUF'S SPEC	-DO-	2	-	-	
		2.DIMENSIONS	MA	-DO-	-DO-	MFG. DRG./ MFG. SPEC.	MFG. DRG./ MFG. SPEC.	-DO-	2	-	-	
		3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA	VISUAL	100%	MFG.SPEC./ RELEVANT IS	MFG.SPEC. RELEVANT IS	-DO-	2	-	-	
0	PAINING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
0	TESTS	1.ROUTINE, TYPE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	IS-325/ BHEL SPEC./ DATA SHEET	SAME AS COL.7	TEST REPORT	2	1*		* NOTE -1 & NOTE-3
		2.OVERALL DIMENSIONS & ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPN. REPORT	2	1	-	NOTE -1 & NOTE-3
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SHEET 2 OF 2		SYSTEM			ITEM AC ELECT. MOTORS BELOW 55KW (LV)			SECTION			VOLUME III	
COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
								P	W	V		
2	3	4	5	6	7	8	9	10			11	
NOTES: 1. ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE, TYPE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 2. WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. 3. FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.	3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-		
<u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY												
BHEL		PARTICULARS		BIDDER/VENDOR								
		NAME										
		SIGNATURE										
		DATE							BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN				TITLE			NUMBER :			
		BIDDER/ VENDOR :				QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION :			
SHEET 1 OF 9		SYSTEM				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION		VOLUME III	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.0	RAW MATERIAL & BOUGHT OUT CONTROL											
1.1	SHEET STEEL, PLATES, SECTION, EYEBOLTS	1.SURFACE CONDITION	MA	VISUAL	100%	-	FREE FROM BLINKS, CRACKS, WAVINESS ETC	LOG BOOK	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	-DO-	3	-	-	
		3.PROOF LOAD TEST (EYE BOLT)	MA	MECH. TEST	-DO-	-DO-	-DO-	INSPEC. REPORT	3	-	2	
1.2	HARDWARES	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, UN-EVENNESS ETC.	-DO-	3	-	-	
		2.PROPERTY CLASS	MA	VISUAL	SAMPLES	MANFR'S DRG./SPEC BOOK	RELEVANT IS/SPEC.	SUPPLIERS TC & LOG	3	-	2	PROPERTY CLASS MARKING SHALL BE CHECKED BY THE VENDOR
1.3	CASTING	1.SURFACE CONDITION	MA	VISUAL	100%		FREE FROM CRACKS, BLOW HOLES ETC.	LOG BOOK	3	-	2	
		2.CHEM. & PHY. PROP.	MA	CHEM & MECH TEST	1/HEAT NO.	MANFR'S DRG./SPEC	RELEVANT IS/	SUPPLIER'S TC	3	-	2	HEAT NO. SHALL BE VERIFIED
		3.DIMENSIONS	MA	MEASUREMENT	100%	MANUFR'S DRG.	MANUFR'S DRG.	LOG BOOK	3	-	2	
1.4	PAINT & VARNISH	1.MAKE, SHADE, SHELF LIFE & TYPE	MA	VISUAL	100% CONTINUOUS	MANFR'S DRG./SPEC	MANFR'S DRG./SPEC	LOG BOOK	3	-	2	
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		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1X800 MW KOTHAGUDEM TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
		SHEET 2 OF 9		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED
		2. CHEM. & PHYSICAL PROPERTIES	MA	CHEM. & PHYSICAL TESTS	1/HEAT NO. OR HEAT TREATMENT BATCH NO	MFG. DRG. SPEC.	RELEVANT IS	SUPPLIER'S TC	3	-	2	
		3. DIMENSIONS	MA	MEASUREMENT	100%	-DO-	MANUFR'S DRG.	LOG BOOK	3	-	2	
		4. INTERNAL FLAWS	CR	UT	-DO-	ASTM-A388	MANUFR'S SPEC. BHEL SPEC.	-DO-	3	2	1	
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING	MA	VISUAL	-DO-	MANUFR'S DRG. SPEC.	MANUFR'S DRG. SPEC.	-DO-	3	-	2	FOR DIA OF 55 MM & ABOVE
		2. PHYSICAL COND.	MA	-DO-	-DO-	-	NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY	-DO-	3	-	2	
		3. DIMENSIONS (WHEREVER APPLICABLE)	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG./ SPEC.	MANUFR'S DRG. / SPEC.	-DO-	3	-	2	
		4. PERFORMANCE/ CALIBRATION	MA	TEST	100%	-DO-	-DO-	INSP. REPORT	3	-	2	
BHEL			PARTICULARS			BIDDER/VENDOR			BIDDER'S/VENDORS COMPANY SEAL			
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		QUALITY PLAN				CUSTOMER : TSPGCL		PROJECT : 1X800 MW KOTHAGUDEM TPS		SPECIFICATION :		
						BIDDER/ :		QUALITY PLAN		NUMBER :		
		SHEET 3 OF 9		VENDOR :		NUMBER PED-506-00-Q-007, REV-03		TITLE		SPECIFICATION :		
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC.	MA	VISUAL	100%	-	NO VISUAL DEFECTS	INSPT. REPORT	3	-	2	FOR MV MOTOR INSULATION/VARNISH THICKNESS SHALL BE MORE THAN THE BURS HEIGHT * MOTOR MANUFACTURER TO CONDUCT VISUAL CHECK FOR SURFACE FINISH ON RANDOM BASIS (10% SAMPLE) AT HIS WORKS AND MAINTAIN RECORD FOR VERIFICATION BY BHEL/CUSTOMER.
		2. OTHER CHARACTERISTICS	MA	TEST	SAMPLE	MANUF'S SPEC.	MANUF'S SPEC.	LOG BOOK AND OR SUPPLIER'S TC	3	-	2	
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND.	MA	VISUAL	100%	-	NO VISUAL DEFECTS (FREE FROM BURS)	LOG BOOK	3	-	-	
		2.DIMENSIONS INCLUDING BURS HEIGHT	MA	MEASUREMENT	SAMPLE	MANUFR'S DRG. .	MANUFR'S DRG.	-DO-	3	-	2	
		3. ACCEPTANCE TESTS	MA	ELECT. & MECH TESTS	-DO-	MANUF'S SPEC./ RELEVANT IS	RELEVANT IS	SUPPLIER'S TC	3	-	2	
1.9	CONDUCTORS	1. SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	LOG BOOK	3*	-	2*	
		2.ELECT. PROP, & MECH. PROP	MA	ELECT. & MECH.TEST	SAMPLES	RELEVANT IS/ BS OR OTHER STANDARDS	RELEVANT IS/ BS OR OTHER STANDARDS	SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3	-	2	
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		QUALITY PLAN				CUSTOMER : TSPGCL		PROJECT : 1X800 MW KOTHAGUDEM TPS		SPECIFICATION : NUMBER :		
						BIDDER/ : VENDOR		QUALITY PLAN : NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION : TITLE		
		SHEET 4 OF 9				SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III
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									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
1.10	BEARINGS	3.DIMENSIONS	MA	MEASUREMENT	-DO-	-DO-	-DO-	Log Book	3	-	2	
		1.MAKE & TYPE	MA	VISUAL	100%	MANFR'S DRG./ APPROVED DATASHEET	MANFR'S DRG./ APPROVED DATASHEET	-DO-	3	-	2	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	BHEL DATA SHEET	BHEL DATA SHEET BEARING MANUF'S CATALOGUES	-DO-	3	-	2	
		3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
1.11	SLIP RING (WHEREVER APPLICABLE)	1.SURFACE COND.	MA	VISUAL	100%	-	-DO-	-DO-	3	-	-	
		2.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
		3.TEMP.WITH-STAND CAPACITY	MA	ELECT.TEST	-DO-	MANUF'S SPEC./ BHEL SPEC.	MANUF'S SPEC./ BHEL SPEC.	-DO-	3	-	2	
		4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
1.12	OIL SEALS & GASKETS	1.MATERIAL OF GASKET	MA	VISUAL	100%	MANUF'S DRG/SPECS	MANUF'S DRG./ SPECS.	-DO-	3	-	-	
		2.SURFACE COND.	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	-	
		3.DIMENSIONS	MA	MEASUREMENT	SAMPLE	MANUF'S DRG	MANUF'S DRG	-DO-	3	-	-	
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		QUALITY PLAN				CUSTOMER TSPGCL			PROJECT 1X800 MW KOTHAGUDEM TPS			SPECIFICATION :		
						BIDDER/ : VENDOR			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			NUMBER :		
		SHEET 5 OF 9		SYSTEM				ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SPECIFICATION : TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			VOLUME III		REMARKS
									P	W	V			
1	2	3	4	5	6	7	8	9	10			11		
2.0	IN PROCESS													
2.1	STATOR FRAME WELDING (IN CASE OF FABRICATED STATOR)	1.WORKMANSHIP & CLEANNESS	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	3/2	2	-			
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-			
2.2	MACHINING	1.FINISH	MA	VISUAL	100%	-DO-	GOOD FINISH	LOG BOOK	2	-	-			
		2.DIMENSIONS	MA	MEASUREMENT	-DO-	MANUF'S DRG	MANUF'S DRG	-DO-	2	-	-			
		3.SHAFT SURFACE FLOWS	MA	PT	-DO-	RELEVANT SPEC./ ASTM-E165	MANUFR'S SPEC./ BHEL SPEC./	-DO-	2	-	1			
2.3	PAINTING	1.SURFACE PREPARATION	MA	VISUAL	100%	MANFR'S SPEC/BHEL SPEC./ RELEVANT STAND	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-			
		2.PAINT THICKNESS (BOTH PRIMER & FINISH COAT)	MA	MEASUREMENT BY ELCOMETER	SAMPLE	-DO-	-DO-	-DO-	2	-	-			
		3.SHADE	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-			
		4.ADHESION	MA	CROSS CUTTING & TAPE TEST	-DO-	-DO-	-DO-	Log Book	2	-	-			
BHEL			PARTICULARS			BIDDER/VENDOR								
			NAME											
			SIGNATURE											
			DATE											

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1X800 MW KOTHAGUDEM TPS		SPECIFICATION :				
				BIDDER/ :		TITLE		NUMBER :				
		SHEET 6 OF 9		VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		SPECIFICATION :				
		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
2.4	SHEET STACKING	1.COMPLETENESS	MA	MEASUREMENT	SAMPLE	MANUFR'S SPEC.	MANUFR'S SPEC.	Log Book	2	-	-	(FOR MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		2.COMPRESSION & TIGHTENING	MA	MEASUREMENT	100%	-DO-	-DO-	Log Book	2	-	-	
		3.CORE LOSS & HOTSPOT	MA	ELECT.TEST	-DO-	-DO-	-DO-	Log Book	2	1*	1	
2.5	WINDING	1.COMPLETENESS	CR	VISUAL	100%	MANUFR'S SPEC./BHEL SPEC.	MANUFR'S SPEC./BHEL SPEC.	Log Book	2	-	-	FOR MV MOTOR
		2.CLEANLINESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		3.IR-HV-IR	CR	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2	-	1	
		4.RESISTANCE	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
		5.INTERTURN INSULATION	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-	
		6.SURGE WITH STAND AND TAN. DELTA TEST	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	THREE DIPS TO BE GIVEN
		2.TEMP. PRESSURE VACCUM	MA	PROCESS CHECK	CONTINUOUS	-DO-	-DO-	Log Book	2	-	-	
		3.NO. OF DIPS	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE			Page 166 of 406						
									BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN			CUSTOMER TSPGCL			PROJECT 1X800 MW KOTHAGUDEM TPS			SPECIFICATION :				
			BIDDER/ :			QUALITY PLAN			NUMBER :				
			VENDOR			NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION :				
SHEET 7 OF 9			SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION AGENCY			VOLUME III REMARKS	
									P	W	V		
1	2	3	4	5	6	7	8	9	10			11	
2.7 2.8 2.9 2.10	COMPLETE STATOR ASSEMBLY	4.DURATION	MA	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	1	VERIFICATION FOR MV MOTOR ONLY	
		1.COMPACTNESS & CLEANLINESS	MA	VISUAL	100%	-DO-	-DO-	Log Book	2	-	-		
	BRAZING/COMPRESSION JOINT	1.COMPLETENESS	CR	-DO-	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.SOUNDNESS	CR	MALLET TEST & UT	-DO-	-DO-	-DO-	Log Book	2		1		
	COMPLETE ROTOR ASSEMBLY	3.HV	MA	ELECT. TEST	-DO-	-DO-	-DO-	Log Book	2		1		
		1.RESIDUAL UNBALANCE	CR	DYN. BALANCE	-DO-	MFG SPEC./ ISO 1940	MFG. DWG.	Log Book	2		1		
	ASSEMBLY	2.SOUNDNESS OF DIE CASTING	CR	ELECT. (GROWLER TEST)	-DO-	MFG. SPEC.	MFG. SPEC.	Log Book	2		1		
		1.ALIGNMENT	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	-		
		2.WORKMANSHIP	MA	VISUAL	-DO-	-DO-	-DO-	Log Book	2	-	-		
		3.AXIAL PLAY	MA	MEAS.	-DO-	-DO-	-DO-	Log Book	2	-	1		
4.DIMENSIONS		MA	-DO-	-DO-	MFG.DRG./ MFG SPEC.	MFG. DRG/ RELEVANT IS	Log Book	2	-	-			
5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE		MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2	-	-			
	6. RTD, BTD & SPACE HEATER MOUNTING.	MA	VISUAL	100%	MFG SPEC. RELEVANT IS	MFG SPEC. RELEVANT IS	Log Book	2		1			
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE			Page 167 of 406			BIDDER'S/VENDORS COMPANY SEAL				

SHEET 8 OF 9			VENDOR			NUMBER PED-506-00-Q-007, REV-03			TITLE			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	SYSTEM			ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)			SECTION			VOLUME III
			CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			
									P	W	V	
1	2	3	4	5	6	7	8	9	10			11
3.0	TESTS	1.TYPE TESTS INCLUDING SPECIAL TESTS AS PER BHEL SPEC.	MA	ELECT.TEST	1/TYPE/SIZE	IS-325/ BHEL SPEC./ DATA SHEET	IS-325/ BHEL SPEC./ DATA SHEET	TEST REPORT	2	1*	1	* NOTE - 1
		2.ROUTINE TESTS INCLUDING SPECIAL TEST AS PER BHEL SPEC.	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		3.VIBRATION & NOISE LEVEL	MA	-DO-	100%	IS-12075 & IS-12065	IS-12075 & IS-12065	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		4.OVERALL DIMENSIONS AND ORIENTATION	MA	MEASUREMENT & VISUAL	100%	APPROVED DRG/DATA SHEET	APPROVED DRG/DATA SHEET & RELEVANT IS	INSPC. REPORT	2	1	-	
		5.DEGREE OF PROTECTION	MA	ELECT. & MECH. TEST	1/TYPE/ SIZE	RELEVANT IS	BHEL SPEC. AND DATA SHEET	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		6. MEASUREMENT OF RESISTANCE OF RTD & BTD	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		7. MEASUREMENT OF RESISTANCE, IR OF SPACE HEATER	MA	-DO-	100%	-DO-	-DO-	-DO-	2	1 ^{\$}	1	^{\$} NOTE - 2
		8. NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPC. REPORT	2	1 ^{\$}	1	^{\$} NOTE - 2
		9.EXPLOSION FLAME PROOF NESS (IF SPECIFIED)	MA	EXPLOSION FLAME PROOF TEST	1/TYPE	IS-3682 IS-8239 IS-8240	IS-3682 IS-8239 IS-8240	TC	2	-	1	TC FROM AN INDEPENDENT LABORATORY, REFER NOTE-3
		10. PAINT SHADE, THICKNESS & FINISH	MA	VISUAL & MEASUREMENT BY ELKOMETER	SAMPLE	BHEL SPEC. & DATA SHEET	BHEL SPEC. & DATA SHEET	TC	2	1 ^{\$}	1	SAMPLING PLAN TO BE DECIDED BY INSPECTION AGENCY ^{\$} NOTE - 2
Page 168 of 406												
BHEL			PARTICULARS		BIDDER/VENDOR							

		QUALITY PLAN		CUSTOMER TSPGCL		PROJECT 1X800 MW KOTHAGUDEM TPS		SPECIFICATION :			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03		NUMBER :			
SHEET 9 OF 9		SYSTEM		ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)		SECTION		VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTIC CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
									P	W	V
1	2	3	4	5	6	7	8	9	10	11	
NOTES: 1 DEPENDING UPON THE SIZE AND CRITICALLY, WITNESSING BY BHEL SHALL BE DECIDED. 2 ROUTINE TESTS ON 100% MOTORS SHALL BE DONE BY THE VENDOR. HOWEVER, BHEL SHALL WITNESS ROUTINE TESTS ON RANDOM SAMPLES. THE SAMPLING PLAN SHALL BE MUTUALLY AGREED UPON. 3 IN CASE TEST CERTIFICATES FOR THESE TESTS ON SIMILAR TYPE, SIZE AND DESIGN OF MOTOR FROM INDEPENDENT LABORATORY ARE AVAILABLE, THESE TEST MAY NOT BE REPEATED. 4 WHEREVER CUSTOMER IS INVOLVED IN INSPECTION, AGENCY (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER. <u>Legends for Inspection agency</u> 1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER) P. PERFORM W. WITNESS V. VERIFY											
BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		

ANNEXURE-I

SUB-VENDOR LIST

The list of approved make of the LT Motors are as mentioned below:

S.No.	LIST OF LT MOTORS
1.	BHARAT BIJLEE LTD.
2.	CROMPTON GREAVES
3.	ASEA BROWN BOVERI
4.	KIRLOSKAR ELECTRIC CO LTD.
5.	NGEF
6.	SIEMENS
7.	MARATHON
8.	GE-POWER
9.	RAJINDRA ELECT INDUSTRIES
10.	LAXMI HYDRAULICS PVT. LTD

However, the final list of makes for the LT Motors is subjected to BHEL/Customer approval, during contract stage, without any commercial implications.

[illegible]

CABLE SCHEDULE FORMAT

ANNEXURE III

[illegible]

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

1. For the purpose of clarity, it may please be noted that the information given in regard to the cables to be routed through WinPath as per the system elaborated below is called "Cable List", while the term "Cable Schedule" applies to the cable list with routing information added after routing has been carried out.
2. The cable list shall be entered as an MS Excel file in the format as per enclosed template EXT_CAB_SCH_FORMAT.XLS. No blank lines, special characters, header, footer, lines, etc. shall be introduced in the file. No changes shall be made in the title line (first line) of the template.
3. The field properties shall be as under:
 - a. UNITCABLENO: A/N, up to sixteen (16) characters; each cable shall have its own unique, unduplicated cable number. In case this rule is violated, the cable cannot be taken up for routing.
 - b. FROM: A/N, up to sixty (60) characters; the "From" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - c. TO: A/N, up to sixty (60) characters; the "To" end equipment/ device description and location to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - d. PURPOSE: A/N, up to sixty (60) characters; the purpose (i.e. power cable/ indication/ measurement, etc.) to be specified here. Information in excess of 60 characters will be truncated after 60 characters.
 - e. REMARKS: A/N, up to forty (40) characters; Any information pertinent to routing to be specified here (e.g., cable number of the cable redundant to the cable number being entered). Information in excess of 40 characters will be truncated after 40 characters.
 - f. CABLESIZE: A/N, 7 characters exactly as per the codes indicated below shall be specified here. The program cannot route cables described in any other way/ format.
 - g. PATHCABLENO: Field reserved for utilization by the program. User shall not enter any information here.
4. One list shall be prepared for each system/ equipment (i.e., separate and unique cable lists shall be prepared for each system).
5. The cables shall be described as per the scheme listed below:

A	NN	A	NNN
Cable	No. of cores	Cable code	Cable size
Voltage	(e.g. 01,03,3H, 07)	(See C below)	(e.g. 035,185,2.5, 0.5)
Code (see B below)			

(A) **SYSTEM VOLTAGE CODES:**

(ac) A = 11KV, B = 6.6KV, C = 3.3KV, D = 415V, E = 240V, F = 110V
 (dc) G = 220V, H = 110V, J = 48V, K = +24V, L = -24V

(B) **CABLE VOLTAGE CODES:**

A = 11KV (Power cables)

Explanatory notes for filling up cable list for routing through WinPath, the cable routing program (developed by Corporate R&D) being used in PEM.

B = 6.6KV (Power cables)

C = 3.3KV (Power cables)

D = 1.1KV (LV & DC system power & control cables)

E = 0.6KV (0.5 sq. mm. Control cables)

(C) CABLE CODES

PVC Copper

A = Armoured FRLS

B = Armoured Non-FRLS

C = unarmoured FRLS

D = Unarmoured Non-FRLS

PVC Aluminium

E = Armoured FRLS

F = Armoured Non-FRLS

G = unarmoured FRLS

H = Unarmoured Non-FRLS

XLPE Copper

J = Armoured FRLS

K = Armoured Non-FRLS

L = unarmoured FRLS

M = Unarmoured Non-FRLS

XLPE Aluminium

N = Armoured FRLS

P = Armoured Non-FRLS

Q = unarmoured FRLS

R = Unarmoured Non-FRLS

S = FIRE SURVIVAL CABLES

T = TOUGH RUBBER SHEATH

U = OVERALL SCREENED

V = PAIRED OVERALL SCREENED

W = PAIRED INDIVIDUAL SCREENED

Y = COMPENSATING CABLES

I = PRE-FABRICATED CABLES

Z = JELLY FILLED CABLES



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUEDEM TPS
(C&I PORTION)**

SPECIFICATION NO. PE-TS-410-166-A001

VOLUME II-B

SECTION 'C4'

REVISION 00

DATE: 24/04/2015

PAGE 1 of 1

**SECTION: C-4
TECHNICAL SPECIFICATION (C&I PORTION)**



1X800 MW KOTHAGUDEM TPS
CONTROL & INSTRUMENTATION
Technical specification for
FUEL OIL HANDLING SYSTEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION 'D'

REV. NO.

00

DATE : 18.03.2015

SHEET

OF

INDEX

	1X800 MW KOTHAGUDEM TPS CONTROL & INSTRUMENTATION Technical specification for FUEL OIL HANDLING SYSTEM	SPEC NO.: PE-TS-410-145-I	
		VOLUME	
		SECTION 'D'	
		REV. NO. 00	DATE : 18.03.2015
		SHEET	OF

INDEX:

1. SPECIFIC TECHNICAL REQUIREMENT
2. DRIVE CONTROL PHILOSOPHY
3. ACTUATOR SPECIFICATION
4. ACTUATOR DATA SHEET
5. INSTUMENT DATASHEET
6. INSTUMENT QUALITY PLAN
7. LCP AND JUNCTION BOX SPECIFICATION
8. LCP QUALITY PLAN
9. CABLE BOQ
10. ERECTION HARDWARE
11. KKS PHILOSOPHY
12. MANDATORY SPARES



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

SPECIFIC TECHNICAL REQUIREMENT

	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FUEL OIL HANDLING SYSTEM	
Specific Technical Requirements (C&I): 1.0 Operation & Control of Fuel Oil Handling System shall be from plant DCS (BHEL Scope) as well as through Local Control Panel provided near FOHS area. 2.0 Local control panel will act as interface between the DCS and the field devices for commands & feedbacks. LCP shall have the provision of command (start/stop, load/unload) & feedback interface with plant DCS. 3.0 Local control panel (without any control system) shall have provision for hardwired annunciation facia, push button lamps, colored mimics etc. Bidder shall connect the same up to terminal box (panel itself). Further cabling with DCS panel shall be in BHEL scope. 4.0 Bidder to include all the instruments (PG, PS, PT, LS, RTD etc.) required for the package along with necessary fittings, accessories and valve manifold etc. 5.0 The solenoid operated valves/ damper/gates shall have limit switches for open/ close feedback. Solenoid valve shall be rated for 24 V DC only. 6.0 The junction boxes/LIEs for termination of instruments /solenoid valve limit switches etc are in bidder's scope. 7.0 BHEL shall provide 230 VAC UPS supply feeder at a single point. Further distribution to various instruments shall be in Bidder's scope. Bidder to include necessary power distribution board in his scope. Any power supply other than the above, if required by any instrument/device, has to be derived by the Bidder and all necessary hardware/software for the same shall be in bidder's scope. Bidder to furnish UPS power requirement along with the bid. 8.0 The make/model of various instruments/items/systems shall be subject to approval of owner/purchaser during detailed engineering stage. No commercial implication in this regard shall be acceptable. In case of any conflict or repetition of clauses in the specification, the more stringent requirements among them are to be complied with. 9.0 Vendor representative shall be available for 3-4 days at BHEL Electronic Division (EDN) Bangalore during testing of DCS. 10.0 Vendor representative shall be available for 6-7 days during commissioning time at site. 11.0 Mandatory spare to be supplied by bidder.		

	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FUEL OIL HANDLING SYSTEM	
12.0	The design, manufacture, inspection, testing, site calibration and installation of all C&I equipment and systems covered under this specification shall conform to the latest editions of applicable codes and standards eg. ANSI, ASME, IEEE, ISO, IEC, IGCI, AWS, NFPA, AISC, IGS, SAMA, UBC, UL, NESC, NEMA, ISA, DIN, VDE, IS etc.	
13.0	For instrument & control cable scope of supply refer 'Electrical scope sheet between BHEL & vendor'.	
14.0	Instrument installation drawings are to be provided by bidder. All instrument fitting and erection hardware as per instrument installation diagram shall be in bidder's scope.	
15.0	Every panel-mounted instrument, requiring power supply, shall be provided with a pair of easily replaceable glass cartridge fuses of suitable rating. Every instrument shall be provided with a grounding terminal and shall be suitably connected to the panel grounding bus.	
16.0	Provision for separate Terminal block/wiring diagram for power and control blocks of control panel to be ensured.	
17.0	The make of all the items shall be from approved sub-vendor list.	
18.0	Bidder shall provide Cable Schedule in BHEL excel format provided in Electrical portion of the specification. Also, cable interconnections details for complete system shall be in Bidders' scope.	
19.0	Editable & pdf copy of Drawings/Documents and data to be furnished after award of the contract: • Control & operational write-up for the system • Recommended control scheme/ logic diagram • Process manuscript for implementation in DCS • List of Drives (Solenoid valves etc) • I/O list (DCS) • GA & wiring diagram of local panel. • Power requirement. • Local control panel and field instruments quality plan. • Local control panel & instruments data sheet. • JB grouping document. • Cable schedule and cable interconnection drawing. • Instrument schedule • Alarm Schedule • SOE schedule • Instrument hook-up diagram. • Mandatory spare BOQ • UPS load list	

	Telangana State Power Generation Corporation Ltd. 1x800 MW Kothagudem TPS	SECTION: C
	SPECIFIC TECHNICAL REQUIREMENTS (C&I) FUEL OIL HANDLING SYSTEM	
- Any other document decided during detailed engineering. NOTES: - All equipment items shall be of latest design with proven on track record from reputed experienced manufacturers of specified type and range of equipment. The make/model of various instruments/items/systems and instrument sub-vendor shall be subject to approval of BHEL/Customer during detailed engineering stage. - The above given scope is indicative & minimum. Any item/ equipment not indicated above however required for the completeness of the system is to be supplied by bidder without any technical, commercial and delivery implication to BHEL. - Documents of C&I System shall be submitted to end user/owner for approval during detail engineering. Changes, if any, shall be accommodated by the bidder without any price/time implication. - Uniformity of make and type of instruments and control components shall be followed throughout for rationalization of spares' inventory, except for certain proprietary items where this requirement cannot be met.		



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

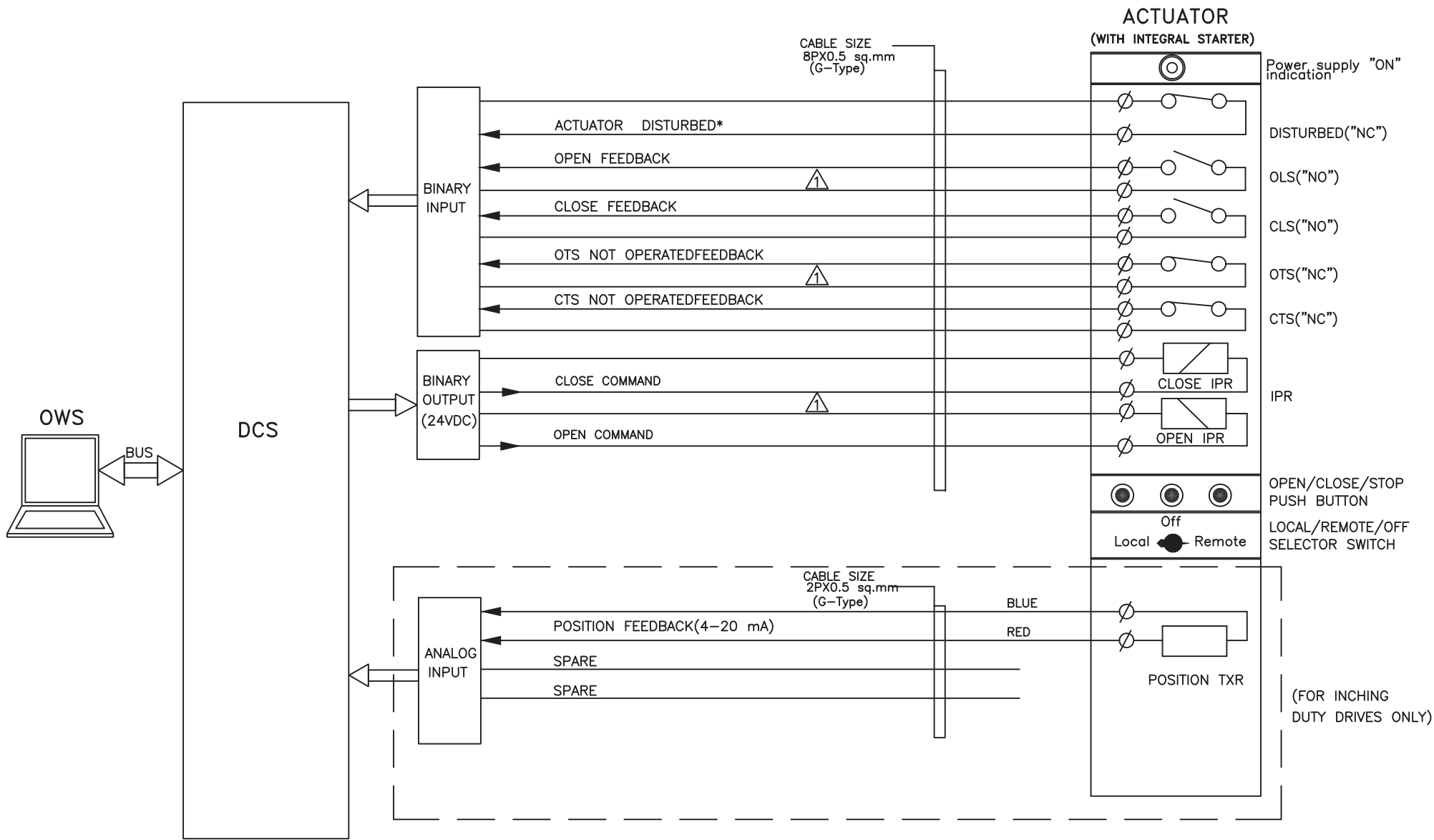
DATE : 10.03.2015

SHEET

OF

Drive Control Philosophy

DCS INTERFACE FOR BIDIRECTIONAL DRIVE (WITH INTEGRAL STARTER)

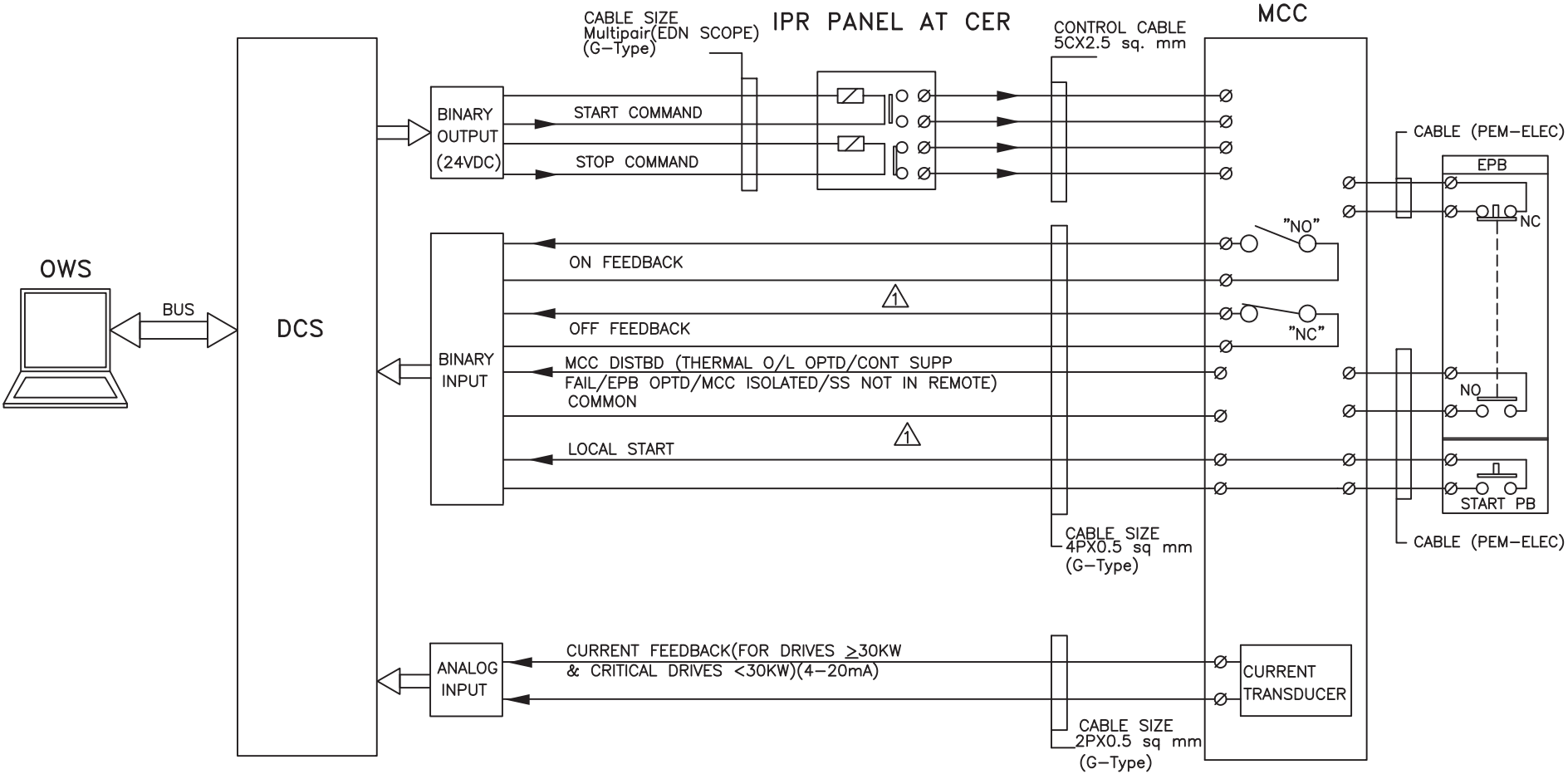


NOTE:

* DISTURBED= Loss of Power supply (1 Phase/3 Phase)/
Loss of control supply/ Motor thermostat trip/
Thermal over load/Torque open/close cutoff mode/
Local/Off/Remote Sel. switch Stop PB optd.

	PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12		DRG.NO.	PE-DM-410-145-I002
	TITLE:	DDCMIS INTERFACE FOR BIDIRECTIONAL DRIVE		DATE	09.03.2015
				REV.NO.	01
				SHT	7 OF 11

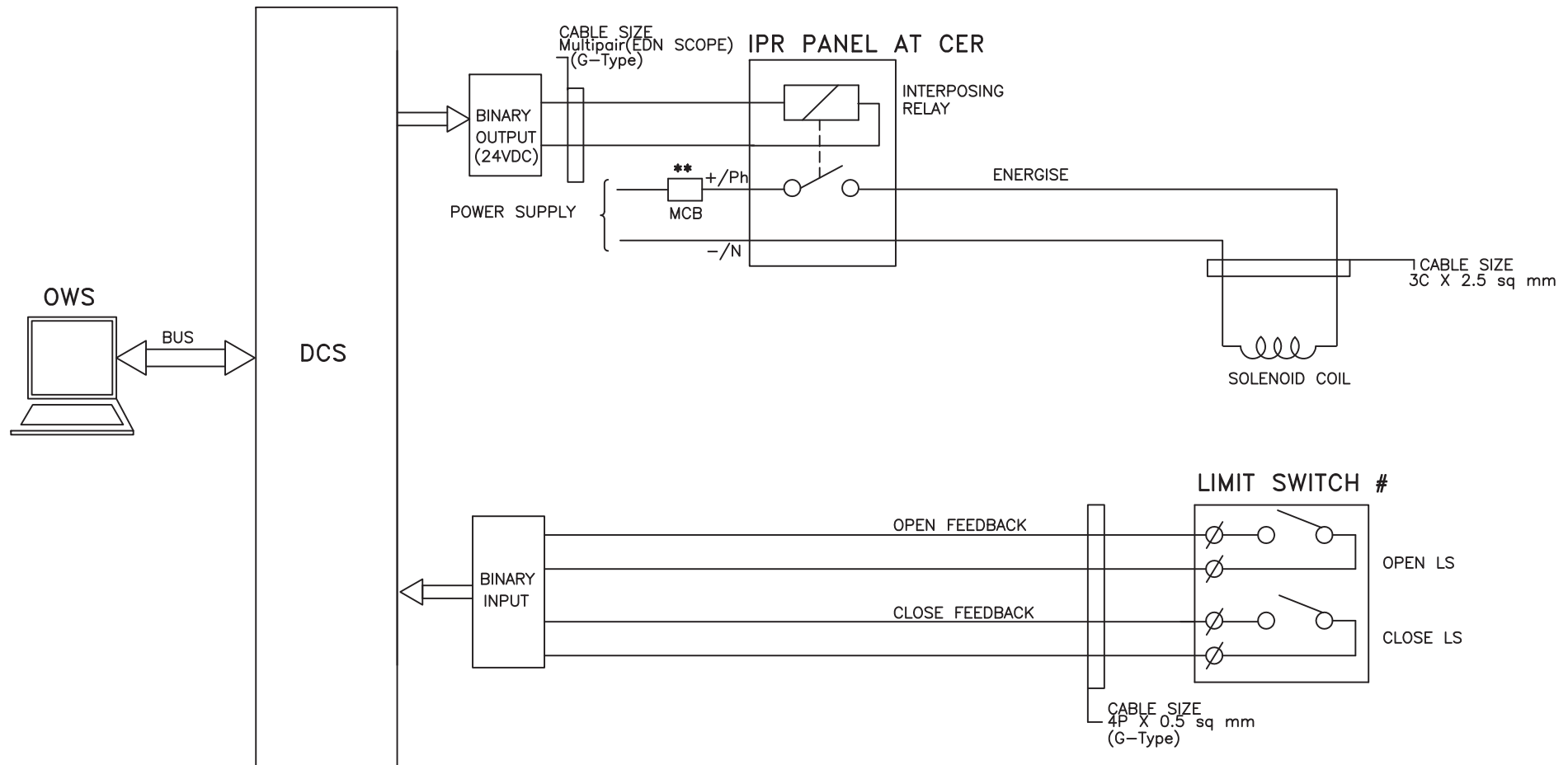
DCS INTERFACE FOR UNIDIRECTIONAL LT DRIVE



* FOR LTUD DRIVES ALL LUBE OIL PUMPS, SCANNER AIR FANS, SEAL AIR FANS, 4-20mA CURRENT TRANSDUCER SHALL BE CONSIDERED.

	PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12		DRG.NO.	PE-DM-410-145-I002
	TITLE:	DDCMIS INTERFACE FOR UNIDIRECTIONAL LT DRIVE		DATE	09.03.2015
				REV.NO.	01
				SHT	8 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



NOTES:

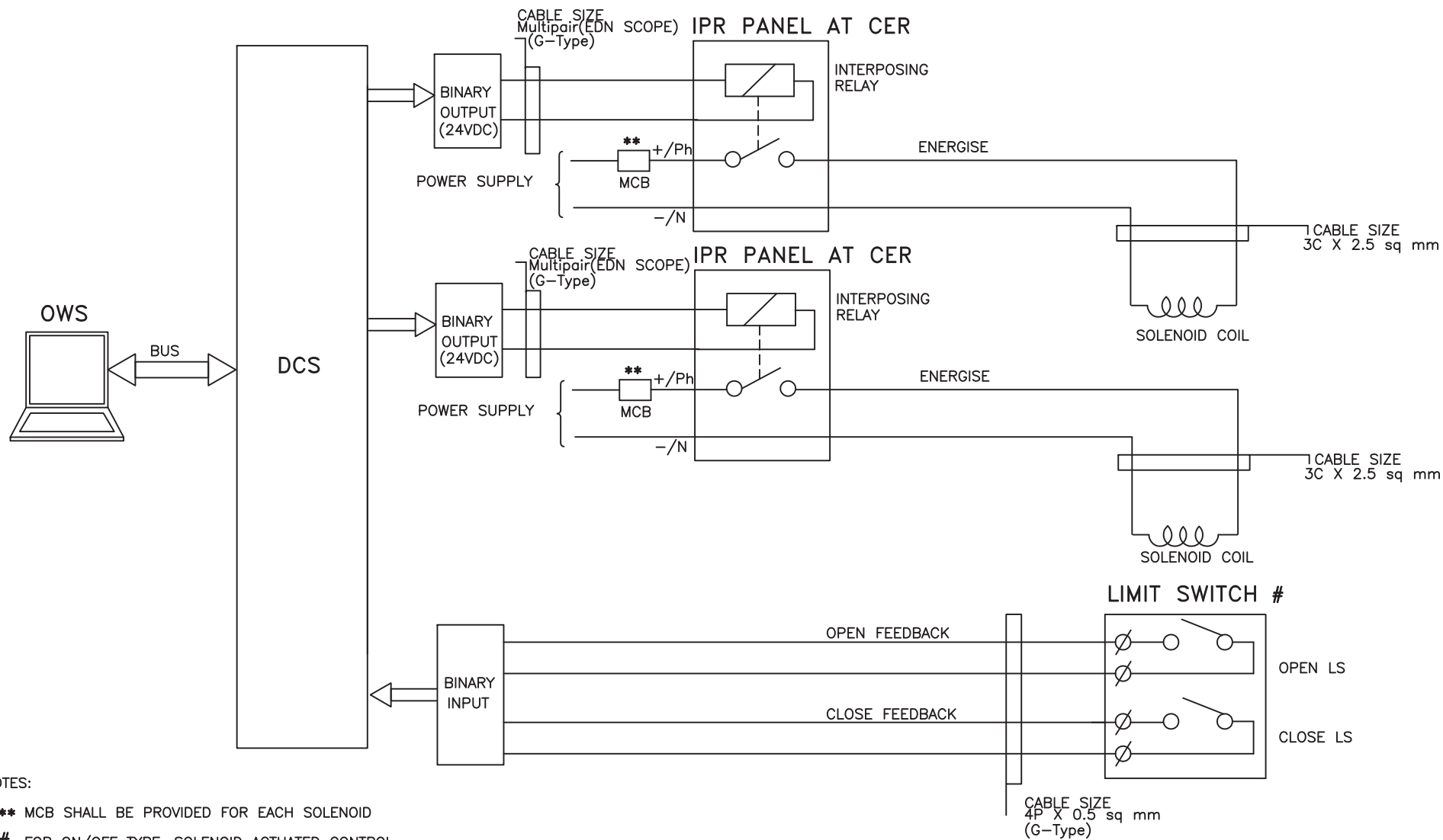
** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12		DRG.NO.	PE-DM-410-145-I002
			DATE	09.03.2015
	TITLE:		REV.NO.	01
	DDCMIS INTERFACE FOR SOLENOID DRIVE (SINGLE COIL)		SHT	9 OF 11

DCS INTERFACE FOR SOLENOID DRIVE (24V DC / 240V AC UPS)



NOTES:

** MCB SHALL BE PROVIDED FOR EACH SOLENOID

FOR ON/OFF TYPE, SOLENOID ACTUATED CONTROL VALVE.



PROJECT:

1X800 KOTHAGUDEM TPS
STAGE-VII, UNIT-12

TITLE:

DDCMIS INTERFACE FOR
SOLENOID DRIVE (DOUBLE COIL)

DRG.NO.

PE-DM-410-145-I002

DATE

09.03.2015

REV.NO.

01

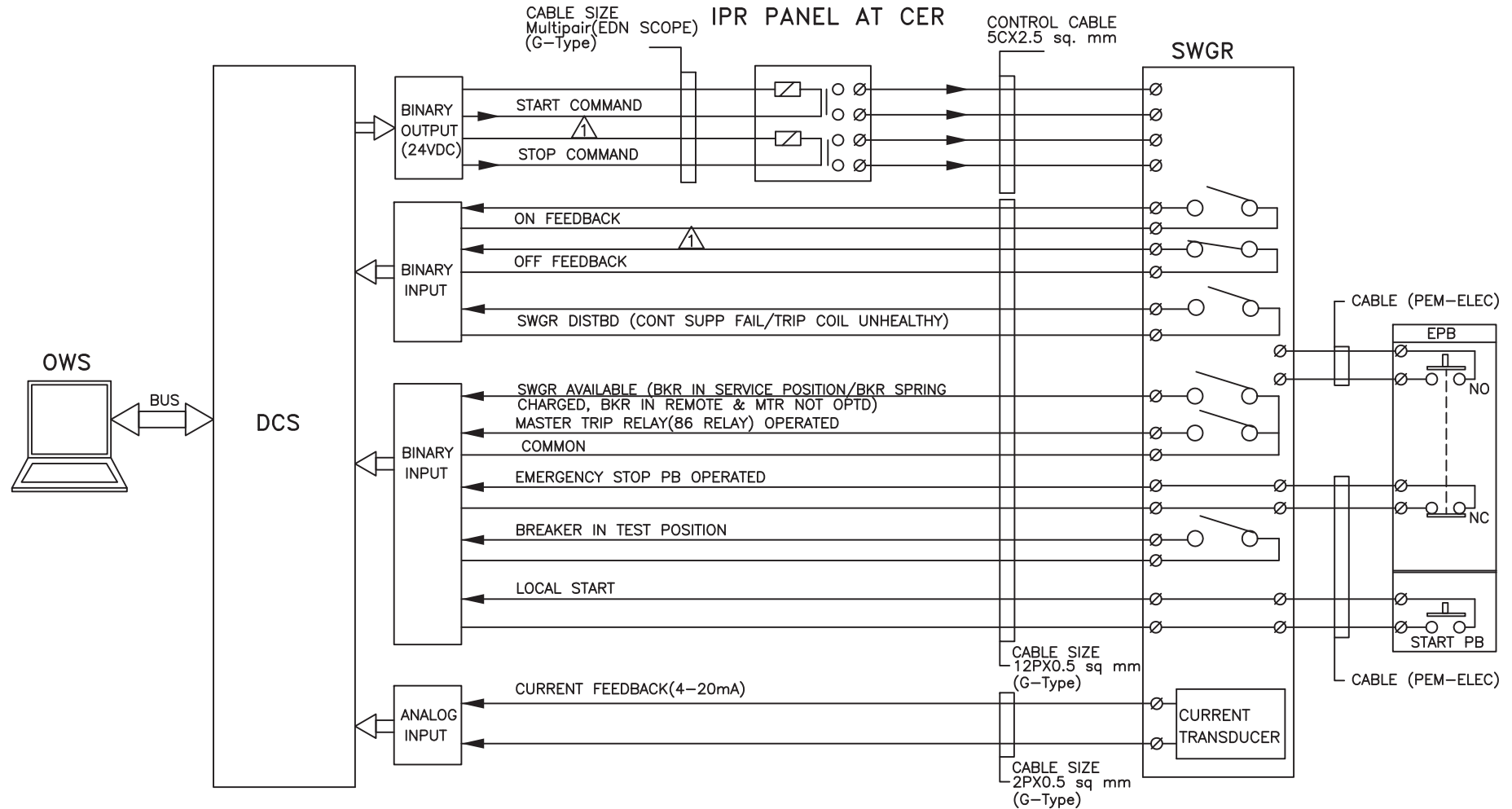
SHT

9a

OF

11

DCS INTERFACE FOR HT/LT UNIDIRECTIONAL DRIVES(BREAKER OPERATED)



Maharatna Company

PROJECT:

1X800 KOTHAGUDEM TPS
STAGE-VII, UNIT-12

TITLE:

DDCMIS INTERFACE FOR
UNIDIRECTIONAL HT DRIVE

DRG.NO.

PE-DM-410-145-I002

DATE

09.03.2015

REV.NO.

01

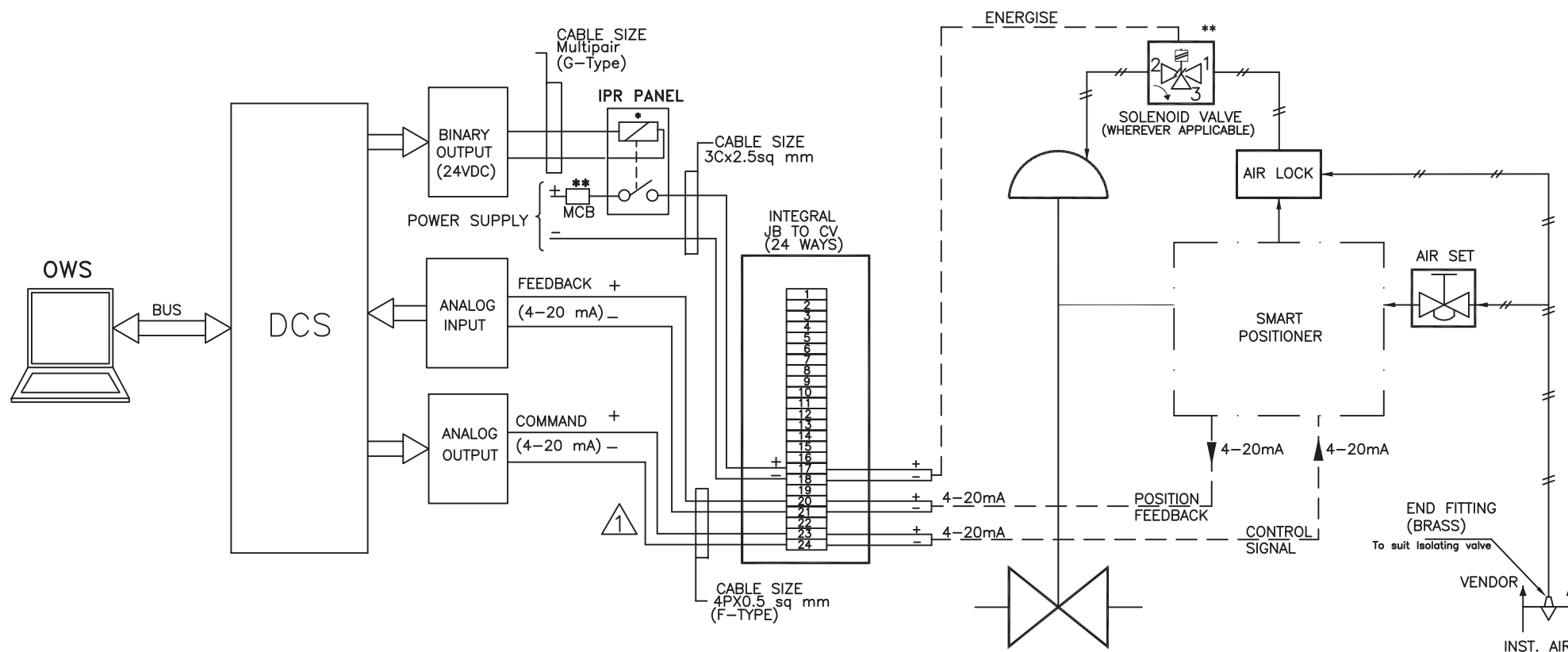
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10

OF

11

DCS INTERFACE FOR ANALOG DRIVE (WITH SMART POSITIONER)



NOTES:

** APPLICABLE TO VALVES WHERE PROTECTION OPEN/CLOSE ACTION FOR CONTROL DEMAND OVERRIDING IS REQUIRED.



PROJECT:	1X800 KOTHAGUDEM TPS STAGE-VII, UNIT-12	DRG.NO.	PE-DM-410-145-I002
TITLE:	TYPICAL HOOK-UP DIAGRAM ANALOG DRIVE (WITH SMART POSITIONER)	DATE	09.03.2015
		REV.NO.	01
		SHT	11 OF 11



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

ACTUATOR SPECIFICATION

VOLUME: V-A

SECTION-III

**TECHNICAL SPECIFICATION
FOR
ELECTRIC MOTOR ACTUATORS**

1.00.00 SCOPE

- 1.01.00 This Section covers the general requirements of Electric Motor Actuators for valves/dampers.
- 1.02.00 All electric motor actuators shall be furnished in accordance with this general specification and the accompanying driven equipment specification. All the electrical actuators shall be INTEGRAL type only.

2.00.00 STANDARDS

- 2.01.00 All electrical equipment shall conform to the latest applicable IS, ANSI and NEMA Standards, except when stated otherwise herein or in driven equipment specification.
- 2.02.00 Major standards, which shall be followed, are listed below. Other applicable Indian Standards for any component part even if not covered in the listed standards shall also be followed
- i) IS -9334
- ii) IS-325

3.00.00 SERVICE CONDITIONS

- 3.01.00 The actuator shall be suitable for operation in hot, humid and tropical atmosphere, highly polluted at places with coal dust and/or fly ash.
- 3.02.00 Unless otherwise noted, electrical equipment/system design shall be based on the service conditions and auxiliary power supply given in the general specification.
- 3.03.00 For actuator motor installed outdoor and exposed to direct sun rays, the effect of solar heat shall be considered in the determination of the design ambient temperature.

4.00.00 RATING

- 4.01.00 For isolating service, the actuator shall be rated for three successive open-close operation of the valve/damper or 15 minutes, whichever is longer.
- 4.02.00 For regulating service, the actuator shall be suitably time-rated for the duty cycle involved with necessary number of starts per hour, but in no case less than 150 starts per hour.

5.00.00	PERFORMANCE
	The actuator shall meet the following performance requirements:
5.01.00	Open and close the valve completely and make leak-tight valve closure without jamming.
5.02.00	Attain full speed operation before valve load is encountered and imparts an unseating blow to start the valve in motion (hammer blow effect).
5.03.00	Operate the valve stem at standard stem speed and shall function against design differential pressure across the valve seat.
5.04.00	The motor reduction gearing shall be sufficient to lock the shaft when the motor is de-energised and prevent drift from torque switch spring pressure.
5.05.00	The entire mechanism shall withstand shock resulting from closing with improper setting of limit switches or from lodging of foreign matter under the valve seat.
6.00.00	SPECIFIC REQUIREMENT
6.01.00	Construction
6.01.01	The actuator shall essentially comprise the drive motor, torque/ limit switches, gear train, clutch, hand wheel, position indicator/ transmitter, in-built thermostat for over load protection, space heater and internal wiring.
6.01.02	The actuator enclosure shall be totally enclosed, dust tight, weather-proof suitable for outdoor use without necessity of any canopy. Degree of protection of enclosure for motor actuator shall be IP-65.
6.01.03	All electrical equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
6.01.04	The actuator shall be designed for mounting in any position without any lubricant leakage or operating difficulty.
6.02.00	Motor
6.02.01	The drive motor shall be three phase, squirrel cage, induction machine with minimum class B insulation and IPW-55 enclosure, designed for high torque and reversing service. Canopy shall be provided for outdoor service.
6.02.02	The motor shall be designed for full voltage direct on-line start, with starting current limited to 6 times full-load current.
6.02.03	The motor shall be capable of starting at 85 percent of rated voltage and running at 80 percent of rated voltage at rated torque and 85 percent rated voltage at 33 percent excess rated torque for a period of 5 minutes each.
6.02.04	Motor leads shall be terminated in the limit switch compartment.
6.02.05	Motor actuators for valves/dampers shall be with integral starter with 3phase/3wire, 415V AC and operable from remote.

- 6.02.06 Earthing terminals shall be provided on either side of the motor.
- 6.03.00 **Limit Switches**
- Each actuator shall be provided with following limit switches: -
- 6.03.01 2 torque limit switches, one for each direction of travel, self-locking, adjustable torque type.
- 6.03.02 4 end-of-travel limit switches, two for each direction of travel.
- 6.03.03 2 position limit switches, one for each direction of travel, each adjustable at any position from fully open to fully closed positions of the valve/damper.
- 6.03.04 Each limit switch shall have 2 NO + 2 NC potential free contacts. Contact rating shall be 5A at 240V A.C. or 0.5A at 220V D.C.
- 6.04.00 **Hand Wheel**
- Each actuator shall be provided with a hand wheel for emergency manual operation. The hand wheel shall disengage automatically when the motor is energized.
- 6.05.00 **Position Indicator/Transmitter**
- The actuator shall have:
- 6.05.01 One (1) built-in local position indicator for 0-100% travel.
- 6.05.02 One (1) position transmitter, 4-20 mA current signal as position feedback, for remote indicator.
- 6.06.00 **Space Heater**
- A space heater shall be included in the limit switch compartment suitable for 240V, 1 phase, 50 Hz supply.
- 6.07.00 **Wiring**
- All electrical devices shall be wired up to and terminated in a terminal box. All wiring shall be done with 1100 V grade fire resistance PVC insulated stranded copper conductor of not less than 2.5 Sq.mm cross section. All wiring shall be identified at both ends with ferrules. All the electrical actuators shall have uniform wiring.
- 6.08.00 **Terminal Box**
- The terminal box shall be weather proof, with removable front cover and cable glands for cable connection. The terminal shall be suitable for connection of 2.5 Sq.mm copper conductor.
- 7.00.00 **ACCESSORIES**

As required for the driven equipment, the actuator shall be furnished with starting equipment mounted on the actuator. This shall include:

- 7.01.00 One (1) triple pole MCCB
- 7.02.00 One (1) reversing starter with mechanically interlocked contactors, 3 thermal overload relays, 2 NO + 2 NC auxiliary contacts for each contactor.
- 7.03.00 One (1) remote-local selector switch.
- 7.04.00 CLOSE-STOP-OPEN oil tight push buttons with indication lights.
- 7.05.00 415/240 V control transformer with primary & secondary fuses.

8.00.00 **TEST**

The actuator and all components thereof shall be subject to tests as per relevant Standards. In addition, if any special test is called for in equipment specification, the same shall be performed.

9.00.00 **DRAWINGS, DATA & MANUALS**

- 9.01.00 Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.02.00 **To be submitted with Bid**

Data sheet for each type of actuator shall be furnished along with internal wiring diagram, suggested control schematic and torque limit switch contact development and manufacturer's catalogues. Drawings, Data & Manuals shall be submitted in triplicate with the bid and in quantities and procedures as specified in General Conditions of Contract and/or elsewhere in the specification for approval and subsequent distribution after the issue of 'Letter of Intent'.

9.03.00 **To be submitted for Owner / Purchaser's Approval and Distribution**

All relevant drawings and data pertaining to the equipment like GTP, GA drawing, foundation plan, BOM, control & schematics, QAP, etc. shall be submitted by the Bidder for approval of Owner/Owner's consultant. Also refer clause no. 1.19.02(u) of Section-I of Volume – V-A: Technical Specifications for Electrical Equipment & Accessories.

ANNEXURE-A

DESIGN DATA

1.0 AUXILIARY POWER SUPPLY

S	upply	Description	Consumer
	L.V. Supply (i)	415V, 3Ø, 3W, 50 Hz Effectively earthed	u Motors above 0.2kW pto less than 175kW.
		Fault level 50 kA symm. for 1 sec.	
	(ii)	240V AC/415V AC	Motors upto 0.2kW.
		240V, 1Ø, 2W, 50 Hz effectively earthed	o Lighting, Space heat- ing , A.C supply for Contr- l & protective devices.
	D.C. Supply	220V, 2W, unearthed	& D.C. alarm, control protective devices
		Fault level 25* kA. for 1 sec.	

* Indicative only, the actual value will be decided by the Bidder, after substantiating the same by calculation.

2.0 RANGE OF VARIATION

A.C. Supply :

V	oltage	:	± 10%
	Frequency	:	+3% to -5%.
	Combined Volt + frequency	:	10% (absolute sum)

During starting of large motor, the voltage may drop to 80% of the rated voltage for a period of 60 seconds. All electrical equipment while running shall successfully ride over such period without affecting system performance.

D.C. Supply :

Voltage	:	187 to 242



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

Actuator Data Sheet

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	1	OF
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
GENERAL *	* PROJECT	1 X 800 MW KOTHAGUDAM TPS			
	OFFER REFERENCE				
	* TAG NO. SERVICE				
	* DUTY	☐ ON / OFF	☐ INCHING		
	* LINE SIZE (inlet/outlet): MATERIAL				
	* VALVE TYPE	☐ GLOBE ☐ GATE ☐ REG. GLOBE ☐ BUTTERFLY			
	* OPENING / CLOSING TIME				
	* WORKING PRESSURE				
	AMBIENT CONDITION	SHALL BE SUITABLE FOR CONTINUOUS OPERATION UNDER AN AMBIENT TEMP. OF 0-55 DEG C AND RELATIVE HUMIDITY OF 0-95%			
	VALVE SEAT TEST PRESS	BIDDER TO SPECIFY			
	REQUIRED VALVE TORQUE	BIDDER TO SPECIFY			
	ACTUATOR RATED TORQUE	BIDDER TO SPECIFY			
	CONSTRUCTION AND SIZING	CONSTRUCTION	TOTALLY ENCLOSED, DUST TIGHT, WEATHER PROOF, SUITABLE FOR OUTDOOR USE WITHOUT CANOPY, IP:65		
MECHANICAL POSITION INDICATOR		TO BE PROVIDED FOR 0-100% TRAVEL			
BEARINGS		DOUBLE SHIELDED, GREASE LUBRICATED ANTI-FRICTION.			
GEAR TRAIN FOR LIMIT SWITCH/TORQUE SWITCH OPERATION		METAL (NOT FIBRE GEARS). SELF-LOCKING TO PREVENT DRIFT UNDER TORQUE SWITCH SPRING PRESSURE WHEN MOTOR IS DE-ENERGIZED.			
SIZING		OPEN/CLOSE AT RATED SPEED AGAINST DESIGNED DIFFERENTIAL PRESSURE AT 90% OF RATED VOLTAGE. FOR ISOLATING SERVICE THREE SUCCESSIVE OPEN-CLOSE OPERATIONS OR 15 MINS. WHICHEVER IS HIGHER. FOR REGULATING SERVICE - 150 STARTS/HR MINIMUM			
HANDWHEEL	* REQUIRED	☒ YES ☐ NO			
	* ORIENTATION	☐ TOP MOUNTED ☐ SIDE MOUNTED			
	*TO DISENGAGE AUTOMATICALLY DURING MOTOR OPERATION.				
ELECTRIC ACTUATOR	ACTUATOR MAKE/MODEL	BIDDER TO SPECIFY			
	MOTOR MAKE / MODEL / TYPE / RATING (KW)	BIDDER TO SPECIFY			
	@ MOTOR TYPE	SQUIRREL CAGE INDUCTION MOTOR, STARTING CURRENT LIMITED TO SIX TIMES THE RATED CURRENT-INCLUSIVE OF I.S. TOLERANCE			
	ACTUATOR APPLICABLE WIRING DIAGRAM	☒ ENCLOSED ☒ DRG. NO. 3-V-MISC-24227 R00 (INDICATIVE)			
	COLOUR SHADE	☒ BLUE (RAL 5012), To be decided during detail engg.			
	PAINT TYPE (## Refer Notes)	☐ ENAMEL ☒ EPOXY ☐			
	SHAFT RPM	BIDDER TO SPECIFY			
	OLR SET VALUE	BIDDER TO SPECIFY			
	@ STARTING / FULL LOAD CURRENT	BIDDER TO SPECIFY			
	NO. OF REV FOR FULL TRAVEL	BIDDER TO SPECIFY			
	@ PWR SUPP TO MTR / STARTER	415V, 3PH, AC, 3 WIRE			
	@ CONTROL VOLTAGE REQUIREMENT	TO BE DERIVED FROM THE POWER SUPPLY TO THE STARTER ☐ 230 V ☐ 110 V			
	@ ENCLOSURE CLASS OF MOTOR	☐ IP 65 ☐ FLAME PROOF			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	2	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	@ INSULATION CLASS	CLASS-F TEMP. RISE LIMITED TO CLASS-B			
	@ WINDING TEMP PROTECTION	☒ THERMOSTAT (3 Nos., 1 IN EACH PHASE) ☐ _____			
	SINGLE PHASE / WRONG PHASE SEQUENCE PROTECTION	REQUIRED			
INTEGRAL STARTER	INTEGRAL STARTER	☒ REQUIRED ☐ NOT REQUIRED			
	TYPE OF SWITCHING DEVICE	☒ CONTACTORS ☐ THYRISTORS			
	TYPE	☒ CONVENTIONAL ☐ SMART (NON-INTRUSIVE)			
	IF SMART	NOT APPLICABLE			
	a) SERIAL LINK INTERFACE	☐ INTEGRAL ☐ FIELD MOUNTED			
	b) SERIAL LINK PROTOCOL	☐ FOUNDATION FIELD-BUS ☐ PROFI-BUS ☐ DEVICE NET ☐			
	c) SERIAL LINK MEDIA	☐ TWISTED PAIR Cu-CBL ☐ CO-AXIAL Cu-CBL ☐ OFC			
	d) HAND HELD PROGRAMMER	☐ REQUIRED ☐ NOT REQUIRED			
	e) TYPE OF HAND HELD PROGRAMMER	☐ BLUETOOTH ☐ INFRARED ☐			
	f) MASTER STATION	☐ REQUIRED ☐ NOT REQUIRED			
	g) MASTER STN INTRFACE WITH DCS	☐ MODBUS ☐ TCP/IP			
	h) DETAILS OF SPECIAL CABLE	☐ ENCLOSED ☐ NOT REQUIRED			
	STEP DOWN CONT. TRANSFORMER	☒ REQUIRED			
	OPEN / CLOSE PB	☒ REQUIRED ☐ NOT REQUIRED			
	STOP PB	☒ REQUIRED ☐ NOT REQUIRED			
	INDICATING LAMPS	☒ REQUIRED ☐ NOT REQUIRED			
	LOCAL REMOTE S/S	☒ REQUIRED ☐ NOT REQUIRED			
	STATUS CONTACTS FOR MONITORING	☒ REQUIRED ☐ NOT REQUIRED			
	INTEGRAL STARTER DISTURBED SIGNAL	REQUIRED (O/L RELAY OPERATED, CONT. /POWER SUPPLY FAILED, S/S IN LOCAL, TORQUE SWITCH OPTD. MID WAY)			
	INTERPOSING RELAY/OPTO COUPLER (Applicable for integral Starter)	TYPE OF ISOLATING DEVICE	☒ INTERPOSING RELAY ☐ OPTO COUPLER ☐ EITHER		
QUANTITY		☐ 2 NOs. ☒ 3 NOs.			
DRIVING VOLTAGE		☒ 20.5 – 24V DC ☐ _____ V DC			
DRIVING CURRENT		☒ 125mA MAX ☐ _____ mA MAX			
LOAD RESISTANCE		☒ > 192 ohms - <25 k ohms ☐ > _____ ohms - < _____ ohms			
TORQUE SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN / CLOSE	☒ 1 No. ☐ 2Nos. / ☒ 1 No. ☐ 2Nos			
	CONTACT TYPE	2 NO + 2 NC			
	RATING	5A 240V AC AND 0.5A 220V DC			
	CALIBRATED KNOBS(OPEN&CLOSE TS)	REQUIRED FOR SETTING DESIRED TORQUE			
	ACCURACY	+3% OF SET VALUE			
LIMIT SWITCH (Not Applicable for Smart Actuator) (\$\$ Refer Notes)	MFR & MODEL NO.	BIDDER TO SPECIFY			
	OPEN : INT : CLOSE	☐ 1 No. ☒ 2 Nos.	2 Nos. (ADJ.)	☐ 1 No. ☒ 2Nos.	
	CONTACT TYPE	2 NO + 2 NC			
	RATING (AC / DC)	5A 240V AC AND 0.5A 220V DC			

	SPECIFICATION FOR MOTORISED VALVE ACTUATOR		SPECIFICATION NO.:		
			VOLUME		
			SECTION		
			REV. NO.	00	DATE: 06.01.2015
			SHEET	3	OF 3
Data Sheet A & B					
DATA SHEET-A (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)		
POSITION TRANSMITTER	POSITION TRANSMITTER	☒ REQUIRED ☐ NOT REQUIRED			
	MFR & MODEL NO.	BIDDER TO SPECIFY			
	TYPE	☐ ELECTRONIC (2 WIRE) R/I CONVERTER ☒ ELECTRONIC (2 WIRE) CONTACTLESS			
	SUPPLY	☒ 24V DC ☐			
	OUTPUT	☒ 4-20mA			
	ACCURACY	± 1% FS			
SPACE HEATER	@SPACE HEATER	REQUIRED			
	@ POWER SUPPLY (NON INTEGRAL)	240V AC, 1 PH., 50 Hz			
	@ POWER SUPPLY (INTEGRAL)	240V AC, 1 PH/415/240 V CTRL TRANSFORMER WITH PRIMARY AND SECONDARY FUSES			
	@ RATING				
TERMINAL BOX	ACTUATOR/MOTOR TERMINAL BOX	REQUIRED			
	ENCL CLASS ACTUATOR/MOTOR T.B.	@ ☐ IP 68 @ ☐			
	@ EARTHING TERMINAL	REQUIRED			
	PLUG & SOCKET (9 PIN) (FOR COMM, LS/TS FEED BACK, PoT)	☐ REQUIRED ☒ NOT REQUIRED ☐ 2 NOS. ☐			
CABLE GLANDS	@ POWER CABLE GLAND	SIZE:-----			
	@ SPACE HEATER CABLE GLAND	SIZE:-----			
	OTHER CONTROL CABLE GLANDS-1	INSTRUMENT CABLE SIZE FOR ON/OFF DUTY VALVES SHALL BE 8PX0.5 SQMM - ONE CABLE GLAND OF OD SIZE 20 MM. INSTRUMENT CABLE SIZE FOR INCHING DUTY TYPE VALVES SHALL HAVE TWO NO. CABLES (ONE NO. 8PX0.5 SQMM AND 2ND 2PX0.5 SQMM) - TWO NO. GLANDS OF OD SIZES 20 MM & 15 MM.			
	OTHER CONTROL CABLE GLANDS-2				
WEIGHT	TOTAL WEIGHT (ACTUATOR + ACCESSORIES)	BIDDER TO SPECIFY		_____ Kg.	
NOTES: SCOPE: DESIGN, MANUFACTURE, INSPECTION, TESTING AND DELIVERY TO SITE OF ELECTRIC ACTUATOR FOR INCHING OR OPEN / CLOSE DUTY. CODES & STANDARDS: DESIGN AND MATERIALS USED SHALL COMPLY WITH THE RELEVANT LATEST NATIONAL AND INTERNATIONAL STANDARD. AS A MINIMUM, THE FOLLOWING STANDARDS SHALL BE COMPLIED WITH: IS-9334, IS-2147, IS-2148, IS-325, IS-2959, IS-4691 AND IS-4722 - TEMPERATURE RISE SHALL BE RESTRICTED TO 70 DEG. C FOR AMBIENT TEMPERATURE OF 50 DEG C. - CABLE GLANDS OF DOUBLE COMPRESSION TYPE, BRASS MATERIAL, WITH NICKEL COATING SHALL BE PROVIDED. - THE TORQUE SWITCHES SHALL BE PROVIDED WITH MECHANICAL LATCHING DEVICE TO PREVENT OPERATION WHEN UNSEATING FROM THE END POSITIONS. THE LATCHING DEVICE SHALL UNLATCH AS SOON AS THE VALVE LEAVES THE END POSITION. IF SUCH PROVISION IS NOT POSSIBLE, THE TORQUE SWITCHES SHALL BE BYPASSED BY END-POSITION LIMIT SWITCHES WHICH OPENS ON VALVE LEAVING END POSITION. THESE LIMIT SWITCHES ARE ADDITIONAL TO THE NUMBER OF LIMIT SWITCHES SPECIFIED ELSEWHERE. - THE MOTOR SHALL OPERATE SATISFACTORILY UNDER THE +/- 10% SUPPLY VOLTAGE VARIATION AT RATED FREQUENCY, -5% TO +3% VARIATION IN FREQUENCY AT RATED SUPPLY VOLTAGE, SIMULTANEOUS VARIATION IN VOLTAGE & FREQUENCY THE SUM OF ABSOLUTE PERCENTAGE NOT EXCEEDING 10%. - THE MOTOR SHALL BE SUITABLE FOR DIRECT ON LINE STARTING. \$\$ TORQUE SWITCH & LIMIT SWITCH SHALL ACT INDEPENDENT OF EACH OTHER. TANDEM OPERATION IS NOT ACCEPTABLE. ## EPOXY PAINT IS RECOMMENDED FOR COASTAL AREAS.					
			VENDOR COMPANY SEAL NAME SIGNATURE DATE		
NOTES* = TO BE FILLED BY MPL (LEAD AGENCY). @ = TO BE FILLED BY ES					

	Technical specification for CONTROL & INSTRUMENTATION 1X800 MW KOTHAGUDEM	SPEC NO.: PE-TS-410-145-I	
		VOLUME	
		SECTION	
		REV. NO. 00	DATE : 10.03.2015
		SHEET	OF

INSTRUMENTATION DATA SHEET

1.00.00 SPECIFICATION FOR ELECTRONIC TRANSMITTERS

1.01.00 PRESSURE TRANSMITTER

1. Working Principle : Smart (HART Compatible)
2. Type : Microprocessor based, 2 – Wire
3. Output Signal : 4-20 mA DC along with superimposed digital signal
4. Measuring Element : Capsule / Diaphragm
5. Element material : SS-316 (Stainless Steel) or better
6. Static Pressure : 150 % of maximum span continuously, without affecting the calibration
7. Turn-down ratio : 100: 1
8. Span and Zero : Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10. Output Indicator : LCD (Integral indicator of 5 digit display)
11. Nameplate : Tag number, service engraved in SS tag plate
12. Body : SS
13. Operating Voltage : 24V DC
14. Load : 600 Ohms (min.) at 24 Volts D.C.
15. Ambient Temperature : 0 - 50 °C
16. Performance:
 - i. Accuracy : $\pm 0.075\%$ of Span or better

ii.	Repeatability	± 0.05% of Span or better
17.	Sealing/Isolation	: Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18.	Accessories	: a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts c. Siphon for steam and hot water services d. ½" NPT 2-valve stainless steel manifold, constructed from SS316 bar stock e. Companion flange with nuts, bolts and gaskets f. ½" NPT cable gland g. Handheld calibrator
19.	Adjustment/Calibration/ Maintenance	: From handheld calibrator/ HART management system

Notes: For primary air/ secondary air/ flue gas applications, DP type transmitters shall be provided for pressure measurement.
LVDT type is not acceptable.

1.02.00 DIFFERENTIAL PRESSURE TRANSMITTER / FLOW TRANSMITTER

1.	Working Principle	: Smart (HART Compatible)
2.	Type	: Microprocessor based, 2 – Wire
3.	Output Signal	: 4-20 mA DC along with superimposed digital signal
4.	Measuring Element	: Capsule / Diaphragm

-
5.	Element material	:	SS-316 (Stainless Steel) or better
6.	Static Pressure	:	150 % of maximum span continuously, without affecting the calibration
7.	Turn-down ratio	:	100: 1
8.	Span and Zero	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
9.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
10.	Output Indicator	:	LCD (Integral indicator of 5 digit display)
11.	Nameplate	:	Tag number, service engraved in SS tag plate
12.	Body	:	SS
13.	Operating Voltage	:	24V DC
14.	Load	:	600 Ohms (min.) at 24 Volts D.C.
15.	Ambient Temperature	:	0 - 50 °C
16.	Performance:		
	i. Accuracy	:	± 0.075% of Span or better
	ii. Repeatability	:	± 0.05% of Span or better
17.	Sealing/Isolation	:	Extended diaphragm (Silicon oil/ Fluorolub filled) with 5 meters SS armoured capillary for corrosive/viscous/solid bearing or slurry type fluid applications
18.	Accessories	:	a. Universal mounting bracket suitable for 2" pipe mounting b. High tensile carbon steel U-bolts

- c. Siphon for steam and hot water services
- d. ½" NPT 5-valve stainless steel manifold, constructed from SS316 bar stock
- e. Companion flange with nuts, bolts and gaskets
- f. ½" NPT cable gland
- g. Handheld calibrator

19. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system

1.03.00 Displacer Type Level Transmitters

- 1. Type : Smart (HART Compatible)
- 2. Stages of operation : Continuous
- 3. Material :
- 4. i. Displacer SS-316
- 5. ii. Suspension wire SS-316
- 6. iii. Torque tube housing SS
- 7. iv. Torque tube Inconel
- 8. v. Displacer chamber SS
- 9. vi. Transmitter Housing SS
- 10. Operating Voltage : 24 V DC
- 11. Transmission : Microprocessor based, 2-wire
- 12. Output Signal : 4-20 mA DC along with superimposed digital signal
- 13. Static / overload : Maximum static pressure without

	pressure		permanent deformation or loss of accuracy
14.	Turn-down ratio	:	10 : 1 or better
15.	Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable with zero elevation and suppression by 100% of span
16.	Enclosure Class	:	IP-65
17.	Output Indicator	:	LCD type (Integral indicator of 5 digit display)
18.	Nameplate	:	Tag number and Service engraved in stainless steel tag plate
19.	Ambient Temperature	:	0 - 50 °C
20.	Load Impedance	:	600 Ohms at 24 Volts (minimum)
21.	Process Connection	:	2" Flanged
22.	Performance - Accuracy	:	± 0.075 % of span or better
23.	Accessories	:	a) Counter Flange, nuts, bolts, gaskets etc b) Weights for 5 point calibration of instruments c) Vent and drain plugs d) ½" NPT Glands e) Handheld calibrator
24.	Preferred Features	:	a) Test plug connection and cutout terminals physically separated from other electronics b) Electronic Damping facility (adjustable)
25.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system

-
	26. Applications	:	During detail engineering on Owner's approval
1.04.00	MASS FLOW METER		
1.04.01	SENSOR		
	1. Measuring Principle	:	Coriolis Mass flow
	2. Primary Element	:	Flow Tube of 316SS or better
	3. Heating Arrangement	:	Integral
	4. Temperature Control	:	For heavy fuel oil application
	5. Process Connection	:	Flanged of rating as per process requirement
	6. Drain	:	Self-draining facility
	7. Enclosure	:	Stainless steel
	8. Accessories	:	Counter flanges, Mounting nuts, bolts, gaskets etc.
1.04.02	TRANSMITTER		
	1. Measured quantities	:	Mass Flow rate, Total Mass Flow, Density
	2. Input Signal Processing	:	Smart (HART compatible)
	3. Display	:	LCD
	4. Output	:	2 nos. isolated output of 4-20mA DC selectable from four measured quantities
	5. Load	:	< 750 ohms
	6. Power supply	:	240V AC, 50 Hz

7.	Turn Down	:	100:1
8.	Accuracy	:	± 0.2 % of measured value
9.	Housing	:	IP 65 (Explosion proof)
10.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
11.	Accessories	:	a) Handheld calibrator b) Mounting U-bolts, nuts, bolts, prefab cable etc c) $\frac{1}{2}$"NPT cable gland
12.	Adjustment/Calibration/ /Maintenance	:	From handheld calibrator/ HART management system
13.	Applications	:	Fuel Oil service

1.05.00 RADAR TYPE LEVEL MEASUREMENT

1.	Type	:	Smart (HART Compatible)
2.	Antenna	:	Co axial / guided wave radar /Overspill protection
3.	Principle	:	TDR (Time Domain Reflectometry)
4.	Communication	:	Two wire 4-20mA DC with HART
5.	Environmental temperature	:	0 – 50 °C
6.	Enclosure	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)
7.	Calibration	:	a) Self calibration with internal reference b) Zero & Span calibration
8.	Process Connection	:	External cage mounting Flanged /screwed
9.	Electronic Housing	:	Epoxy painted Die-Cast aluminium

		alloy	
10.	Antenna / Flange assembly	:	316 SS or Hest alloy (as required)
11.	Power supply	:	24 V DC
12.	Output Indicator	:	LCD
13.	Accuracy	:	5 mm or 0.1% of probe length
14.	Accessories	:	a) Handheld calibrator
		:	b) Counter Flange, nuts, bolts, gaskets etc
		:	c) ½"NPT cable gland
		:	d) SS Nameplate
15.	Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
16.	Applications	:	Vessels under vacuum or low pressure applications, solid levels
1.06.00	ULTRASONIC LEVEL TRANSMITTER		
1.	Type	:	Microprocessor based, 2-wire, Smart (HART Compatible)
2.	Operating Principle	:	Detection of reflected ultrasonic pulse
3.	Output Signal	:	4-20 mA DC along with superimposed digital signal
4.	Operating frequency	:	10 KHz to 50 KHz (typical)
5.	Display	:	LCD
6.	Temperature Compensation	:	Built in –Programmable
7.	Power supply	:	24 V DC
8.	Enclosure	:	SS, IP-65 (Explosion proof for NEC Class-1, Division 1 area)

9. Zero & Span	:	Continuous, tamper proof, remote as well locally adjustable. It shall be possible to calibrate the instrument without any level in the sump/ tank
10. Accuracy & Repeatability	:	0.15 % of span or better
11. Resolution	:	0.1 % of span
12. Operating temp.	:	Transmitter- 500 C and Sensor - 800 C
13. MOC Sensor	:	SS-316/Body- PVC and Face – Polyurethane
14. Mounting	:	4" Flanged/ 2" NPT for sensor and Transmitter on panel
15. Accessories	:	a) Handheld calibrator b) Weather canopy for protection from direct sunlight and direct rain c) ½"NPT cable gland d) All mounting hardware (SS-316), Prefab cable e) SS Nameplate
16. Diagnosis	:	On-line
17. Status Indication	:	Power On, HI, HI-HI, Lo, LO-LO, Fault
18. Output Contacts	:	2 SPDT, 230V, 5A
19. Adjustment/Calibration/ Maintenance	:	From handheld calibrator/ HART management system
20. Applications	:	Coal Bunker, Water Service etc.

1.07.00 ULTRASONIC FLOW TRANSMITTER

1. Type : Ultrasonic – Clamp On
2. Accuracy : +/- 1 % of reading
3. Repeatability : +/- 0.3 % of reading
4. Rangeability : 400 : 1
5. Output Signal : 4-20 mA DC with HART
6. Measured Parameter : Volumetric flow, Totalized flow and flow Velocity
7. Display : LCD with internal Key Pad (Flow rate & Totalization)
8. Power Supply : 24 V DC (2 Wire)
9. Enclosure : SS (IP- 68 – Submersible)
10. Mounting : SS Chain or Strap
11. Accessories
 1. Handheld calibrator
 2. ½"NPT cable gland
 3. Transducer cable
 4. All mounting hardware (SS-316)
 5. SS Nameplate
12. Adjustment/Calibration/ Maintenance : From handheld calibrator/ HART management system
13. Applications : Plant water service

Note: Multi-path insertion type (minimum 4 path) Ultrasonic Flow meter shall be provided for Raw water/ Cooling Water flow measurements.

2.00.00 HART HAND HELD CALIBRATOR

Hand held calibrators (5 nos. for each type) shall be provided for adjustment/ calibration/maintenance of the HART compatible

transmitters. The hand held calibrator shall be suitable for all types of transmitters supplied in the package. If one type of hand held type calibrator is not suitable for communicating with all types of transmitters then separate hand held calibrator will be provided.

3.00.00 PROCESS ACTUATED SWITCHES

3.01.00 PRESSURE SWITCH

1. Type :
 - i. Piston for high pressure application
 - ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale.
Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure
6. Adjustments :
 - a) Internal Set Point
 - b) Differential adjustment
7. End Connection : 1/2" NPT bottom connected
8. Switch configuration : Two SPDT (240V, 5A AC/220V, 0.5A DC)
9. Switch Type : Snap acting, shock & vibration proof
10. Terminal Block : Suitable for full ring lugs
11. Enclosure Class : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
12. Performance :
 - a) Repeat accuracy $\pm 1.0\%$
 - b) Accuracy of Setting Indication of $\pm 1.5\%$
13. Ambient temperature : 0 – 50 Deg.C

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14. Nameplate : Tag number, service engraved in SS tag plate
15. Accessories : a) Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary for corrosive/ viscous/ solid bearing or slurry type fluid applications
b) Snubbers for pulsating fluid applications
c) Siphons for steam and hot water services
d) Retention ring and screws for surface mounting
e) 1/2" NPT 2 Valve SS-316 barstock manifold
f) 1/2" NPT cable gland
16. Applications : During Detail Engineering on Owner's approval

3.02.00 DIFFERENTIAL PRESSURE SWITCH

1. Type : i. Piston for high pressure application
ii. Bellow / Diaphragm for low pressure application
2. Sensing element : SS-316.
material All other wetted part SS316
3. Case Material : SS
4. Setter Scale : Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
5. Over range : 150 % of maximum pressure

-
6.	Adjustments	:	a)	Internal Set Point
		:	b)	Differential adjustment
7.	End Connection	:	1/2" NPT bottom/ back connected	
8.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)	
9.	Switch Type	:	Snap acting, shock & vibration proof	
10.	Terminal Block	:	Suitable for full ring lugs	
11.	Enclosure Class	:	IP-65 (Explosion proof for NEC Class-1, Division 1 area)	
12.	Performance	:	a)	Repeat accuracy $\pm 1.0\%$
			b)	Accuracy of Setting Indication of $\pm 1.5\%$
13.	Ambient temperature	:	0 – 50 Deg.C	
14.	Nameplate	:	Tag number, service engraved in SS tag plate	
15.	Accessories	:	a)	Silicon oil/ Fluorolub filled Remote diaphragm seal with SS-316 capillary Diaphragm seals for corrosive/ viscous/ solid bearing or slurry type fluid applications
			b)	Snubbers for pulsating fluid applications
			c)	Siphons for steam and hot water services
			d)	Retention ring and screws for surface mounting
			e)	1/2" NPT 5 Valve SS-316 barstock manifold
			f)	1/2" NPT cable gland
16.	Applications	:	During Detail Engineering on Owner's	

approval

3.03.00 LEVEL SWITCH

3.03.01 FLOAT OPERATED

1. Float material : SS-316
2. Wetted parts : SS-316
3. Float chamber : Stainless steel/Carbon steel, construction welded
4. Float chamber : Side mounted
mounting
5. Fluid connection : Side – Side
6. Fluid connection size : 1" ANSI RF Flange (rubber line, if required)
7. Drain : ½ inch NPT with Plug
8. Pressure rating of chamber : Minimum 1.5 times of design pressure
9. Repeatability : +/- 1.5 mm or better
10. Switch housing : Stainless Steel
11. Switch housing type : IP- 65
12. Type of switch : Snap acting magnetically operated hermetically sealed
13. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
14. Accessories :
 - a) Counter flange, nuts & bolts, suitable gasket etc.
 - b) Steel globe type drain valve
 - c) ½"NPT cable gland

d) Stainless steel nameplate with alpha-numeric engraved for service and tag

15. Application : During Detail Engineering on Owner's approval

3.04.00 FLOW SWITCH

1. Type : Paddle /Piston/Disk
2. Wetted part material : Stainless steel or Hastelloy for acidic application
3. End connection :
 - a) Threaded upto 1" line size with integral Tee
 - b) Flanged for line size > 1 ½"
4. Enclosure material : Stainless Steel
5. Enclosure class : IP 65
6. Switch configuration : 2 SPDT (5A, 240 V AC, 0.5A, 220V DC)
7. Repeatability : 2%
8. Cable connection : ½"NPTF
9. Accessories :
 - a) Tee, Counter flange, nuts & bolts, suitable gasket etc
 - b) ½"NPT cable gland
 - c) Stainless steel nameplate with alpha-numeric engraved for service and tag

3.05.00 RF LEVEL SWITCH

1. Type : RADIO FREQUENCY
Sensing probe
2. Material : SS-316
3. Mounting : Threaded
4. Application : 250°C (Max.)
Temperature
Electronic Controller
5. Input Supply Voltage : 240V AC ±10%, 50 Hz.
6. Relay Output : 2 SPDT (240V AC, 5A)
7. Ambient Temperature : 50 °C
8. Enclosure Protection : IP-66
9. Enclosure Housing : SS
Normal Level
10. Local LED Indication : Power On
Alarm Level
Probe Healthy
11. Switching Repeatability : ±0.5%
Co-axial cable for probe connection to
controller
12. Accessories : SS Tag plate
½" NPT Cable Glands
13. Application : Solid level

3.06.00 CONDUCTIVITY TYPE LEVEL SWITCH

1. Type : Conductivity discrimination
2. Probe MOC : SS-316
3. Mounting : Flanged on external cage
4. Application : 250°C (Max.)
Temperature
5. Test Pressure : Two times rated pressure

6.	Input Supply Voltage	:	240V AC $\pm$ 10%, 50 Hz. Four independent channel with
7.	Input	:	selectable switching threshold for water conductivity
8.	Relay Output	:	2 SPDT (240V AC, 5A)
9.	Ambient Temperature	:	50 °C
10.	Enclosure Protection	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
11.	Enclosure Housing	:	SS HI,LO, HIGH-HIGH, LOW-LOW
12.	Local LED Indication	:	Power Fault
13.	Accessories	:	a) Interconnecting cable from probe to electronics b) Mounting accessories c) External cage d) Washer & Gasket e) ½" NPT Cable Glands f) SS Tag Plate
14.	Application	:	During Detail Engineering on Owner's approval

3.07.00 TEMPERATURE SWITCH

1.	Type	:	Bimetallic or gas filled
2.	Sensing Element Material	:	SS-316
3.	Bulb Material	:	SS-316
4.	Capillary	:	Stainless Steel armored

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5.	Movement Material	:	Stainless Steel
6.	Case material	:	Stainless Steel with neoprene gasket and clear glass where applicable cover conforming to IP-65. (Explosion proof for NEC Class-1, Division 1 area).
7..	Scale	:	Black graduation on white linear scale. Graduation 0-100% with red pointer for set points
8.	Over range Protection	:	120 %
9.	Instrument connection	:	Bottom
10.	Switch configuration	:	Two SPDT (240V, 5A AC/220V, 0.5A DC)
11.	Switch type	:	Snap acting, shock and vibration-proof
12.	Adjustability	:	Internal Set point adjustable over span range
13.	Compensation	:	a) Capillary compensation with invar wire throughout the capillary length b) Case compensation
14.	Performance		
	a) Scale Accuracy	:	±1.0 % of full scale
	b) Repeatability	:	< 0.5 % of full range
	c) Response time	:	Less than 40 seconds with thermowell
15.	Capillary length	:	5 meters (minimum) for local mounting/15 meters for local panel mounting
16.	Nameplate	:	Tag number, service engraved in stainless steel tag plate
17.	Accessories	:	Mounting accessories, ½" NPT cable gland
18.	Applications	:	During Detail Engineering on Owner's

approval

4.00.00 **LOCAL INSTRUMENTS**

4.01.00 PRESSURE GAUGE AND DIFFERENTIAL PRESSURE GAUGE

1. Type	:	Bourdon/Bellows/Diaphragm
2. Sensing & Socket	:	SS-316
3. Movement Material	:	SS-316
4. Case Material	:	Stainless steel. IP-65 (Explosion proof for NEC Class-1, Division 1 area)
5. Dial Size	:	Generally 150 mm
6. Scale	:	Black lettering on white in 270 O arc.
7. Window	:	Shatterproof glass
8. Range Selection	:	Normal process pressure: 50~70 % of range
9. Over-range Protection	:	125% of maximum range by internal stop. External stop at zero
10. Adjustment	:	For Zero adjustment (Micrometer screw external) For Range adjustment (Micrometer screw internal).
11. Element Connection	:	Argon welding
12. Process Connection	:	1/2" NPT (M) Bottom for local, back for panel mounting
13. Performance	:	Accuracy of ± 1.0 % of span or better
14. Operating ambient	:	0 - 50 °C
15. Safety Feature	:	Blow out disc /diaphragm at the back
16. Accessories	:	a) Snubbers for pulsating fluid application.discharge b) Stainless steel Diaphragm seals

- for corrosive/ viscous/ solid bearing or slurry type fluid applications
- c) 3-Way SS316 Gauge cock for pressure gauges
- 5-valve SS316 manifold from
- d) barstock for differential pressure gauge
- e) Siphons for steam and hot water services
17. Nameplate : Tag number, service engraved in stainless steel tag plate

4.02.00 LEVEL INDICATOR (FLOAT & BOARD TYPE)

1. Type : Float and Board
2. Float Material : SS-316
3. Float Cable : SS-316
4. Indicator Assembly : Epoxy painted Aluminium
5. Guide wire spring assembly : SS-316 (2 Nos.)
6. Guide Wire Anchor : SS-316
Anodized Aluminium with engraved marking (Minimum graduation 10mm),
7. Scale Board :
mounting brackets and suitable hardware required as per tank height
8. Elbow Assembly : Anodized Aluminium
9. Flanges : RF , ANSI 150 , SS (3 Nos.)
10. Accuracy : ± 10 mm or better
11. Accessories : All mounting accessories including counter flange, nuts & bolts, suitable

gasket etc. as applicable, SS Tag plate

4.03.00 GAUGE GLASS

1. Type : Reflex /Transparent
2. Material :
Glass : Toughened borosilicate resistant to thermal shock
Body Material : ~~Carbon Steel~~ Stainless Steel
Enclosure : IP-65 (Explosion proof for NEC Class-1, Division 1 area)
3. Integral cocks & valves/Fittings :
i. SS 316
Rubber lined corrosion resistant
4. :
ii. stainless steel (for DM/RO service)
5. Vessel Connection : ANSI Flanged SS316
6. Accessories :
i. Integral cocks
ii. Drain Valves
Companion Flanges, Bolts, nuts, gaskets, SS Tag plate
iii.
Illuminating lamps, Mica shield as required
iv.
v. Calibrated scale
7. Pressure rating : Twice the maximum working pressure
8. Temperature : 300 ° C
For larger lengths (greater than 1200mm), additional gauge glasses
9. Other details : shall be provided with minimum of 50 mm overlap.

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- 4.04.00 SLIGHT GLASS
1. Type : Flap-type.
 2. End connection : Screwed / Flanged
 3. Material
 - a) Body : SS- 304
 - b) Cover plate : SS- 304
 - c) Indicator : SS- 316
 4. Sight Glass : Toughened Borosilicate
 5. Gasket : Neoprene
 6. Bolts & Nuts : High tensile steel.
 7. Hydraulic Test Pressure : 1.5 times maximum working pressure
 8. Accessories : Companion Flanges, Bolts, nuts, gaskets as required, SS Tag plate.
- 4.05.00 ROTAMETER
1. Type : ON-LINE for line upto and including 50 mm NB.
: Borosilicate BY-PASS for line size above 50 NB
 2. Metering tube : Toughened Borosilicate
 3. Float : SS-316
 4. End fittings : SS-316
 5. Packing material : Teflon / PTFE
 6. Casing : Stainless Steel
 7. Gland Rings : Stainless Steel
/Followers/ Other
wetted parts
 8. Orifice Plate : Stainless Steel (for bypass type)
 9. Operating Temperature : 0-50 Deg. c

10. Test Pressure	:	200% of maximum operating pressure
11. Scale	:	250 mm nominal length
12. Graduation	:	Direct reading
13. Process Connection	:	Flanged (RF) to line size as per ANSI standards (150#)
14. Tapping	:	D & D/2
15. Accuracy	:	+/- 2% of full scale reading
16. Reproducibility	:	Within 0.5% of instantaneous reading
17. Accessories	:	SS Tag Plate, orifice plate

5.00.00 **TEMPERATURE ELEMENTS & ACCESSORIES**

5.01.00 RESISTANCE TEMPERATURE DETECTOR

1. Type	:	Platinum (Duplex), Ungrounded
2. Platinum (Duplex), Ungrounded	:	100 ohm at 0 °C
3. Base	:	Wound on ceramic (anti-inductive)
4. Wiring	:	3 Wire
5. Protecting Tube		
a) O.D.	:	6 mm
b) Material	:	SS-316, Seamless
c) Filling	:	Magnesium oxide (Purity above 99.4%).
6. Response time	:	a) 15 sec. (bare). b) 30 sec. (with thermowell)
7. Calibration	:	DIN 43760
8. Accuracy	:	± 0.5%
9. Head		
a) Type	:	IP-65 universal screwed type

- b) Material : Stainless Steel
- c) Terminal : Nickel plated Brass-screw type / silver
blocks : plated
- d) Cable : ½" NPT gland and grommet
connection
- e) Others : Terminal head cover with SS chain and
suitable gasket.
- Head of TE to be provided with sufficient
space and arrangement to mount head
mounted temperature transmitter (as
applicable).
- Adjustable nipple-union-nipple
[1/2" Sch 80 X ½" NPT] with
thermowell connection
10. Accessories : a)
- b) Compression fittings/unions
- Flanges etc. (for flanged
connections only)
- c)
- Thermowell (As specified
below)
- d)
11. Thermowell : ½" NPT (M) or 150 RF Flanged
connection
- Tag number, service engraved in
12. Nameplate : stainless steel tag plate

Note: The specifications for RTDs of winding/ bearing of motor/pump, can be as per their manufacturer standards. The manufacturer shall submit the adequate supporting documents for establishing their standard practice. However, the type of RTD shall be Pt-100.

5.02.00 THERMOCOUPLES

1. Type :
 - a) 16 SWG wire of Chromel Alumel) (Type-K)
 - b) Duplex
 - c) Ungrounded
2. Protecting Tube
 - a) O.D. : 6 mm
 - b) Material : SS-316, Seamless
 - c) Filling : Magnesium oxide (Purity above 99.4%).
3. Response time :
 - a) < 20 seconds for measurement
 - b) < 10 seconds for control
4. Accuracy : $\pm 1.1^{\circ}\text{C}$ up to 300°C & 0.4% of measured temperature range above 300°C
5. Head
 - a) Type : IP-65 universal screwed type
 - b) Material : Stainless Steel
 - c) Terminal blocks : Nickel plated Brass-screw type / silver plated
 - d) Cable connection : $\frac{1}{2}$ " NPT gland and grommet
 - e) Others : Terminal head cover with SS chain and suitable gasket.

Head of TE to be provided with sufficient space and arrangement to mount head mounted temperature transmitter (as applicable).

7. Accessories :
 - a) Adjustable nipple-union-nipple [1/2" Sch 80 X 1/2" NPT] with thermowell connection
 - b) Compression fittings/unions
 - c) Flanges etc. (for flanged connections only)
 - d) Thermowell (As specified below)
8. Thermowell connection : 1/2" NPT (M) or 150 RF Flanged
9. Nameplate : Tag number, service engraved in stainless steel tag plate

5.03.00 TEMPERATURE GAUGE

1. Type : Expansion type (Liquid filled system)
2. Sensing Element : Bourdon – SS-316
3. Bulb and Capillary : SS-316
4. Capillary Tubing : Inner sheath - solid drawn Material
copper tube
Outer sheath - PVC tube
5. Movement Materials : Stainless Steel / Direct Bourdon tip connection to pointer spindle
6. Case Material : Stainless Steel stove enameled, black finish, threaded bezel ring, clear glass

- cover conforming to IP 65.
7. Dial size : 150 mm
 8. Scale : Black lettering on white background in 270 Deg.C arc
 9. Over range protection : 125 percent of FSD
 10. Capillary Glandng : 1/2" NPT(M) x compression fitting (SS) to suit capillary
 11. Instrument Connection : Bottom connection for local mounting, back connection for panel mounting
 12. Process Connection : 1/2" NPT (M) or 150 RF Flanged
 13. Extension Neck Length : 50 mm
 14. Compensation : a) Capillary compensation
 15. : b) Case compensation
 16. Performance : a) Accuracy : + /- 1.0 percent of full scale Deflection
 - : b) Repeatability : Less than 0.5 percent of full range
 - : c) Response time: 15 seconds (max.).
 17. Capillary length : 3.0 meters (local) / 15.0 metres (local panel)
 18. Other features : Shatter proof glass
 19. Nameplate : Tag number, service engraved in stainless steel tag plate
 20. Accessories : SS316 Thermowell

5.04.00 THERMOWELL

1. Material : SS-316
2. Manufacture : Drilled from bar stock, Hex Head, Tapered design (As per ASME PTC 19.3)

3. Process connection : M33x2
4. Certification : Not applicable
5. Bore concentricity : +5% of wall thickness
6. Identification mark : Tag number punched on head
7. Surface treatment : Polish after machining
8. Element connection : ½" NPT (M) or 150 RF Flanged
9. Head : Hex
10. Length of the hex head : 31.75 mm (min.)
11. Accessories : SS Plug and chain for test thermo wells
SS Nameplate, Flange with companion
flange & all required accessories for
flanged connections.

Note: Wake frequency calculations shall be furnished for all thermowells for approval.

Thermowells shall be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid.

5.05.00 METAL TEMPERATURE THERMOCOUPLE

1. Measuring medium : Metal temperature
2. Type : Chromel Alumel (Type-K)
Duplex, Ungrounded
3. Insulation : Mineral Insulation Magnesium Oxide
4. Wire gauge : 16 AWG
5. Protective sheath : SS
6. Protective sheath :
diameter 8 mm O.D.
7. Characteristics : Special limits of error as in ANSI
thermocouple MC 96.01
8. Accessories : ½" BSP SS sliding end connector, weld
pad, clamps of heat resistant steel

1. Type : Hydrometer Type
2. Mounting : On line
3. Accuracy : +/- 2% of range
4. Scale : Black letter on white scale
5. End connection : PVC flange

9.06.00 DENSITY/ CONCENTRATION METER

1. Wetted Part : Stainless Steel
2. Enclosure : Stainless Steel (IP-65)
3. Power Supply : 24 V DC
4. Output signal : 4-20 mA DC (isolated) into 600 ohms
5. Accuracy : ±0.001 g/cc
6. Indication : LCD display
7. Temp. Compensation : Integral
8. Accessories : Mounting hardware, integral amplifier
(if required), cable glands, tag plate
etc.

10.00.00 SOLENOID VALVES

1. Operating Principle : Electromagnetic (noiseless)
2. Coil voltage rating : 240 V AC /24 V DC (as required)
3. Ways : 2/3/4 way
4. Port size : 1/4" NPT all ports
5. Body : SS bar stock
- Trim : SS-316
6. Duty : Suitable for continuous energization
7. Sealing : Airtight and leak proof
8. Ambient Temperature : 0 - 50 ° C

9.	Fluid Temperature	:	0-150 ° C (approx.)
10.	Coil Enclosure	:	Stainless Steel
11.	Insulation	:	Class-H
12.	Coil Casing	:	IP-65 (Explosion proof for NEC Class-1, Division-1 area)
13.	Mounting	:	On pipe or on panel
14.	Cable Connection	:	½" NPT
15.	Accessories	:	Cable glands, SS Tag plate

NOTES :-

1. IMPULSE PIPES SHALL BE OF SEAMLESS AND ANNEALED CONFORMING TO ANSI B36.10 IN LINE WITH THE MAIN PIPE MATERIAL.
2. PIPE FITTINGS SHALL BE OF FORGED MATERIAL CONFORMING TO ANSI B16.11-1991.
3. SNUBBER SHALL BE PROVIDED FOR PUMP DISCHARGE PRESS MEASUREMENTS.
4. IN CASE OF STEAM SERVICE SYPHON SHALL BE MADE BY BENDING THE TUBE OR PIPE.
5. VALVE MANIFOLDS & SNUBBER SHALL BE OF FORGED SS-316.
6. FOR SEA WATER APPLICATION SS316L FITTINGS TO BE PROVIDED.
7. 25NB x 15NB WELDED REDUCER SHALL BE USED FOR ROOT VALVE OF 25NB SIZE.
8. ROOT VALVES SHALL BE AS FOLLOWS:
 - i) FOR PRESS <40 ATA & TEMP <425 DEG C, ONE(1) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
 - ii) FOR PRESS >40 ATA & TEMP <425 DEG C, TWO(2) NO. 15Nb, ROOT VALVE OF SUITABLE CLASS SHALL BE USED.
 - iii) FOR PRESS >40 ATA & TEMP >425 DEG C, TWO(2) NO. 25Nb, ROOT VALVES OF SUITABLE CLASS SHALL BE USED.
9. HORIZONTAL PIPE RUNS SHOULD HAVE A SLOPE IN THE DIRECTION  SHOWN OF 1:20 AS MINIMUM.
10. FOR PRESSURISED STEAM & WATER SERVICE THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED BELOW THE TAPPING POINT. FOR VACUUM/AIR/GAS SERVICE, THE ASSOCIATED INSTRUMENT SHOULD BE MOUNTED ABOVE THE TAPPING POINT.
11. SEAMLESS PIPE/SEAMLESS TUBE/CAPILLARY LENGTH SHALL BE SUCH THAT THE GAUGES/TRANSMITTERS/SWITCHES ARE MOUNTED IN ACCESSIBLE AREA.

LEGEND :-

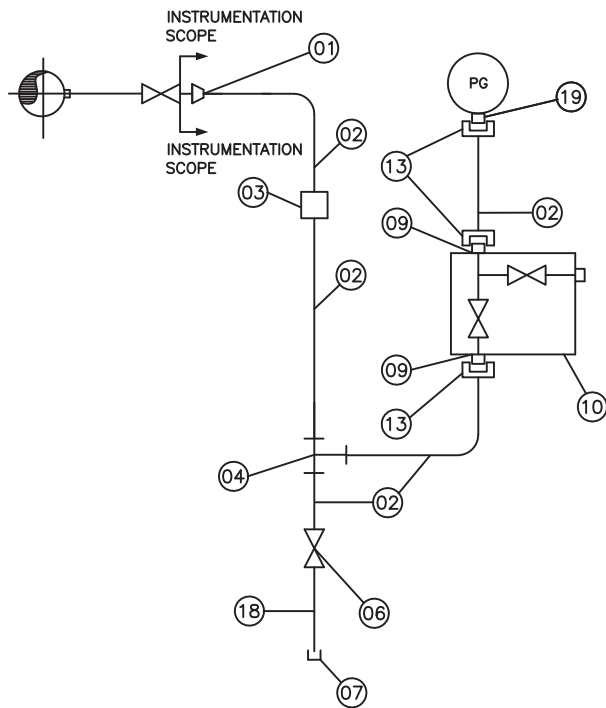
A/R - AS REQUIRED

NPTF - NATIONAL PIPE THREAD FEMALE

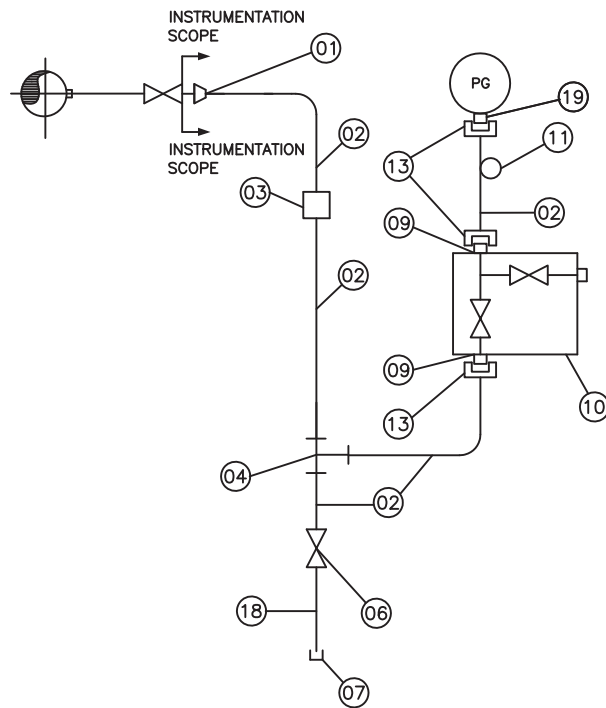
NPTM - NATIONAL PIPE THREAD MALE

SW - SOCKET WELD

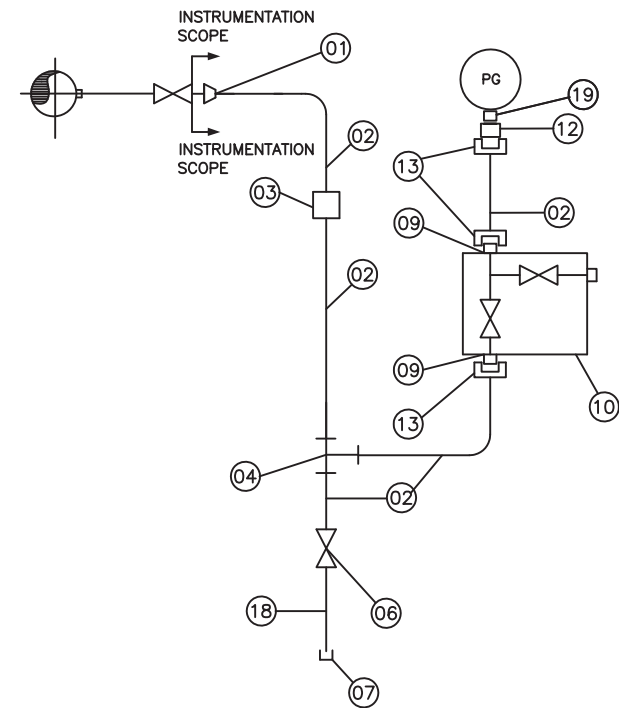
	TITLE :-			DRG. NO.	PE-DG-999-145-IXXX		
	INSTRUMENT INSTALLATION DIAGRAM			REV. NO.	00	DATE	05.11.13
	NOTES			SHT	2	OF	9



WATER SERVICE

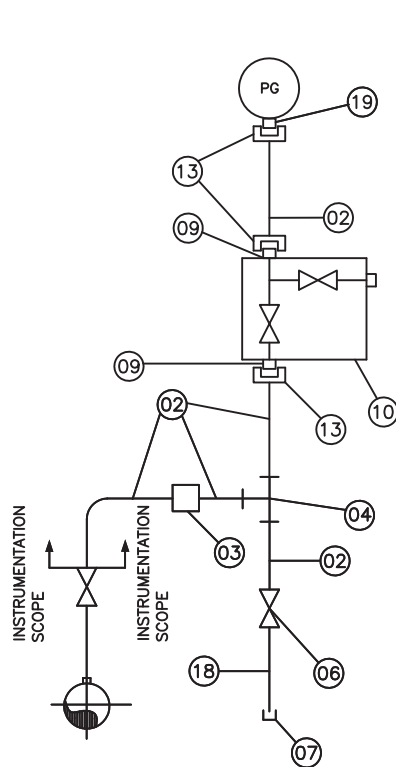


STEAM SERVICE

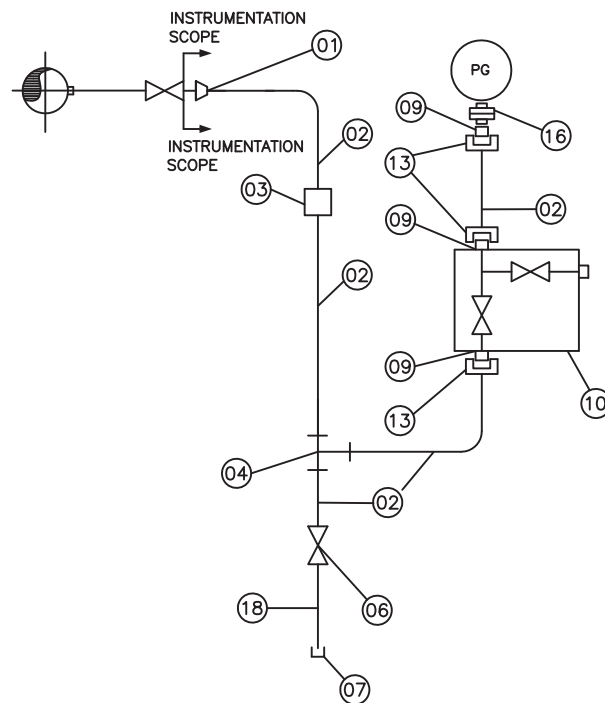


PULSATING SERVICE

	TITLE :-			DRG. NO.		PE-DG-999-145-IXXX		
	INSTRUMENT INSTALLATION DIAGRAM			REV. NO.		00	DATE	05.11.13
	PRESSURE GAUGES			SHT		3	OF	9



AIR SERVICE



WITH CHEMICAL SEAL
(FOR VISCOUS NON-CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02	02	02	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	SS316	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01
19	ADAPTER – M TO F	SS316	M20X1.5M X 1/2" NPTF	01	01	01	01	00



TITLE :-

INSTRUMENT INSTALLATION DIAGRAM

PRESSURE GAUGES

DRG. NO.

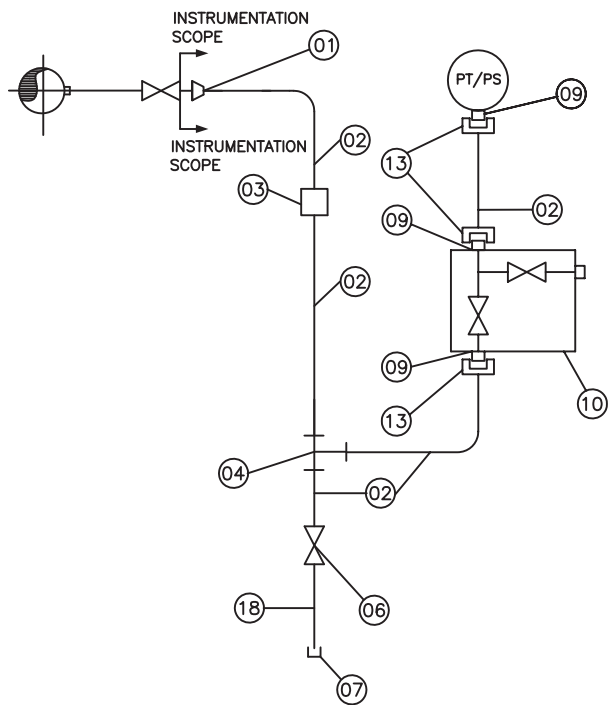
PE-DG-999-145-IXXX

REV. NO.

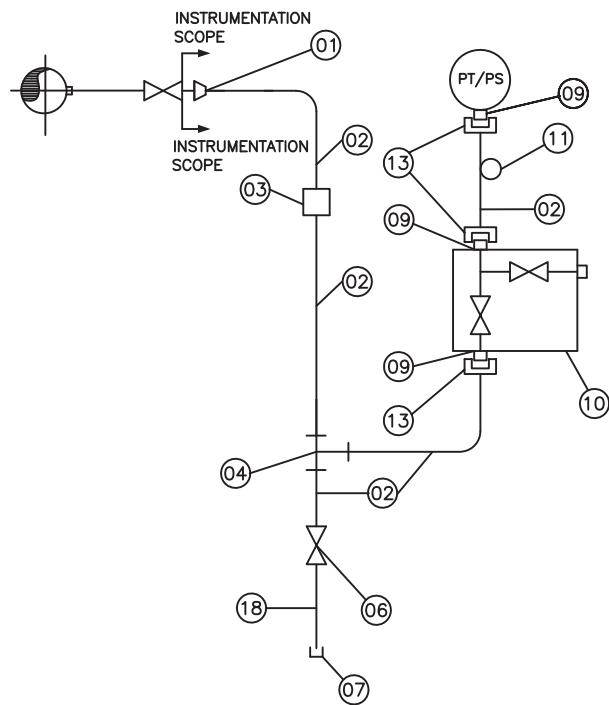
00 DATE 05.11.13

SHT

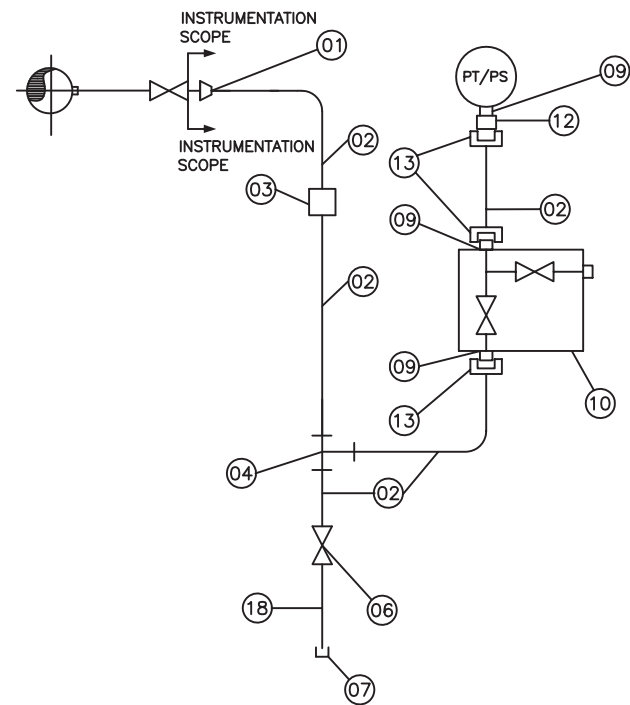
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WATER SERVICE

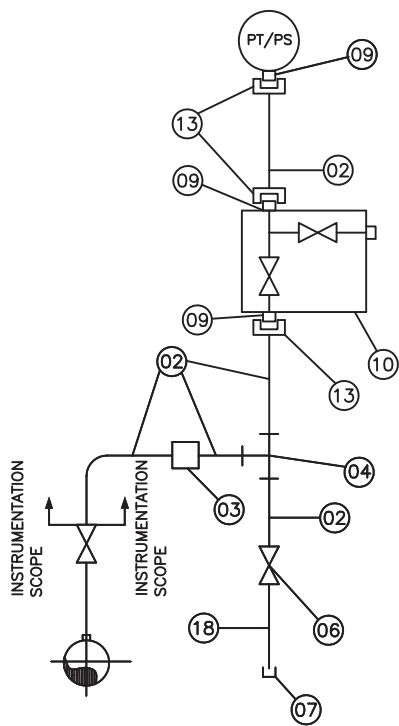


STEAM SERVICE

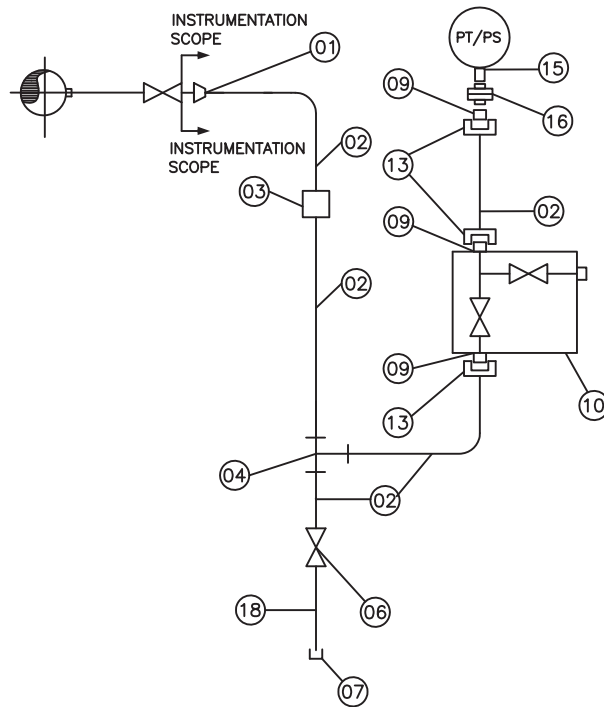


PULSATING SERVICE

	TITLE :-			DRG. NO.		PE-DG-999-145-IXXX		
	INSTRUMENT INSTALLATION DIAGRAM			REV. NO.		00	DATE	05.11.13
	PRESSURE SWITCHES/TRANSMITTERS			SHT		5	OF	9



AIR SERVICE



WITH CHEMICAL SEAL
(FOR VISCOUS NON-CORROSIVE FLUID ONLY)

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY				
				WATER	STEAM	PULSATING	AIR	CHEMICAL
01	REDUCER (IF APPLICABLE)	SAME AS MAIN PIPE	1" X 1/2"SW	01	01	01	00	01
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R	A/R	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R	A/R	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	01	01	01	01	01
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	01	01	01	01	01
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	03	03	03	03	03
10	TWO VALVE 3 WAY MANIFOLD WITH VENT PLUG	SS316	1/2" NPTF	01	01	01	01	01
11	SYPHON	CS	1/2" SW	00	01	00	00	00
12	SNUBBER	SS316	M20X1.5M X M20X1.5F	00	00	01	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00	00	00	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00	00	00	01
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	03	03	03	03	03
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	01	01	01	01	01



TITLE :-

INSTRUMENT INSTALLATION DIAGRAM

PRESSURE SWITCHES/TRANSMITTERS

DRG. NO.

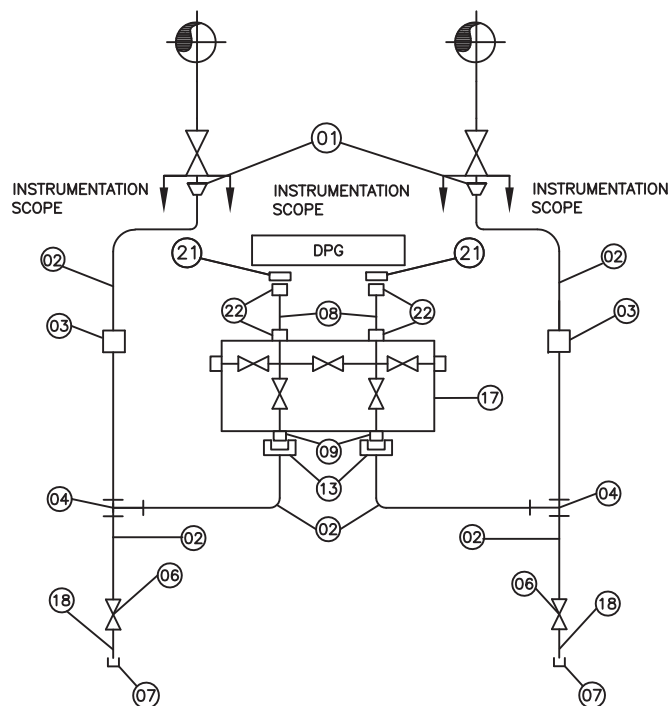
PE-DG-999-145-IXXX

REV. NO.

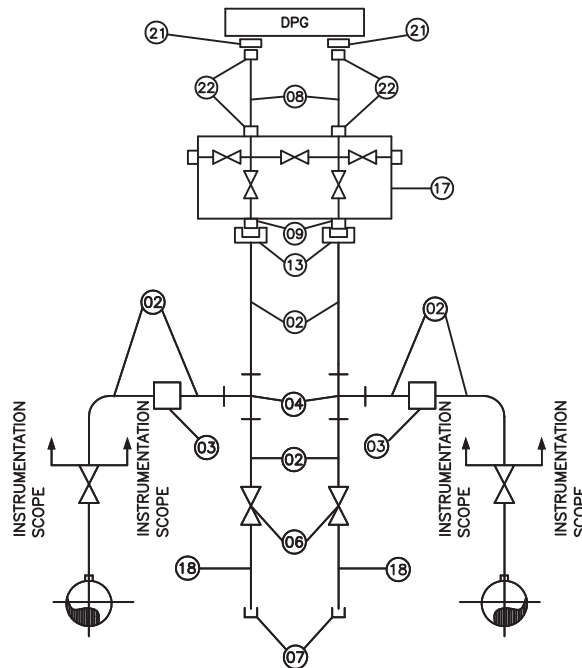
00 DATE 05.11.13

SHT

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WATER SERVICE



AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SAME AS MAIN PIPE	1/2" SW	02	02
06	FORGED GLOBE VALVE	SAME AS MAIN PIPE	1/2" SW	02	02
07	CAP	SAME AS MAIN PIPE	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTOR – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	02	02

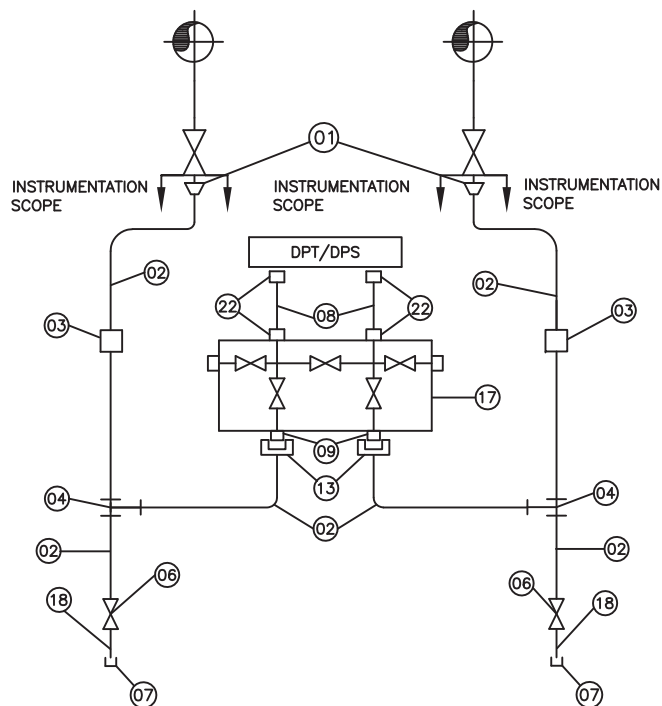


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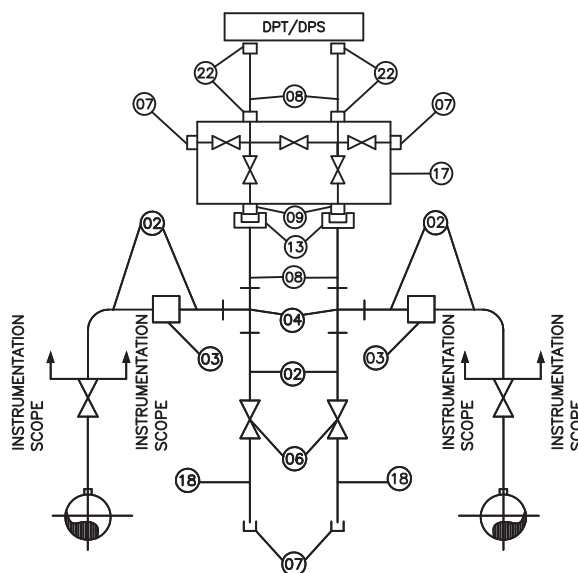
INSTRUMENT INSTALLATION DIAGRAM

DIFFERENTIAL PRESSURE GAUGES

DRG. NO.	PE-DG-999-145-IXXX			
REV. NO.	00	DATE	05.11.13	
SHT	7	OF	9	



WATER SERVICE



AIR SERVICE

ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				WATER	AIR
01	REDUCER (IF APPLICABLE)	SS316	1" X 1/2"SW	02	00
02	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
03	FORGED COUPLING	SAME AS MAIN PIPE	1/2" SW	A/R	A/R
04	FORGED TEE	SS316	1/2" SW	02	02
06	FORGED GLOBE VALVE	SS316	1/2" SW	02	02
07	CAP	CS	1/2" NPTF	02	02
08	SEAMLESS TUBE	SS316	1/2" OD	A/R	A/R
09	ADAPTER – M TO M	SS316	M20X1.5M X 1/2" NPTM	02	02
17	FIVE VALVE MANIFOLD WITH DRAIN PLUG	SS316	1/2" NPTF	01	01
16	CHEMICAL SEAL	SS316	1/2" NPTF X 1/2" NPTF	00	00
15	CONNECTOR – M TO M	SS316	1/2" NPTM X 1/2" NPTM	00	00
13	NUT & TAIL PIECE WITH ANNEALED COPPER/SS304 WASHER	SS316	NUT SIZE : M20 X 1.5 WITH 100MM TAIL	02	02
18	NIPPLE	SAME AS MAIN PIPE	1/2" NPTM X 1/2" SW	02	02
21	CONNECTOR – F TO F	SS316	1/2" NPTF X 1/2" NPTF	00	00
22	TUBE FITTING DFDC	SS316	1/2" NPTM X 1/2"OD TUBE	04	04



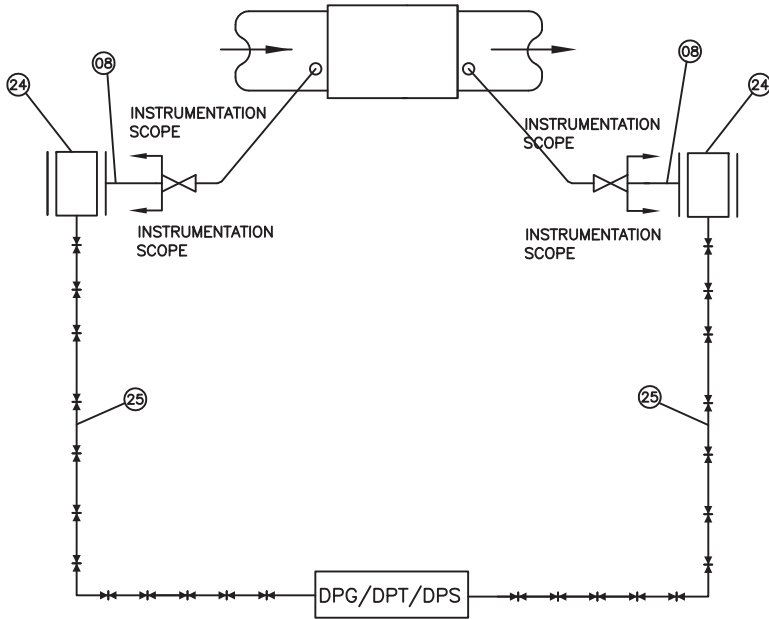
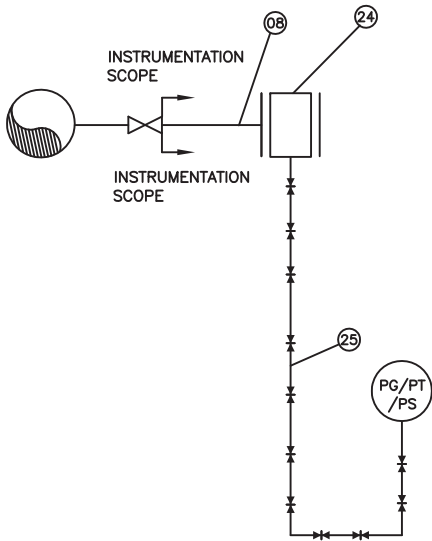
TITLE :-

INSTRUMENT INSTALLATION DIAGRAM

DIFFERENTIAL PRESSURE SWITCHES/TRANSMITTERS

DRG. NO.	PE-DG-999-145-IXXX			
REV. NO.	00	DATE	05.11.13	
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ITEM NO	ITEM/DESCRIPTION	MATERIAL	SIZE	QTY	
				PG/PS/PT	DPG/DPS/DPT
24	FLANGE SUPPLIED WITH PG/PS PT/DPG/DPS/DPT TO SUIT 1/2" OR 1" NB PIPE	SAME AS MAIN PIPE	1/2" SW	01	02
08	SEAMLESS PIPE	SAME AS MAIN PIPE	1/2"	A/R	A/R
25	SS ARMORED CAPILLARY TUBE (MINIMUM 5M IN LENGTH)	SS316	—	A/R	A/R



TITLE :-
INSTRUMENT INSTALLATION DIAGRAM
 WITH CAPILLARY TUBES

DRG. NO.	PE-DG-999-145-IXXX		
REV. NO.	00	DATE	05.11.13
SHT	9	OF	9



Technical specification for
CONTROL & INSTRUMENTATION

1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

Instrumentation Quality Plan



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE SWITCH

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	V	V	
	1.1 MODEL NO/TAG NO						
	1.2 RANGE						
	1.3 END CONN						
	1.4 NO. OF CONTACT						
2	CALIBRATION			P	V	V	
	2.1 REPEATABILITY						
	2.2 SET POINT ADJUSTMENT						
	2.3 DIFFERENTIAL						
3	OVER PR & LEAK TEST				P	V	V
4	ELECT. INSULATION/HV TEST	ONE		P	V	V	
5	REVIEW OF TC FOR MATERIALS OF	FOR LOT		V	V	V	
	5.1 SENSOR						
	5.2 MOVEMENT						
	5.3 PROCESS CONNECTION						
	5.4 HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST		V	V	V	
7	REVIEW OF TC OF MICROSWITCH	FOR LOT		V	V	V	

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and the same alongwith test certificates to be verified by BHEL



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR TRANSMITTER

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECKS FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	VISUAL.						
	MODEL/TAG No						
2	PROCESS CONNECTION			P	W	V	
3	ACCURACY			P	W	V	
4	REPEATABILITY			P	W	V	
5	HYSTERESIS			P	W	V	
6	EFFECT OF TEMP VARIATION ON ACCURACY			P	W	V	
7	SPAN / ZERO ADJUSTMENT	ONE / TYPE		P	W	V	
8	EFFECT OF SUPPLY VOLTAGE VARIATION			P	W	V	
9	EFFECT OF LOADING (500 OHM METERS)			P	W	V	
10	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
11	BURN-IN TEST	ONE / TYPE		P	W	V	
12	DEGREE OF PROTECTION			P	W	V	
13	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW		V	V	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- When material correlation are not available manufacturer's compliance to be provided.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR PRESSURE & DP GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	SENSOR TYPE						
	DIAL SIZE						
	MODEL NO/TAG NO						
	RANGE/SCALE						
	SWITCH CONTACT RATING & NOS.						
	END CONNECTION						
2	CALIBRATION	ONE		P	W	V	
	ACCURACY						
	REPEATABILITY						
	SET POINT ADJUSTMENT						
3	OVER PRESSURE & LEAK TEST	FOR LOT	P	W	V		
4	OPERATION OF PRESSURE. RELIEF DEVICE		P	W	V		
5	REVIEW OF TC FOR		V	V	V		
	MATERIALS OF SENSOR						
	MOVEMENT						
	PROCESS CONNECTION						
	HOUSING						
6	REVIEW OF TC FOR DEGREE OF PROTECTION	TYPE TEST	V	V	V		
7	ACCESSORIES AS APPLICABLE	SEE NOTE-1 BELOW	V	V	V		

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- When material correlation is not available, MFR's compliance to be provided
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR LEVEL GAUGE

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS / DRWGS	P	W	V	
	TYPE						
	MODEL/ TAG NO.						
	DAIL SIZE						
	RANGE/SCALE						
	END CONNECTION						
2	DIMENSIONS, PROCESS CONNECTION	ONE / LOT		P	W	V	
3	ACCURACY			P	W	V	
4	MATERIAL TC FOR			P	V	V	
	BODY ISO.						
	VALVE						
	GAUGE GLASS						
5	HYD. TEST	SEE NOTE-1 BELOW		P	W	V	
6	ACCESSORIES AS APPLICABLE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



STANDARD CHECK LIST FOR C&I INSTRUMENTS (for Maux Pkgs)

CHECK LIST FOR ANNUNCIATORS

Sl. No.	Test / Checks	Quantum of check	Reference Doc. / Acceptance Norms	Agency **			Remarks
				M	C	B	
1	CHECK FOR	SEE NOTE-1 BELOW	APPROVED SPEC./ DATA SHEETS	P	W	V	
	TYPE/ MODEL						
	DIMENSIONS OF HARDWARE						
	MODULARITY						
	SEQUENCE						
	FACIA DETAILS						
2	FUNCTIONAL TEST	100%		P	W	V	
3	IMMUNE TO STEP VARIATIONS IN THE POWER SUPPLY	SEE NOTE-1 BELOW		P	W	V	
4	DEGREE OF PROTECTION FOR ENCLOSURE	TYPE TEST		P	W	V	
5	I/R CHECK	SEE NOTE-1 BELOW		P	W	V	
6	RESPONSE			P	W	V	

Legend :

** M = Manufacturer / Sub-contractor, C = Contractor / Nominated Inspecting Agency, B = BHEL, P = Perform, W = Witness, V = Verification

Note :

- Quantum of check shall be as below :
100 % - By Manufacturer
- Manufacturer to maintain calibrated instrument having better accuracy than the item under test. Inspecting engineer shall check the same.
- Manufacturer to carry out ROUTINE TEST on 100 %.
- Contractor to provide compliance certificate for tests/checks verified by contractor and submit the same alongwith test certificates to be verified by BHEL.



Technical specification for
CONTROL & INSTRUMENTATION
 1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

LCP and JUNCTION BOXES SPECIFICATION

- 1.00.00 **GENERAL REQUIREMENT**
- 1.01.00 ENCLOSURES FOR INSTRUMENTS AND OTHER EQUIPMENT
- 1.01.01 All panels, cabinets, distribution boxes, junction boxes, terminal boxes and all other field mounted equipment / enclosures shall have suitable environmental protection as detailed in Section-I of this volume of the specification.
- 1.02.00 SURFACE PREPARATION & PAINTING
- 1.02.01 All sheet metal panel/ desk exterior steel surfaces shall be sand blasted, ground smooth and painted as specified below.
- 1.02.02 Suitable filler shall be applied to all pits, blemishes and voids in the surface. The filler shall be sanded so that surfaces are level and flat; corners are smooth and even. Exposed raw metal edges shall be ground burr-free. The entire surface shall be blast clean to remove rust and scale and all other residue due to the fabrication operation. Oil, grease and salts etc. shall be removed from the panels by one or more solvent cleaning methods prior to blasting.
- 1.02.03 Two spray coats of inhibitive epoxy primer surfacer shall be applied to all exterior and interior surfaces, each coat of primer surfacer shall be of dry film thickness of 1.5 mil. A minimum of two spray coats of final finish color (Catalyzed epoxy or polyurethane) shall be applied to all surface of dry film thickness 2.0 Mil. The finish colors for exterior and interior surfaces shall conform to the following shades:
- Exterior – Opaline green shade 275 of IS: 5 or equivalent international code..
 - Interior - Brilliant White.
- 1.02.04 Paint films, which show sags, cheeks, blisters, teardrops, fat edges or other painting imperfections, shall not be acceptable.
- 1.03.00 WIRING
- 1.03.01 All spare contacts of relays, switches and push buttons shall be wired up to the terminal blocks. All intercommunications between sections of panels/desks shall be furnished.
- 1.03.02 Each wire shall be identified at both ends with wire designation as per approved wiring diagram. Heat shrinkable type ferrules with indelible computerized ink print shall be used with cross- identification.
- 1.03.03 All wire termination shall be made with insulated sleeve and crimping type lugs. Wire shall not be spliced or tapped between terminals. Open-ended terminal lugs will not be accepted. Wires shall not be looped around the terminal screws or studs.

- 1.03.04 Internal wiring should be terminated uniformly on one side of the terminal block leaving the other side available for termination of outgoing cables. Internal wiring shall be grouped so that all outgoing wiring to each particular remote location is terminated on adjacent terminal blocks. Interior wiring and jumperings shall be arranged so that external connections can be made from internal side of terminal blocks. Common connections shall be limited to two (2) wires per terminal.
- 1.03.05 Wiring shall be arranged to ensure free access to all instrument or devices for maintenance. No wire shall be routed across the face or rear of any device in a manner, which will impede the opening of covers or obstruct access to leads, terminals or devices
- 1.03.06 Wires shall be dressed and run in trays or troughs with clamp-on type covers. Wirings may be neatly bunched in groups by non-metallic cleats or bands. Each group shall be adequately supported along its run to prevent sagging or strain on termination.
- 1.03.07 Shield wires shall be terminated on separate terminal blocks. Common connections shall be limited to two wires per terminal. Signal circuit shields shall be grounded at the power supply end only or as recommended by manufacturer.
- 1.03.08 All low level signal cables shall be separately bundled to from control cable and maintained at 300 mm minimum spacing from control bundles.
- 1.03.09 Panel internal wiring shall follow distinct color-coding to segregate different voltage levels viz. 24V DC, 48V, 110V AC, 240V AC, 220V DC etc.
- 1.03.10 Thermocouple lead wires, analyzer measuring lead wires, or any other lead wires carrying measuring signal of the order of low milli volt or micro volt shall be electrically and physically isolated from other AC and DC wiring. Shielded wires used in such cases for panel internal wiring shall be continuous and ungrounded with the shield terminated individually and separately in panel terminal block.
- 1.03.11 Wiring to door mounted devices shall be provided with multi-strand wires of (49 strands minimum) adequate loop lengths of hinge-wire so that multiple door openings will not cause fatigue failure of the conductor.
- 1.03.12 Internal wiring in factory pre-wired electronic systems cabinets may be installed according to the Contractor's standard wire size, insulation, and method of termination on internal equipment. Insulation for all wiring, including circuit board wiring, back panel wiring, power supply wiring and interconnecting cables between devices shall pass the vertical flame test per IPCEAS-1981. Identification of conductors may be done by insulation color-coding identified on drawings or by printed wiring lists.

- 1.04.00 TERMINAL BLOCKS
- 1.04.01 All terminal blocks shall be rail mounted/ post mounted type, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 Deg C. The terminal blocks in field mounted junction boxes, instrument enclosures racks etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room termination/ marshalling cubicles shall be suitable for post mounted cage clamp connection at the field input end. The exact type of terminal blocks to be provided by Bidder shall be subject to Owner.
- 1.04.02 All terminal blocks shall be provided complete with all required accessories including assembly rail, locking pin and section, end brackets, small partitions, transparent covers, support brackets, distance sleeves, warning level, marking etc. For RTDs ring - tong type lugs shall be used at Junction Boxes.
- 1.04.03 The characteristics of the terminal blocks shall be as follows.
- i) High contact force, independent of conductor cross-section and large contact surface area.
 - ii) Integrated self-loosening protection to avoid shifting of contact surface that may allow contamination of connection point.
 - iii) Inspection and maintenance free (resistant to thermal aging and vibration)
 - iv) Low and constant voltage drop
- 1.04.04 The insulation of the terminal blocks shall be of suitable thermoplastic material.
- 1.04.05 The spacing between Terminal blocks channels in panels and cubicles shall be adequate for routing the cable troughs and to allow adequate free workspace for termination and removal of wires. The terminal blocks shall be arranged with atleast 100 mm clearance between two sets of terminal blocks and junction box walls.
- 1.04.06 Signals of different voltage levels shall be clearly segregated by providing separate rows to each type of signal and by using terminal blocks of different color for each type of signal and by providing barrier strips between them.
- 1.04.07 Terminal blocks shall be provided with white marking strips / self-adhesive marker cards and where permitted by the safety codes and standards, shall be without covers. Power terminals and high voltage (above 48 volts) terminals shall have protection covers. All terminals shall be provided with permanent terminal identification numbers on both sides.
- 1.04.08 At least 20% spare unused terminals shall be provided on each terminal block for circuit modifications and for termination of all conductors in a multi-conductor control cable.

- 1.04.09 The bottom of the terminal block shall be at least 200 mm above the cable gland for bottom entry type panels.
- 1.04.10 For extending 24 V DC supply to panels, the size of the terminals shall be decided based on voltage drop and not based on current.
- 1.04.11 Other requirements of the terminal blocks are as follows:
- i) The last terminal in a rail-mounted assembly shall be closed with an end plate and end bracket.
 - ii) For visual and electrical separation of terminal groups, partition plates shall be provided, which can be push fitted after forming an assembly.
 - iii) Design shall permit testing of incoming and outgoing signals by using suitable test plug and socket without disconnecting the cable connections.
 - iv) It shall be possible to use jumper plugs through the above test plug socket to connect adjacent terminals. Adequate number of short circuit jumper plugs shall be provided for the purpose.
 - v) Where more than one connection to a terminal block is required, two tier terminals shall be used.
- 1.05.00 GROUNDING
- 1.05.01 Separate Protective and Electronic system ground as required shall be provided.
- 1.05.02 All panels, desks, cabinets shall be provided with a continuous bare copper ground bus (Frame ground), bolted to the panel structure at bottom on both sides and effectively ground the entire structure. The bolts shall face inside of panels.
- 1.05.03 For electronic system cabinets the electronic system ground bus (Electronic ground) shall be similar but insulated from the cabinet and shall be separately connected to the system ground. The same ground may be used to earth the shield of shielded signal cables, otherwise a separate ground bus shall be provided for connecting the signal cable shields. Cable shields shall be grounded at the panel end only and shall never be left open. The electronic ground between panels of a shipping section shall be firmly looped.
- 2.00.00 **CONTROL DESKS & PANELS**
- 2.01.00 GENERAL
- 2.01.01 All control desk, panels etc. shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, utility receptacles, grounding, ventilation, space heating, anti-vibration pads, internal piping &

- accessories as required for completeness of the system.
- 2.01.02 The design shall conform to the EN ISO 11064 (Ergonomical design of Control Room), Part 1, 2 and 3.
- 2.01.03 The exact dimensions, material, construction details, grounding, general arrangement etc. shall be as per actual requirement and shall be finalized during detail engineering and subjected to Owner's approval.
- 2.01.04 Incoming power supply feeders shall be duplicated. Alarm shall be provided for failure of a power supply feed.
- 2.01.05 For Control desk/ panel mounted instruments/ devices etc. which are to be powered from UPS, all required conversion of interface equipments/ accessories to make such devices compatible with UPS supply shall be provided. All necessary hardware like input switches/ fuse unit for each feeder as well as switch fuse unit for each instrument/ device on the power supply line shall be provided. From UPS redundant feeders shall be provided with suitably rated MCB and provision of fast auto changeover of UPS feeders.
- 2.01.06 Crating of the panels and desks shall be suitable for protection against shock, vibration, inappropriate handling and inclement weather conditions during transportation and warehousing. Mounted equipment shall have adequate protection against damage during handling, transit and storage. Suitable desiccant shall be used inside the packing case.
- 2.01.07 Nameplate
- a) Nameplate shall be provided for instrument or device mounted on the panel.
 - b) Nameplates for panels shall be provided both in front and rear.
- 2.02.00 CONTROL DESK
- 2.02.01 Control desk shall be free standing, floor mounting, table top type with doors at back and shall be constructed of 3 mm thick (minimum) CRCA steel or Aluminium extrusion. Aluminium structure shall be anodized or powder coated paint finish. The top surface of control desk shall be 30 mm (minimum) thick with the top 12 mm (minimum) of acrylic solid surface and the remaining 18 mm of laminated medium density fibre (MDF) board.
- 2.02.02 Monitors with retractable keyboard shall be provided on the desk. Desk shall be arranged in arc-like shape without any sharp edges. Edges shall be extruded PVC or rounded post-formed laminate.
- 2.02.03 Desks shall be of modular, scalable and industrially ruggedized design and shall have connections for PA system handsets & telephone sets.
- 2.02.04 Desks shall have concealed cable trays for wire dressing. Both Horizontal & Side Managers (2 separate horizontal cable routing wire baskets for power & data cables) shall be provided.

Each User station will be provided with 2 separate power distribution units (1 for Main line & 1 for UPS line). Each power distribution unit will have 6 points of 5/13 Amp sockets, Mains MCB On/Off Switch & Indicator.

Adequate heat management provision for Exhaust of heat from within the Console Desk Assembly shall be provided. There will be multiple fans provided in the Main Control Desk. Each Fan will be of 230 VAC 250 CFM Ball Bearing based. Ventilation louvers will be provided on both Front & Rear Modesty with special Air Filters. Adequate space for CPU & Other equipments placed with in the desk.

- 2.02.05 Design shall include Earthing bolts.
- 2.02.06 Back installed items shall be suitably concealed from front view.
- 2.02.07 All operator workstations for SG, TG, Auxiliaries & Off-site Plants shall be mounted on this Control Desk. The cabling / wiring between OWS & CPUs, power supply cables etc. shall be aesthetically routed and concealed from view.
- 2.02.08 **HARDWIRED DEVICES ON CONTROL DESK (DRAW OUT SECTION)**
- Release and Lamp Test push buttons shall be provided for a set of push buttons (decided during detail engineering stage). Depending on the type of control/ function, required number of push buttons/ indicating LEDs & their color, push button stations shall be selected. The size of push button stations shall be 24 x 48 mm or 25 x 50 mm and shall have service inscription details at the front. Emergency push buttons (with cover) shall be mounted on top of Control Desk.
- 2.03.00 **BACK UP PANEL**
- 2.03.01 Construction shall be from CRCA steel of thickness not less than 3mm.
- 2.03.02 Upright back-up panel shall be provided where hardwired devices shall be mounted on a mosaic grid type console. The mosaic grid tiles shall be of 24 mm x 48 mm (or 25 mm x 50 mm) size, made of heat & flame retardant, self extinguishing and non-hygroscopic material with flat matt finish without glare and non reflecting type.
- 2.03.03 DDCMIS Back-up Panel (referred as Unit Control Panel-UCP) shall also mount annunciation fascia (minimum 500 nos.) and the flame monitoring cameras along with other hardwired devices as decided during detail engineering stage by Owner. Color coding shall also subject to Owner's approval.
- 2.03.04 Colored Mimic for different Off-site plant control systems (as enumerated elsewhere in this specification) and hardwired annunciation system shall also

be mounted on the back up panels.

2.04.00 PANELS/CABINETS

2.04.01 All DDCMIS system modules, power supply components and other Local Control panels (PLC/Relay based) shall be housed in cabinets as specified below.

2.04.02 The cabinet mounted equipments shall be fully assembled, installed in mounting racks, wired and fully tested as per specification requirements and Owner approved drawings prior to shipment to the project site.

2.04.03 The Bidder shall ensure that the cabinets are complete & ready for installation before dispatch from manufacturing works. The installation work at project site for these cabinets shall only involve connections through multi-pair cables from marshalling cabinets (wherever provided) to system cabinets and inter-cabinet/cabinet to Control Desk/ Back up Panel.

2.04.04 All electronic cards, network components, power supply modules etc. located shall be suitably housed in cabinets and shall be neatly arranged in sub-racks. Network components shall be visible in door closed condition (e.g. Glass doors etc.) as approved by Owner.

2.04.05 Bidder shall design the cabinet internal arrangement, floor cutout and cable gland plate such that all the cables entering or leaving the cabinet can be properly glanded in the gland plate.

2.04.06 The packaging density of panels shall be such that the temperature rise within the panels shall never exceed 10°C above ambient even under worst operating conditions. Cooling Fans shall be provided wherever required and this shall be of industrial grade.

2.04.07 TECHNICAL PARTICULARS

1.	Material of Construction	:	Cold Rolled Coal Annealed (CRCA) steel sheet
2.	Thickness of Sheet	:	a) 2.0 mm for faces supporting instruments / terminals b) 1.6 mm for other sides and top
3.	Construction	:	Welded throughout as per approved National Standards
4.	Post welding operation	:	a) Grounding of all welds to smoothness b) Rounding of corners

- : c) Cleaning of weld spatters
- 5. Panel height : 2300 mm (approx)
- 6. Corners : 7 mm inner radius
- 7. Dimensional Tolerances :
 - a) In height & length - 3 mm
 - b) In height between adjacent sections - 2 mm
 - c) Total for a group - 6 mm
- 8. Doors : Double, recessed, turned back edges, full height front & rear
 - i) Thickness of Sheet : 2 mm
 - ii) Hinges : Stainless steel
 - iii) Door latches : Three point type
 - iv) Door gaskets : Neoprene rubber on fixed frame to result dust proof/weatherproof enclosure
 - v) Opening of the doors : Outward
 - vi) Louvers : With removable wire mesh to ensure dust and vermin proof
- 9. Gland plates : Removable in sections
4 mm thick (bottom)
- 10. Cable entry : Bottom
- 11. Hardware :
 - a) Anti vibration pad- 15 mm
 - b) Predrilled base channel ISMC – 100 or equivalent for all sides
 - c) Stainless steel buff- finished 2 mm thick kick plate for all sides
 - d) Stainless steel scratch strips along desk edges fixed with pan-head recessed screws
 - e) Rubber strips to ensure air

tightness between kick plate and finished floor

f) Lifting hook / Eye bolt

g) Drawing pocket

Door switch, lamps, thermostat, heaters and industrial grade cooling fans,, illumination fixtures

12. Name Plate	:	Both at front and back surface of the panel
13. Fixing of name plate	:	Stainless steel pan head screws
14. Name plate material	:	Laminated phenolic (3 layers)
15. Lettering	:	Black with white engraved
16. Mounting of terminal blocks	:	Vertical angle support bracket tack welded on sheet steel plate, screwed on internal wall of enclosure

2.05.00 FURNITURE

All the furnitures in the Central / Local control Room (s), Engineers' rooms, Instrument laboratory , SWAS Room & any other rooms with C&I equipments located in different plant buildings under Bidder's scope shall be included in Bidder's scope of supply. Bidder shall provide following industrial grade furniture items as a minimum from reputed manufacturers/suppliers meeting International Standards. The furniture shall be modular and latest with ease of operational features. The furniture shall be modern, aesthetically designed, modular, flexible, space saving and future safe.

2.05.01 WORK STATION FURNITURE

Modular work station furniture, suitable for mounting servers & historians, programmer stations, PC based systems, printers (A4/A3 color laserjet) etc. shall be provided.

2.05.02 PC RACK

PC Racks shall be provided to mount CPUs of workstations/PCs of OWS/LVS etc. in control room. For each PC / workstation / monitor at least one chair shall be included.

2.05.03 CHAIRS

Industry standard revolving chairs with wheels and with provision for adjustment of height (hydraulically/gas lift) shall be provided for the operators, unit-in-charge & other personnel in control room area. These shall be designed for sitting for long duration such that these are comfortable for the back.

2.05.04 TABLES

Industry standard computer tables shall be provided & shall be as approved by Owner during detailed Engineering. Glass top teak wood horse shoe shaped table with vertical file mounting arrangement (two layers to house approx. 40 Nos of files and lockable drawers at both ends) for Engineering Room shall be provided.

2.05.05 ALMIRAHs

Steel Almirahs shall be provided for keeping documents in the documentation room. Glass doors for each rack shall be provided such that the documents are visible from outside. Size of the rack shall be sufficient to easily fit technical manuals. The exact details shall be approved by Owner during detailed Engineering.

2.05.06 KEYPAD

One keypad per unit shall be provided for the storing of keys of relevant areas of the unit in the control room.

2.05.07 LOCKERS

Suitable lockers shall be provided in the room adjacent to the control room for storing of personal articles of control room personnel. Also, lockers of bigger size shall be provided in documentation Room for storing of personal documents. Details shall be finalized and approved by Employer during detailed engineering.

3.00.00 LVS PANEL

3.01.00 An arc shaped Large Video Screen (LVS) panel shall be supplied for mounting large video screens in number of tiers in various Control rooms as specified elsewhere in this specification.

Bidder shall provide and fix ACP cladding around the LVS screen including covering the LVS back side and LVS stand. The cladding will be from floor finish to 600 mm above LVS screen like a self-standing partition with necessary openings for system requirement. ACP paneling shall be with 304 grade & approx. 0.5 mm mirror finish SS strip.

3.02.00 The profile, dimensions and the general arrangement shall be finalized & approved by Owner during detailed engineering. Recommendations, if any, for the control room lighting in order to ensure continuous proper viewing of the LVS screen by the operator & shift incharge (without any fatigue) shall be

- clearly brought out by the Contractor in his offer, alongwith all relevant details/basis.
- 3.03.00 Any other requirement for proper LVS mounting & functioning & viewing shall also be specifically brought out by the Contractor in his offer, along with all relevant details.
- 4.00.00 **LOCAL INSTRUMENT RACK (LIR) & LOCAL INSTRUMENT ENCLOSURE (LIE)**
- 4.01.00 GENERAL
- 4.01.01 Devices (Transmitters/ Switches) located in the field shall be suitably grouped together to the extent possible and installed in the LIE (Closed Rack) and LIR (Open Rack) in Boiler/TG Building and Off-site plant areas.
- 4.01.02 Racks and enclosure shall be factory prefabricated & painted and shall complete with internal piping, tubing, manifold, isolation valves, blowdown valves, integral junction box, illumination etc.
- 4.01.03 No more than six instruments shall be grouped in a single rack / enclosure.
- 4.01.04 Racks shall be installed above the tapping points for air, flue gas and coal air mixture application whereas for applications such as for water and steam, racks to be installed below the source point.
- 4.01.05 Attention shall be paid in the layout to avoid air traps in liquid piping and water accumulation in air /gas piping.
- 4.01.06 Racks used for furnace, flue gas and air application shall be provided with intermittent & continuous air purging
- 4.01.07 Welding of impulse lines shall comply with the provisions of the latest applicable ANSI Code for Pressure Piping.
- 4.01.08 Earth stud shall be furnished at rack for safety grounding.
- 4.02.00 LOCAL INSTRUMENT ENCLOSURE (LIE)
- 4.02.01 Enclosure shall be free standing type. Racks shall be adequately reinforced to ensure true surfaces and to provide support. Major load - bearing posts shall be suitably supported by gusset plates or moment members.
- 4.02.02 Enclosure outer shall be constructed from at least 3 mm thick steel plate and epoxy painted to shade gray. Base frame shall be made of ISMC 100 and black colour finish.
- 4.02.03 2" NB galvanized pipes shall be laid horizontally and supported at two end channels to mount transmitters at accessible height. Center posts or any

member, which would reduce access, shall be avoided.

- 4.02.04 Double leaf interlocking front opening doors with three point locking shall be provided and shall be arranged for maximum possible access to the interior. Key shall be of identical for all enclosures.
- 4.02.05 Doors shall have concealed quick removal type pinned stainless steel hinges and locking handles. Gaskets shall be used between all mating sections to achieve dust and weather proof enclosure rated for IP-65 including the internal junction box. All enclosures shall have access doors on front side.
- 4.02.06 Removable type bulkhead plates of thickness not less than 6 mm shall be mounted at the racks with suitable high temperature gasket. Impulse lines within the enclosures shall be properly clamped.
- 4.02.07 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings within transmitter racks both open and closed type, is admissible.
- 4.02.08 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..
- 4.02.09 Each rack shall be provided with one receptacle, light fixtures with wire guard and one lighting switch each at instrument & Junction box compartments with wire guard. Lighting switches may be door actuated & mounted inside the panel. Outlet box, switch box and device covers shall be of galvanized stamped steel. Light switches and receptacles shall be installed inside the enclosure on the wall near the latch side of the enclosure door. Light fixtures shall be installed on the ceilings of the enclosures.
- 4.02.10 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.
- 4.02.11 Vibration dampeners shall be installed for supporting each enclosure. The loading at each corner of the enclosure shall be determined by actual test weighting when construction is complete to determine the correct length of each dampener for proper loading of the dampener in accordance with manufacturer's recommendations
- 4.03.00 LOCAL INSTRUMENT RACK (LIR)
- 4.03.01 Rack shall be free standing type constructed from 6 mm thick steel channel frame provided with a canopy to protect the instrument from dripping water or

falling objects and shall be epoxy painted. Canopy shall be of CRCA steel sheet of at least 3 mm thickness.

- 4.03.02 Rack Major load-bearing posts shall be suitably supported by gusset plates or moment members. Suitable fenders grill shall be welded to the end-posts of the rack to outline a boundary beyond which no mounted equipment shall project to protect instrument from accidental contact during personnel movement. Center posts or any member, which would reduce access, shall be avoided.
- 4.03.03 2" NB galvanized pipes laid horizontally and supported at two end channels shall be employed at working accessible height for mounting of instruments.
- 4.03.04 All internal wirings between the instruments and junction box shall run through flexible conduits. No exposed wirings are admissible.
- 4.03.05 Racks shall have a common blowdown drain header, which will connect individual instrument blowdown line after suitable pressure breaking through regulating globe type blowdown valves. Covered funnels shall be used for saturated liquid and steam service, whereas, open funnels may be used for cold liquid services. Header (2" NB ASTM A 106, Sch-80 Gr. C) shall be suitably sloped and shall have one end flanged and extending beyond the rack for connection to plant drain header..

Each rack shall be provided with one receptacle, one light fixture with wire guard and one lighting switch. Outlet box, switch box and device covers shall be galvanized stamped steel. Light fixtures shall be installed on the canopy of the rack

- 4.03.06 Power supplies for miscellaneous devices shall be provided with MCB located within the enclosures. MCB shall be mounted in fuse blocks. Nameplates shall be furnished above the MCB blocks, identifying the devices being served.

4.04.00 JUNCTION BOX

1.	Type of Enclosure	:	Dust tight & weatherproof conforming to IP 65
2.	Material	:	3 mm sheet steel / fiberglass reinforced polyester(UV stabilized)
3.	Type of Cover	:	Solid unhinged with retention chain / Screwed at all four corners
4.	Paint	:	i) Exterior : Opaline green shade 275 of IS: 5 ii) Interior - Brilliant Glossy White.

- Surface / Two (2) inch Pipe stanchion
5. Mounting : (At a dry compartment at one side of the enclosure / rack with front opening type door)
6. Cable Entry : 3 mm (min) Bottom / side Gland plate
7. Gasket : Neoprene
8. Grounding : Brass earth lug with green screw head
 External-2 nos , Internal-1no. (M6)
9. Number of Drain Holes : Two at bottom capped
10. Identification : Label for JB and Tags for cable
11. Accessories : Rail mounted cage clamp type screwless terminals (suitable for conductor size up to 2.5sq.mm of suitable voltage grade) with markers and 20% spare terminals
- b) Cable gland (Brass) & raceways
- c) Ferrules & lugs (Brass)
- d) Aluminum back panel
- e) Canopy at top
- f) Mounting brackets
- g) bolts and nuts made of brass etc.

	DATA SHEET FOR LOCAL PANELS		SPECIFICATION NO.: PE-SS-999-145-054A	
			VOLUME	
			SECTION	
			REV. NO. 02	DATE: 16.09.2013
TAG No. Qty.....		Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B				
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)			DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
GENERAL	MANUFACTURER			
	CONSTRUCTION		☒ FOLDED ☐ WELDED	
	ENCLOSURE SHEET THICKNESS (As per Section 8.13, Volume V of contract specification)	FRONT	☐ 2.0 mm	
		OTHER	☐ 2.0 mm	
		DOOR	☐ 1.6 mm	
		HEIGHT	☐ 2365 mm for stand alone panels. ☐ Other	
	OTHER	☐ Load bearing sheet front shall have 3mm thickness		
TECHNICAL	INPUT POWER SUPPLY * (As per Electrical specification) (ANY OTHER POWER REQUIREMENT TO BE DERIVED FROM THIS SUPPLY ONLY)		☐ 240V 50 Hz AC ☐ 220V DC ☒ 415V 3 PHASE 3W ☐ 400V 3 PHASE 4W	
	NO. OF FEEDERS (As per Electrical specification)		☐ ONE ☐ TWO	
	STARTER WITH MCC		☐ REQUIRED ☒ NOT REQUIRED	
	IPR POSITION		☒ MCC ☐ RELAY PANEL	
	CONTACT RATING OF RELAY		☒ 5 Amp, 230 V AC ☒ 0.25 Amp, 220V DC	
	CONTROL SUPPLY		☐ 110V AC ☐ 220V AC ☐ 220V DC ☐ Other. (As per requirement)	
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		_____ NOS. (AS REQUIRED)	
	TEMP SCANNER (IF REQUIRED –NO. OF CHANNELS TO BE SPECIFIED UNDER SEC-C)		☐ REQUIRED ☒ NOT REQUIRED	
	PAINT TYPE (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ EPOXY ENAMEL ☐ EPOXY POWDER COATED	
	MIMIC (TYPE OF MIMIC- MATERAIL, THICKNESS TO BE SPECIFIED DURING DETAILED ENGG.)		☒ REQUIRED ☐ NOT REQUIRED	
	PANEL COLOUR (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ LIGHT GREY ☐ OPALINE GREEN	
	FINISH (EXTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	PANEL COLOUR (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ WHITE ☐ CREAM ☐ OFF WHITE	
	FINISH (INTERNAL) (As per Annex-1, Section 7.6, Volume IV of contract specification)		☐ MATT ☐ GLOSSY ☐ SEMI GLOSSY	
	CLASS OF PROTECTION		☒ IP-55 (FOR INDOOR SERVICE) ☒ IP-67 (FOR OUTDOOR SERVICE) ☐ ANY OTHER	
	CONTROL HARDWARE		☒ RELAY BASED	
FOUNDATION ARRANGEMENT		☐ FOUNDATION BOLTS ☐ ANCHOR FASTENERS		
WEIGHT OF PANEL (Kg.)		(Vendor to specify)		

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 02	DATE: 16.09.2013
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet A & B					
DATA SHEET-A FOR LOCAL PANEL (TO BE FILLED BY PURCHASER)				DATA SHEET-B (TO BE FILLED-UP BY BIDDER)	
	PANEL TYPE		☐ PRESSURISED ☐ UNPRESSURISED As per Requirement		
	CABLE GLAND		☒ DOUBLE COMPRESSION		
	AMMETER (TYPE OF INPUT) *		☐ 1 Amp CT ☐ 4-20 mA		
	SCOPE OF SUPERVISION FOR ERECTION & COMMISSIONING		☐ APPLICABLE ☒ NA		
	* TO BE CO-ORDINATED WITH PEM ELECTRICAL				
NAME DESIGNATION SIGNATURE DATE	PREPARED BY		CHECKED BY		APPROVED BY
	AANCHAL CHOUDHARY		SACHIN SRIVASTAVA		MA MANSOORI
	SR.ENGR		DY.MNGR		D. GM
	16.09.2013		16.09.2013		16.09.2013
COMPANY SEAL NAME: SIGNATURE: DATE:					



DATA SHEET FOR LOCAL PANELS

SPECIFICATION NO.: PE-SS-999-145-054A

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SECTION

REV. NO. 02

DATE: 16.09.2013

SHEET 3 OF 3

TAG No. Qty.....

Data Sheet No.: PES-145A-DS1-0

Data Sheet C

DATA SHEET-C FOR LOCAL PANEL
(TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)

GENERAL	MANUFACTURER		
	CONSTRUCTION		☐ FOLDED ☐ WELDED (As per requirement EDN)
	ENCLOSURE SHEET THICKNESS	FRONT	
		OTHER	
		DOOR	
		HEIGHT	
	OTHER		
TECHNICAL	INPUT POWER SUPPLY		
	NO. OF FEEDERS		
	CONTACT RATING OF RELAY		
	TEMP SCANNER		
	CONTROL SUPPLY		
	ALARM ANNUNCIATOR WINDOW (EXCLUDING SPARES)		
	PAINT TYPE		
	PANEL COLOUR (EXTERNAL)		
	FINISH (EXTERNAL)		
	TYPE OF MIMIC MATERIAL OF MIMIC THICKNESS OF MIMIC		
	PANEL COLOUR (INTERNAL)		
	FINISH (INTERNAL)		
	CLASS OF PROTECTION		
	CONTROL HARDWARE		
	FOUNDATION ARRANGEMENT		
	WEIGHT OF PANEL (Kg.)		

	DATA SHEET FOR LOCAL PANELS			SPECIFICATION NO.: PE-SS-999-145-054A	
				VOLUME	
				SECTION	
				REV. NO. 02	DATE: 16.09.2013
			SHEET 3 OF 3		
TAG No. Qty.....			Data Sheet No.: PES-145A-DS1-0		
Data Sheet C					
DATA SHEET-C FOR LOCAL PANEL (TO BE FILLED BY CONTRACTOR AFTER AWARD OF CONTRACT)					
	PANEL TYPE				
	CABLE GLAND				
	AMMETER (TYPE OF INPUT)				
	SCOPE OF SUPERVISION				
NAME SIGNATURE DATE	PREPARED BY	CHECKED BY	APPROVED BY		COMPANY SEAL NAME: SIGNATURE: DATE:
	AANCHAL CHOUDHARY	SACHIN SRIVASTYAVA	MA MANSOORI		
	16.09.2013	16.09.2013	16.09.2013		



Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

LCP Quality Plan

बीएल PEM :: C&I		STANDARD QUALITY PLAN FOR LOCAL CONTROL PANEL							STD QUALITY PLAN NO.: PE-QP-999-145-I056					
									VOLUME		IIB			
									SECTION		D			
									REV. NO.		01		DATE: 22-02-2008	
									SHEET		1		OF 7	
Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks		
									P	W	V			
1.0	INCOMING Sheet Steel (CRCA & HR)	1. Chemical Composition	MA	Chemical analysis	Sample	Relevant standard	Relevant standard	Test Certificate	3	---	2			
		2. Bend Test	CR	Mech. test	Sample	Relevant standard	Relevant standard	Log Book	2	---	---			
		3. Surface finish	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---			
		4. Waviness	MA	Visual	100%	Factory Standard	No Waviness	Log Book	2	---	---			
		5. Thickness	MA	Measurement	100%	BHEL Spec.	BHEL Spec.	Log Book	2	---	---			
		6. Mill marking	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	1			
2.0	Flats / Angles / Channels	1. Dimensions	MA	Measurement	Sample	Relevant standard	Relevant standard	Log Book	2	---	---			
		2. Surface Defects	MA	Visual	100%	Factory Standard / Sample	Factory Standard / Sample	Log Book	2	---	---			
		3. Straightness	MA	Measurement	100%	Factory Std.	Factory Std.	Log Book	2	---	---			
		4. Mill marking	MA	Visual	100%	Relevant standard	Relevant standard	Log Book	2	---	1			
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---			
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---			
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1 - BHEL 2 - Vendor 3 - Sub-vendor														

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
		3. Conductor a) Resistance b) Size c) Sheet colour	MA MA MA	Electrical Measurement Visual	100% 100% 100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and Relevant standard	BHEL Spec. and Relevant standard	Log Book	3	---	2	
4.0	Electrical Components like Annunciator Transformers Lamps Switches PBs Contactors Relays Timers Space Heaters Thermostat Indicating meters etc.	1. Verification at make and Type 2. Verification of Test Certificates 3. Operation / Functional check 4. I.R. 5. H.V. 6. Calibration 7. Pick up / Drop off Voltage	CR CR CR MA MA MA MA	Visual Scrutiny of Type / Routine T.Cs. Electrical Electrical Electrical Electrical Electrical	Sample 100% Sample+ 100% 100% 100% 100% 100%	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	BHEL Spec. and BOM Relevant standard Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue Relevant standard & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- --- 1	+ for relay & contactors only @ for all components except relays & contactors.
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
5.0	Misc. Components like Gaskets, Terminal Blocks etc.	1. Verification of Type / Make	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		2. Surface defects	MA	Visual	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
		3. IR / HV on Terminal Blocks	MA	Electrical	Sample	BHEL Spec. & Mfrs. Catalogue	BHEL Spec. & Mfrs. Catalogue	Log Book	2	---	---	
6.0	IN PROCESS Blanking / Bending / Forming	1. Dimensions	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Surface defects after bending	MA	Visual	100%	Factory Standard	Factory Standard	Log Book	2	---	---	
7.0	Nibbling / Punching	1. Cutout Sizes	MI	Measurement	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
		2. Deburring	MA	Visual	100%	Approved Mfr. drgs.	Approved Mfr. drgs.	Log Book	2	---	---	
8.0	ASSEMBLY Frame Assembly & Sheet fixing	1. Dimensions	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		2. Alignment	MA	Measurement	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		3. Welding Quality	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
		4. Surface defects	MA	Visual	100%	Approved drg. / Mfr. Standards	Approved drg. / Mfr. Standards	Log Book	2	---	2	
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									P	W	V		
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & Relevant standard	Factory Standard & Relevant standard	Log Book	2	---	1		
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									P	W	V			
10.	Panel Wiring	1. Wiring Layout	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		2. Wiring Termination (Crimped Lugs)	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		3. Ferrule numbers	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	---			
		4. Colour of wiring	MA	Visual	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1			
		5. Size of Conductor	MA	Measurement	100%	Approved drgs. & Specs.	Approved drgs. & Specs.	Log Book	2	---	1			
11.	Component Mounting	1. Correct components	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---			
		2. Fixing	MA	Visual	100%	Approved drgs., Specs. & BOM	Approved drgs., Specs. & BOM	Log Book	2	---	---			
12.	FINAL Final Inspection	1. Workmanship	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.		
		2. Component layout (neatness, accessibility & safety) Mounting / Proper fixing of all components	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
		3. Components identification Marking / Name plates	MA	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1			
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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^s			Remarks	
									P	W	V		
		5. Dimensions	MA	Measurement	100%	BHEL approved drg. / Spec., BOM	BHEL approved drg. / Spec., BOM	Inspection Report	2	1	1	At Random by BHEL, based on 100 % internal test reports by Mfr.	
		6. Door functioning	MA	Functional	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		7. Paint Shade	CR	Visual	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		8. Paint Thickness	CR	Measurement	100%	BHEL approved drg. / Spec.	BHEL approved drg. / Spec.	Inspection Report	2	1	1		
		9. Workmanship of Gaskets	MA	Visual	100%	Factory Standard	Factory Standard	Inspection Report	2	1	1		
		10. Wiring Layout	MA	Visual	100%	BHEL approved drg.	BHEL approved drg.	Inspection Report	2	1	1		
		11. Wire Termination	MA	Pulling manually	Sample	----	Firm termination	Inspection Report	2	1	1		
		12. Continuity	MA	Electrical	100%	----	Continuity OK	Inspection Report	2	1	1		

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency ^{\$}			Remarks
									P	W	V	
13.	TYPE TEST	Degree of Protection	CR	Mech. Protection	Sample	BHEL approved spec., drg relevant IEC-60947, IEC-60079	BHEL approved spec., drg relevant IEC-60947, IEC-60079	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant standard	BHEL approved spec., drg., BOM & relevant standard	Test Report	2	1	1	
15	FUNCTIONAL TEST	1. Control Logic Operation	CR	Electrical	100%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		2. Instrument Calibration	CR	Electrical	10%	BHEL approved spec. / drg.	BHEL approved spec. / drg.	Inspection Report	2	1	1	
		3. Temperature rise	CR	Electrical	100%	BHEL approved spec/drg. & relevant standard	BHEL approved spec/drg & relevant standard	Inspection Report	2	1	1	

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Technical specification for
CONTROL & INSTRUMENTATION
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I**

VOLUME

SECTION

REV. NO.

00

DATE : 10.03.2015

SHEET

OF

CABLE BOQ

CABLE SIZES FOR 1X800 MW KOTHAGUDEM TPS	
Sl no.	Cable Type
	G-TYPE
1	2P X 0.5 sqmm
2	4P X 0.5 sq mm
3	8P X 0.5 sqmm
4	12P X 0.5 sqmm
5	2P X 1.5 sqmm
	F-TYPE
1	4P X 0.5 sqmm
2	8P X 0.5 sqmm
3	12P X 0.5 sqmm
4	20P X 0.5 sqmm
	CONTROL CABLE
1	3C X 2.5 sqmm
2	5C x 2.5 sq mm
3	12C x 2.5 sqmm

ERECTION HARDWARES

1.00.00 GENERAL TECHNICAL REQUIREMENTS

This section provides the general technical guidelines for the erection materials for instruments. All erection materials shall be of good quality and conform to the operating environment of the corresponding instrument.

However, any item required for erection of Bidder supplied system but not categorically indicated in this section, shall be supplied by the Bidder and all these items shall conform to International / National standards / codes.

1.01.00 Electrical Accessories

Electrical conduit and associated materials shall conform to the requirements of the articles which follow :

- a) Rigid Steel Conduit
 - i) Conduits up to and including 25 mm shall be of 16 SWG and conduits above 25 mm shall be of 14 SWG. Minimum size of conduits shall be 19 mm.
 - ii) Each piece of conduit shall be straight, free from blister and other defects and covered with capped bushing at both ends.
 - iii) All rigid conduit couplings and elbows shall be hot dip galvanized rigid mild steel in accordance with IS:9537 Part-I (1980) and Part-II(1981).. The conduit interior and exterior surfaces shall have a continuous zinc coating with an over coat of transparent enamel lacker or zinc chromate. Conduits shall be furnished in standard length of 3 meters, threaded at both ends.
 - iv) All rigid conduit fittings shall conform to requirements of IS:2667,1976. Galvanised steel fittings shall be used with steel conduit. All flexible conduit fittings shall be liquid tight, galvanized steel. The end fitting shall be compatible with the flexible conduit supplied.
- b) Flexible Conduit
 - i) Flexible conduit shall be of three layer construction of very high quality of lead coated steel. Outside and inside layer shall be reinforced with heat resistant material.
 - ii) Lead coating outside and inside of the conduit steel surface shall provide a non-corrosive characteristic particularly in acidic atmosphere. Besides flexibility, this shall be strong enough to stay at the desired profile without support and shall be durable and strong so as to offer sufficient mechanical protection. It shall also be fully liquid dust and air tight and shall withstand a continuous hydraulic pressure up to 2 Kg/Sq. cm and temperature up to 200 °C.
- c) Special Fittings
 - i) Conduit sealing and fittings shall be provided as required and shall be consistent with the area and equipment with which they are installed.
 - ii) Double locknuts shall be provided on all conduit terminations not provided with threaded lugs and couplings. Locknuts shall be designed to securely bond the conduit to the enclosure when tightened. Locknuts shall not loosen due to vibration.

- 1.02.00 Electrical Junction Box:
Please refer to Section VII , Subsection – D of this volume of the Specification.
- 1.03.00 Cable Gland
1. Type : Double compression
 2. Entry Thread : NPT / ET
 3. Material : Brass
 4. Finish : Cadmium Plated.
 5. Protection : IP 54 or better
 6. Accessories : Neoprene gasket, locknuts, reducers etc
- 1.04.00 Cable Tray
1. Material : Mild steel, slotted
 2. Thickness : not less than 2.0 mm
 3. Finish : Hot dip galvanized
 4. Perforation : As per MFR standard
 5. Cover : Suitable for tray
- 1.05.00 Process Hook Up Accessories & specification
Material and rating of the hook up items shall suit the piping and fluid condition. Hook up materials shall be IBR certified for applicable cases. Bidder shall furnish hook up drawings and the drawings for open racks & closed racks for owner's approval.
- 1.05.01 Seamless Stainless Steel Pipe
1. Reference : ASTM A-312 TP 316
 2. Material Grade : TP 316
 3. Type : Seamless /Plain end
 4. Size : As applicable (e.g. 1/2" NB etc)
 5. Schedule : 40
 6. Standard Length : 5 meter
- 1.05.02 Stainless Steel Pipe Fittings

1. Reference : ASTM A-182 F 316 / ANSI B16.11
2. Type : Forged
3. Rating : 3000 lbs / 6000 lbs / 9000 lbs
4. Size : To suit related SS pipe.
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.03 Seamless Stainless Steel Tube

1. Reference : ASTM A-213 , ASTM A-249 or ASTM A-269
2. Material Grade : TP 316
3. Size : As applicable (e.g. ½" OD X 0.083" wall thickness / ¼" OD X 0.049" wall thickness etc.)
4. Type : Cold drawn annealed, pickled, passivated, de-scaled, hydraulically cleaned seamless tube.
5. Properties : The tube shall be free from scratches and suitable for bending and capable of being flared by hardened and tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80.
6. Test Pressure : 400 Kg/Sq. cm (minimum)
7. Tolerance : ± 0.13 mm for outside diameter
: ± 15 % for wall thickness
8. Standard Length : 5 meter
9. Test : Flare, Hardness, Ball and Bubble Test

1.05.04 Stainless Steel Tube Fittings

1. Reference : ASTM-A-182
2. Type : Double ferrule double compression
3. Material : 316 Stainless steel forged
4. Ferrule : 316 Stainless Steel

	5.	Type of Fittings	: Male / female connector, elbow, cross /equal tee, straight connector, bulkhead union, ferrule etc. as required to suit installation.
	6.	Size	: To suit SS tubing and NPT end connection
1.05.05		C.S. Pipe	
	1.	Reference	: ASTM-A 106 Gr. C
	2.	Material	: Cold drawn seamless black C.S.
	3.	Type	: Seamless / Plain ends
	4.	Size	: As applicable (e.g. ½" NB etc)
	5.	Schedule	: 80, 160, XXS as required
	6.	Standard Length	: 5 meter
1.05.06		C.S. Pipe Fittings	
	1.	Reference	: ASTM-A 105 / ANSI B16.11
	2.	Type	: Forged
	3.	Rating	: 3000 lbs / 6000 lbs / 9000 lbs
	4.	Size	: Suitable to related C.S.Pipe
	5.	End connection	: Generally socket weld
	6.	Type of Fittings	: Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.
1.05.07		A.S. Pipe	
	1.	Reference	: ASTM-A 335 P22 AS PER ANSI B 36.10
	2.	Material	: Cold drawn seamless A.S.
	3.	Type	: Seamless / Plain ends
	4.	Size	: As applicable (e.g. ½" NB etc)
	5.	Schedule	: XXS
	6.	Standard Length	: 5 meter
1.05.08		A.S. Pipe Fittings	

1. Reference : ASTM-A 182 F22 AS PER ANSI B 16.11
2. Type : Forged
3. Rating : 9000 lbs
4. Size : Suitable to related A.S.Pipe
5. End connection : Generally socket weld
6. Type of Fittings : Reducing coupling, male-female reducer, straight coupling, equal tee, three piece union, elbow, cap etc.

1.05.09 G.I.Pipe

1. Reference : IS-1239, Part-I
2. Type : Medium grade, threaded at both ends protected with end caps
3. Material : Continuous ERW galvanized MS pipe
4. General : Pipe shall be galvanized both inside and outside
5. Size : As applicable (e.g 1/2"/3/4"/1" etc.)

1.05.10 G.I.Pipe Fittings

1. Reference : IS-1239, Part-II for material, dimension, thread etc.
2. Style : Threaded
3. Type of Fittings : Equal tee, three piece union, unequal tee, straight socket, 90 Deg. elbow, reducing socket cap. etc. to suit installation.
4. Size : Suitable to related G.I.Pipe

1.05.11 Carbon Steel Globe Valve

1. Reference : ASTM A-105
2. Type : Globe
3. Construction : Forged Body Cadmium Plated
4. End Connection : As applicable (eg. 1/2" Socket Weld etc.)
5. Rating : Cl. 800 / CL. 2500

6.	Material	: Body - Carbon steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Teflon / Grafoil as required
8.	Yoke	: ASTM A105
9.	Hand wheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.12 Stainless Steel Globe Valve

1.	Reference	: ASTM A-182 F316
2.	Type	: Globe
3.	Construction	: Forged Body
4.	End Connection	: As applicable (eg. ½" Socket Weld etc.)
5.	Proof Pressure	: 400 Kg/Cm2
6.	Material	: Body - Stainless steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Teflon as required
8.	Yoke	: ASTM A182 F316
9.	Handwheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.13 Alloy Steel Globe Valve

1.	Reference	: ASTM A-182 F22
2.	Type	: Globe
3.	Construction	: Forged Body

4.	End Connection	: As applicable (eg. ½" Socket Weld etc.)
5.	Rating	: CL. 2500
6.	Material	: Body - Alloy steel
		: Stem - Hardened Steel
		: Plug - AISI 316 SS
		: Seat- Stainless steel stellited
7.	Packing	: Grafoil as required
8.	Yoke	: ASTM A182 F22
9.	Handwheel	: Carbon steel
10.	Design standard	: As per ANSI B 16.34

1.05.14 Structural Steel

Steel supports for JB's, trays; tubes and related equipments shall not be limited to the following:

a)	MS Angle
b)	MS Channel
c)	I-Beam
d)	Hexagonal head Bolt & Nut with washer
e)	Foundation Bolt & Nut
f)	Expansion Bolt
g)	Steel Plates / Flats
h)	CRCA sheet
i)	50 NB Pipe
j)	Pipe clamps, U Bolts & Nuts
k)	Checker plate

1.05.15 Condensate Pot

1.	Reference	: ASTM A182 F22 /ASTM A105
2.	Material	: Alloy steel / carbon steel as per application
3.	Construction	: Drilled from barstock
4.	End connection	: As applicable (e.g 3 nos. ½" socket weld end etc.)

	5. Accessories	: Vent valves
1.05.16	Instrument Valve Manifold	
	1. Type	: Two valve manifold
		: Five valve manifold
	2. Mounting	: Remote 2" Pipe Mounting / Transmitter Rack mounting
	3. Construction	: Single block (bar stock)
	4. Material	: Forged body and bonnet AISI 316 stainless steel
	5. Ports	: Mfg std. (e.g 1/2 " NPT (F) etc.)
	6. Rating	: 420 Kg/Sq. cm at ambient
	7. Operating Temperature	: (-)30 to (+)170 Deg C
	8. Packing	: PTFE Wafer
	9. Seat & Stem	: AISI 316 SS
	10. Plug	: AISI 316 SS free to turn on stem / 17-4 PH
	11. Handle Bar	: AISI 316 SS
	12. Connection	: Straight
	13. Accessories	: Plugs for all ports, Mounting Bracket , bolts , nuts

1.06.00 Pneumatic Hook Up Accessories

1.07.00 Air Header

Technical Particulars	For Panel	For Field
Material of Construction	: Stainless steel	: Stainless steel
Inlet Connection	: 2" NPT (M)	: 1" NPT (M)
Header Take-off Material	: Stainless steel	: Stainless steel
Take off connection	: 1 / 2" NPT (M)	: 1/ 2" NPT (M)
Take-off Valves Material	: stainless steel	: stainless steel

Tube Take-off	: Tube adapter on valve	: Tube adapter on valve
Drain	: SS drain valve at lowest point	: SS drain valves at lowest point



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REV. NO.

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DATE : 10.03.2015

SHEET

OF

KKS PHILOSOPHY

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY
	1X800MW KOTHAGUDEM

KKS NUMBERING PHILOSOPHY

For identifying (tagging) an instrument / equipment in Power plant KKS numbering scheme is used. The purpose is to assign a unique number to every equipment in the power plant. For C&I equipment unique number are to be provided up to the signal level so that a unique number Input / Output exist in DCS for every signal.

Normally KKS number is a 10 digit alpha-numeric code and is typically split into the following:

X	X	X	A A Y			Y B B B		

First three digits indicate the Sub-System. The Code for the major system are given as per **Annexure-1**.

Fourth and Fifth digits are the **Numerical Keys at System Code Level** and used to distinguish between main systems having same Alpha Codes.

Sixth and Seventh digits are the **Equipment / Apparatus / Measuring Circuit Code**. The code of various Equipment / Apparatus / Measuring Circuit is shown in **Annexure-2**

Eight, Nine and tenth digits are the **Numerical Keys at Equipment / Apparatus / Measuring Circuit Code** and used to distinguish between various instruments in the same sub-group. Numerical keys at System / Equipment / Apparatus / Measuring Circuit is shown in **Annexure-3**.

	DOCUMENT TITLE KKS NUMBERING PHILOSOPHY 1X800 MW KOTHAGUDEM
ANNEXURE-1	
List of System / Sub-System Codes used in Power Plant:	
1) Compressed air system : QEA, QEC 2) Ventilation System : SAA TO SAZ 3) Fire Detection & Protection System + Fire Water pumps : SGM, SGN, SGO, SGP 4) Sewage Treatment : SJA TO SJZ 5) Pre-treatment Plant : GBI, GBM, GBV 6) RO DM Plant : GCI, GCM, GBV	
ANNEXURE-2	
Standard Equipment Codes:	
AA AB AC AE AF AG AH AK AM AN AP AT AV	Valves including drives, also hand operated Seclusions, Lock, Gates, Doors Heat Exchanger Turning, Driving, Lifting equipment Continuous conveyors, Feeders Generator Units Heating and Cooling Units Pressing and Packaging equipment Mixer, Stirrer Blower, Air Pumps / Fans, Compressor Units Pump Units Purification, Drying, Filter Combustion Equipment e.g. grates
Standard Apparatus Codes:	
BB BF BG BN BP BQ BR BS BU	Vessels and Tank Foundation Boiler Heating Surfaces Injector, Ejector Flow and throughput limitation equipment (Orifice) Holders, Carrying Equipment, Support Piping, Ducts, Chutes, Compensator Sound Absorber Insulations, Sheatings



DOCUMENT TITLE

KKS NUMBERING PHILOSOPHY

1X800 MW KOTHAGUDEM

Standard Measuring Circuits Codes:

CD	Density
CE	Electrical Quantities
CF	Flow, throughput
CG	Distance, Length, Position
CK	Time
CL	Level
CM	Humidity
CQ	Analysis (SWAS)
CS	Speed, Velocity, Frequency
CT	Temperature
CY	Vibration, Expansion

ANNEXURE-3**Numerical Keys****A) Numerical Keys at System Code Level**

- i) Use 10, 20, 30, ... To distinguish between main systems having same Alpha Codes. Examples:
 - a) Main Steam (Left) and Main Steam (Right)
 - b) BFP – A/B/C
 - c) ID Fan – A/B, FD Fan A/B, AH – A/B
- ii) For branch off from main system path having code say 10, keep the same alpha code and use 11, 12, 13 etc. Similarly for other branch off from main system path having code say 20, keep the same alpha code and use 21, 22, 23 etc and shall carry on further in the same way.
- iii) If the branch off from main system / sub system path is used for some other system, where different alpha codes can be applied, then in that case the said branch line will be designated by the alpha codes of the system to which it is providing the input.

B) Numerical keys at Equipment Code level:

There are three numerical keys available for each type of equipment code. Following has been agreed upon considering present practice, better flexibility and ease in sorting.

- i) Valves and Dampers --- *Equipment Code – AA*

N1N2 N3

DOCUMENT TITLE			
	KKS NUMBERING PHILOSOPHY		
	1X800 MW KOTHAGUDEM		
Motorised (<i>on/off duty</i>)	-	0	01 to 50
Motorised (<i>inching duty</i>)	-	0	51 to 99
Pneumatic (Control)	-	1	01 to 50
Motorised (<i>thyrestor Control</i>)	-	1	51 to 99
Sol. Operated	-	2	01 to 99
(Open / Close duty (Valves, NRVs, Gate)			
Hydraulic	-	3	01 to 99
NRV (Without actuation)	-	4	01 to 99
Manual	-	5	01 to 99
Manual	-	6	01 to 99
Relief & Safety Valves	-	7	01 to 99
Reserve	-	8	01 to 99
Reserve	-	9	01 to 99
ii) Field Instruments			
Field Transmitters & Analog Signals	-	0	01 to 99
Field Switches & Binary Signals	-	1	00 to 99
PG Test Point	-	4	00 to 99
Gauges	-	5	00 to 99
Automatic Turbine Tester (ATT)-HWR	-	2	00 to 99
(Reserved for protection Signals used by Hardwar)			
Example of Numerical Key Usage:			
In line with the philosophy adopted for Valves / Dampers /instruments etc. pumps and fans in the main systems (having different system code) can be numbered as AP/N100 and as AP/N101, 102, ... Where system code is same.			

**C&I MANDATORY SPARES LIST FOR
AUXILIARY PACKAGE
FOR 1 X 800 MW KOTHAGUDEM**



Technical specification for
Control Valves with Accessories
(Pneumatically Operated)
1X800 MW KOTHAGUDEM

SPEC NO.: **PE-TS-410-145-I 801**

VOLUME II B

SECTION D

REV. NO. 00 DATE : 03.04.2015

SHEET OF

SECTION – D

EQUIPMENT SPECIFICATION

VOLUME : VI
SECTION-VII
SUB SECTION - B
CONTROL VALVES

1.00.00 **GENERAL**

1.01.00 Control valves for regulating service shall normally be globe body, preferably cage guided, metal-to-metal seated, pneumatically operated and shall be provided with characterized plugs

1.02.00 Where high stroking speed , high actuation forces and accurate positioning is critical for the operation of the plant, as in case of HP or LP bypass valves, Separator Drain Valves , hydraulic actuators with electro-hydraulic interface shall be offered.

2.00.00 **GENERAL TECHNICAL REQUIREMENTS**

2.01.00 Bidder shall exercise caution in selecting severe service control valves like BFP recirculation, HP & LP bypass, superheater & reheater attemperator, PRDS for Boiler & Turbine, Feed control station ,Soot blower steam pressure, Fuel oil heating and pressurizing ,minimum economizer flow control ,DM make up (emergency / normal), control valves whose down stream are connected to vacuum such as HP/LP heater emergency level control, condenser make up water, separator level control , CEP minimum flow control etc. For such critical applications, Bidder shall offer valves which are proven for similar application. Above valves shall have leakage class equal or better than **CLASS-V** with metal-to-metal seating.

2.02.00 Valve with ANSI leakage **CLASS-IV** shall be provided for all applications except for the control valves indicated above.

2.03.00 Bidder shall provide redundant control valves for some services such as Main condensate flow control, Superheat attemperation control and Reheat attemperation control as a minimum for high availability. For other application, if the availability criteria for the plant cannot be met even with the best established product, redundant control valves shall be provided.

2.04.00 Control valves shall be located near floor or platform for ease of access and with adequate clearances for maintenance and lay-down and shall be placed as station with upstream motorized isolating valve, down-stream motorized isolating valve, inching duty motorized bypass valve and manual drain valves. Each redundant control valve shall have its upstream motorized and down-stream motorised isolating valves. Where quick shut off requirement is foreseen such as in case of SH & RH attemperation valves, upstream isolation valve shall be pneumatic type.

2.05.00 Wherever, steam conditioning calls for , Pressure reducing & desuperheating, combined PRDS type valves shall be offered.

2.06.00 Control Valve shall be furnished with IBR certification wherever required .

2.07.00 Valve Body / End Connections

2.07.01 Valve end to end dimension and connection shall be according to ANSI standard, straight through pattern. However, Bidder may offer angle body valve for high pressure drop applications. For high pressure drop applications, construction of the valve shall be such that the gland is not exposed to inlet pressure.

2.07.02 Control valves of 40 mm. size and above with line pressure up to 50 Kg / Sq. cm may have flanged or welded end connections.

- 2.07.03 Control valves, used in high pressure services shall have butt welded end connections for size 65mm and above and socket weld end connection for size 50 mm or below.
- 2.07.04 Control valve body shall be selected as per the ISA GUIDeline. Generally control valve body shall be cast and machined for pressure rating up to 1500 lbs. Above 1500 lbs, valve body shall be of Cast Steel . For Demineralized Water application, valve body shall be Stainless Steel.
- 2.07.05 Bonnet joints for all control valves shall be of flanged and bolted type.
- 2.07.06 Flanged valve shall be rated at no less than class 300 lbs
- 2.07.07 The direction of flow shall be clearly engraved on the body . Valve tag no, , description or purpose, stroke time shall be painted on all control valve body with black letters on white background in Bold letters.
- 2.07.08 Valve Body Materialial shall match the process conditionrequirement as per ANSI. . General guideline shall be as follows

SR. No.	SERVICE	MATERIAL
1.	Non corrosive, non-flashing and non cavitating service for fluid temperature up to 275°C	: Cast carbon steel ASTM A216 Gr. WCB , Trim material - 316 SS stellited faced GUIDe posts and bushings.
2.	Non corrosive, non-flashing and non cavitating service for fluid temperature above 275°C	: Cast alloy steel ASTM A217 Gr. WC9 Trim material - 316 SS stellited faced GUIDe posts and bushings.
3.	Severe flashing / cavitating services	: Alloy steel ASTM A217 Gr. WC9 , Trim material - 440C
4.	Low flashing / cavitating services	: Alloy steel ASTM A217 Gr. WC6 ,Trim material - 17-4 PH SS
5.	DM water application (condenser hotwell normal, emergency make up etc.)	: 316 stainless steel

- 2.07.09 Bidder may supply valves with body and trim materials with superior quality than specified material and in such cases Bidder shall furnish the comparison of offered material properties ,such as cavitation resistance , , hardness , tensile strength , strain energy , corrosion and erosion resistance etc. , with specified material for Owner's approval.
- 2.08.00 Valve Size
- The control valve sizing (Cv / Kv) shall be based on following guidelines :
- a) The valves shall pass normal flow (MCR condition) with 60 to 70 percent opening for linear characterised valves and between 70 to 80 percent opening for equal percentage characterised valves.

- b) The valves shall have adequate rangeability to pass the minimum and maximum flows at 10% and 85% of the valve opening respectively. Valve stem travel range from minimum to maximum flow condition shall not be less than 50% of the total valve stem travel.
 - c) Valve Cv shall be selected in such a way that the valve shall be capable of handling at least 120% of required maximum flow.
 - d) The valve selection shall be based on the highest size dictated by the above considerations unless noise, flashing or other factors dictate the final selection.
 - e) Trim exit outlet velocity as defined in ISA handbook does not exceed 8 m / sec for liquid services , 150 m/sec for steam services and 50% of sonic velocity for flashing services The sizing procedure followed shall be as per latest edition of ANSI/ISA or equivalent standard.
- 2.09.00 Valve Top work
- 2.09.01 Top work shall be sized so that the valve shall operate properly when upstream pressure is 10 percent above maximum inlet pressure and downstream pressure is atmospheric.
- 2.09.02 Extended bonnet/ bonnet when maximum temperature fluid is greater than 280° C shall be provided and high temperature packing shall also be used for high temperature application.
- 2.09.03 The gland material shall be chosen to suit the operating temperature. PTFE may be chosen for lower temperature application (232°C maximum) and for high temperature application graphited asbestos glands are to be provided. For vacuum services,. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications eg. double vee type chevron packing.
- 2.10.00 Valve Trim
- 2.10.01 Valve trim for applications up to leakage class-V shall be stainless steel 316 SS for pressure drop up to 7 Kg/ Sq. cm. For pressure drops above 7 Kg/Sq. cm hard trim (stelliting or equivalent) shall be used. Other alloys or treatment such as nitride shall be used if severe erosion is expected.
- 2.10.02 Balanced trim valves shall be offered for high shut-off pressure or high pressure drop condition to reduce the size of the actuators.
- 2.10.03 For flashing services and two stage mixtures, the trim material shall be 17-4 PH SS or equivalent.
- 2.10.04 If cavitating condition is foreseen, Bidder shall offer multistage or labyrinth trims valves. Trim of severe service valves shall be of multistage and multipath design with number of discrete pressure drop stages to eliminate the chances of erosion, cavitation, noise and vibration throughout the control range of the valve.
- 2.10.05 Quick replacement type trim shall be considered for easy maintenance.
- 2.10.06 Plug shall be one-piece construction cast , forged or machined from solid bar stock .Plug shall be screwed or pinned to valve stems or shall be integral with the valve stems.

- 2.11.00 Noise Level
- The equivalent sound level measured at 1.5M above nearest floor level in elevation and 1 M horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA. The noise abatement shall be achieved by valve body & trim design and not by use of silencers. Valve Actuators
- 2.12.00 Actuator
- 2.12.01 Spring-diaphragm type actuators shall generally be used. Piston type actuators shall be offered in case of high shut-off pressure & quick response requirement. Hydraulic actuation system shall be provided for Critical valves as described elsewhere in the specification.
- 2.12.02 The actuator shall be designed for 150% thrust required for the valve (at shut-off pressure) at an air line supply pressure of 5.5 Kg/Sq. cm.
- 2.12.03 Diaphragms shall be designed for 200% maximum operating pressure.
- 2.12.04 Nylon reinforced neoprene is preferred as diaphragm material.
- 2.12.05 Valve actuators shall be capable of operating at 80⁰ C ambient, continuously.
- 2.12.06 Entire actuator assembly shall be painted with corrosion inhibiting paint.
- 2.12.07 Air connection size shall be 1/4" NPT (F) unless otherwise dictated by process response time. Integral tubing shall be stainless steel.
- 2.12.08 Bidder shall indicate the stroking time of the valve assemblies with positioned and ensure that the stroke time shall meet the process and equipment dynamics and shall be better than 10 seconds.
- 2.12.09 All actuators shall be of fail safe design signifying that the spring direction will tend to move the valve (open or close) in a direction safe for the process. "Failure to Open" or "Failure to Close" shall be marked on the actuator.
- 2.12.10 Hydraulic actuation system
- The system shall consist of , but not limited to , Hydraulic cylinder , proportional valve with blocking unit , SMART positioner with position transmitter , SOVs , safety bypass unit , safety control unit , Hydraulic supply unit and local controller cubicle with controller unit
- 2.13.00 Valve Positioners
- 2.13.01 All regulating service valves shall be offered with HART protocol based Smart Electro Pneumatic Positioners to ensure accuracy and repeatability of response.
- 2.13.02 Positioners shall have integral non contact type position transmitter, input and output gauges, local keypad & display and 4-20 mA DC output to DDCMIS in CCR.
- 2.13.03 Positioners shall be capable of functioning under hot, humid and vibrating conditions.
- 2.13.04 Positioner casings shall be dust tight, corrosion resistant and weatherproof to IP 65 .and explosion proof in hazardous areas.

- 2.13.05 In general, positioner shall operate at signal range 4 – 20 mA DC for the full travel of the valve. Split range operation in few cases may be required.
- 2.13.06 Remote calibration from control room shall be possible through HART management station.
- 2.14.00 Performance
- 2.14.01 Performance of the complete assembly of the control valves shall be better than +/- 1% of FS for linearity , +/- 0.5 % of FS for hysteresis , 1% for accuracy.
- 2.15.00 Valve Accessories
- 2.15.01 Accessories shall include side mounted hand wheels, open & close , intermediate (as applicable) limit switches for both regulating and On off valves ,, junction boxes with 20 % spare terminals , Air filter regulators , airlock relays , volume chambers etc. Solenoid valve (SOV) wherever required shall be furnished. Each limit switch shall have not less than 2 NO & 2 NC contacts with contact rating 5A , 240 V AC / 0.5 A , 220 V DC . SOV shall have SS bar stock body , SS316 Trim , SS coil enclosure , Class H insulation Air filter regulator shall have sintered bronze filter element with maximum 5 microns filter size & 2 inch dial size pressure gauges. .Protection class of all Limit switches , junction boxes , SOV etc. shall have protection class IP 65 and explosion proof for hazardous areas.
- 2.15.02 Air distribution line to all final control elements like control valves, pneumatic dampers (both regulating / on-off type) , SOV operated valves shall be through SS manifolds and SS isolating valves only. These valves shall be properly tagged also with KKS tag no. and description of final control element / instrument for which they are intended.
- 2.16.00 Test and Examination
- All valves shall be tested in accordance with the Quality Assurance programme agreed between the Owner and Bidder , which shall meet the requirements of IBR and other applicable codes mentioned elsewhere in the specification . The test shall include but not be limited to Non destructive test , Hydrostatic shell test prior to seat leakage test , Seat leakage test , Valve closure test , Functional test of fully assembled valves including actuators and accessories. CV test etc. For all control valves Cv test shall be witnessed by Owner.



SPECIFICATION FOR CONTROL VALVE (WITH PNEUMATIC / ELECTRIC ACTUATOR)

SPECIFICATION NO.: PES – 145 - 06

VOLUME II B

SECTION D

REV. NO. 05

DATE : 15-05-2007

SHEET 1 OF 11

1.0 SCOPE

This specification covers the Design, Manufacture, Inspection and Testing at the manufacturer's works, proper packing for transportation and delivery to site of Control valve (with Pneumatic/Electric Actuator) for use in Utility/Captive Power Station/Combined Cycle Station.

2.0 CODES AND STANDARDS

2.1 All the equipments specified herein shall comply with the requirements of the latest issue of the relevant National and International standards.

2.2 The Design and Materials used for the components shall also comply with the relevant National and International standards.

2.3 As a minimum requirement, the following standards shall be complied with :

Indian Boiler Regulation (IBR)	:	ANSI-B16.104 / FCI-70.2
Allowable Seat leakage	:	ANSI-B16.34
Pressure & Temperature ratings	:	IEC-144 / NEMA / IS-13947
Enclosure class	:	ISA S-75
Control Valves	:	IS-9334
Electric Motor operated Actuators	:	

3.0 TECHNICAL REQUIREMENTS

The Control valve, Actuator and the accessories shall be suitable for continuous operation under an ambient temperature of 0-55°C and Relative Humidity of 0-95% unless specified otherwise in volume IIB Section-B or Section-C.

3.1 Control Valve

The control valve shall be suitably designed for the operating conditions and system characteristics as specified in the Data Sheet-A.

3.1.1 The control valve shall be of globe body design with single port. The valve trim, shall be suitable for quick removal without any cutting or welding.

3.1.2 The material of body, internals and packing shall be as specified in the data sheets. Alternatives, considered more suitable for service specified may be given as alternative offer, along with adequate justification. However main offer shall totally meet specification requirements. Asbestos shall not be used for the packing or any other component.

3.1.3 The valve bonnet and packing shall be suitable for the service conditions as in Data Sheet-A. Gland sealed type bonnets are not acceptable. Double packing is mandatory for applications involving vacuum service. Bonnets having teflon packing shall have valve stem finished to 2-4 microns. Packing material requiring lubrication will not be acceptable. Justification for proper selection of bonnet & packing shall be furnished in the bid.

3.1.4 The valve end connection as specified in Data Sheet-A shall conform to ANSI B16.25 for Butt Weld connection and ANSI B16.5 for flanged ends. End to end dimension shall be as per ANSI 16.10.

3.1.5 The valve seat leakage shall be as per ANSI B16.104 / FCI-70.2. The leakage class shall be as per Data Sheet-A.



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- 3.1.6 The valve body shall have the direction of flow embossed on all valves.
- 3.1.7 The sizing shall conform to the requirements of ANSI/ISA(S75- 01), and the valve capacity shall be selected so as to meet the following:
- | | | | | |
|--|---|---|---|--------------------|
| Valve with Linear characteristic. | - | Normal Flow (Design Point) | : | 70-75% valve lift. |
| | - | Max. Flow | : | 90% valve lift. |
| | - | Min. Flow | : | >10% valve lift. |
| Valve with Equipercantage Characteristic | - | Normal Flow (Design Point) | : | 75-85% valve lift. |
| | - | Max. Flow | : | 90% valve lift. |
| | - | Min. Flow | : | >10% valve lift. |
| ON/OFF Quick open Characteristic | - | 1.1 times the CV calculated on the basis of maximum flow condition. | | |
- 3.1.8 Calculation for valve sizing, velocity and noise shall be subject to purchaser's approval during contract stage. However responsibility of proper selection and design for the duties specified lies with the vendor. Any modifications required to be done on the valves or actuators & accessories to achieve satisfactory performance of the control system shall be done without any commercial implication.
- 3.1.9 Suitable justification and evidence shall be furnished regarding proper selection of the valve.
- 3.1.10 The valve outlet velocities shall be limited to the following values, unless otherwise specified in the Data sheet-A.
- | | | | |
|-----|----------------|----|--|
| i) | Liquid service | <= | 7 Metres/Sec. |
| ii) | Steam service | <= | 1/3 Sonic velocity in the flow medium. |
- 3.1.11 For flashing duty, the trim design shall be such that the vapour bubbles are kept away from valve body.
- 3.1.12 For cavitation service, the trim design shall be of multistage pressure drop type, so as to avoid cavitation altogether, instead of keeping cavitation away from valve parts.
- 3.1.13 In case of predicted noise level above 85 dBA, suitable low noise trim or inbuilt diffusers shall be provided to bring down the noise level below 85dBA.
- 3.1.14 The equivalent weighted sound level measured at 1.5M. above floor level in elevation and one metre horizontally from the control valve expressed in decibels to a reference of 0.0002 microbar shall not exceed 85 dBA (without pipe insulation). The offer shall include noise prediction calculations for each valve.
- 3.1.15 In case of wrong selection/mal operation of valve and for associated actuator during guarantee period, the vendor shall replace the valve suitably with a modified/new valve of design as approved by purchaser and all the expenses for replacement, rectification/modification including transportation both ways will be at vendor's expenses.



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3.2 Pneumatic Actuator

The pneumatic actuators shall be employed for modulating or open/close duty, as specified in Data Sheet-A. The bidder shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drops and shut off pressure.

3.2.1 The pneumatic spring opposed diaphragm actuator for modulating duty shall be capable of positioning the associated valve at desired opening for all the operating conditions specified.

3.2.2 The pneumatic actuator for open/close duty shall be suitable for fast opening/closing of the associated valve.

3.2.3 The actuator design shall allow valve assembly to be mounted at 45° inclination on either side in the vertical plane.

3.2.4 The actuators shall be suitably sized to ensure that the associated valve travel time from full open to full closed position and vice versa is less than 20 seconds under the most stringent service conditions.

3.2.5 The actuator shall be painted with epoxy based paint.

3.3 Accessories for Control valve with Pneumatic Actuator

The bidder shall offer all the accessories as specified in the Data Sheet - A for the Pneumatic Actuators under modulating or OPEN/CLOSE duty. The accessories specified shall be supplied duly mounted on the valve actuator and piped with PVC covered copper tube and flareless brass fittings (Refer typical hook up diagram in sheet 12 of 12).

3.3.1 Handwheel

Handwheel shall have OPEN & CLOSE direction marking and clockwise rotation as viewed from front shall close the valve. The handwheel shall have a circular stainless steel plate with Tag number and service.

3.3.2 Local Position Indicator

Each actuator shall be provided with a mechanical pointer attached to stem, moving over a graduated scale with markings, for OPEN, 25%, 50%, 75%, CLOSE positions.

3.3.3 Position Transmitter

The position transmitter shall be supplied as indicated in Data Sheet-A. The electronic position transmitter shall be non-contact type with 4-20 mA DC 2-wire output suitable for 12-50V DC supply. The resistance type position transmitter shall have 0-100 ohm variation for valve position change of 0-100%. The position transmitters of both types shall have accuracy and enclosure class. Necessary cable glands shall be supplied.



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3.3.4 Air Filter Regulator

Instrument quality air at suitable pressure of 5.5 Kg/Cm²(g) to 7 Kg/Cm²(g) shall be supplied to each valve through air filter regulator. The filter regulator shall include an inbuilt blow-down valve, 5 micron size filter. The design pressure for regulator shall be 7 Kg/cm²g. The Air filter regulator shall be selected to meet the requirements of positioner/actuator, E/P convertor and air-lock. The flow capacity of the Air filter regulator shall be variable with a knob. Output gauge shall be provided wherever pneumatic positioner is not specified for the valve.

3.3.5 Air Lock Relay

Air lock relay shall retain the valve position stayput, in case of air supply failure and shall reset automatically on resumption of air supply. Air lock shall have a threaded plug for evacuating diaphragm air if required for local manual operation.

3.3.6 Solenoid Valves

Solenoid valves are meant for interlock & protection purposes overriding the controller signal, and/or to result stayput action on controller signal failure. The Solenoid valve shall be 3-way **Universal** type and the valve internals shall be of stainless steel. The coil shall have class-H insulation and rated for continuous AC/DC duty as specified in Data sheet-A. The enclosure shall be to IP-55. Cable gland shall be provided for cable entry. The solenoid shall in general conform to IS-8935. The solenoid operation shall be universal type. The solenoid shall be suitable for 24V DC supply, unless specified otherwise in Data Sheet-A.

3.3.7 Limit Switches

Limit switches are required as specified in the data sheet-A. Each limit switch shall have 2NO+2NC contacts with contact rating of 5A at 240V AC/0.2A at 220V DC unless otherwise specified. The switch enclosure shall conform to IP-55. Each limit switch shall be supplied with cable glands.

3.3.8 I/P Converter

I/P Converters shall preferably be of force balance type and shall produce pneumatic output signal corresponding to input current signal, also specified in Data Sheet. Convertor electronics shall be protected against reverse connection of signal polarities and a separate external connection shall be provided to facilitate grounding of instrument casing. Cable glands with neoprene gromets suitable for PVC cables shall be provided. I/P convertor shall have span adjustment facility. I/P convertor enclosure shall conform to IP-55 enclosure class.

3.3.9 Positioner

Positioner shall be suitable for accepting controller output signal 0.2-1.0 Kg/cm², 0.2-0.6 Kg/cm² or 0.6-1.0 Kg/cm² as specified and give an output suitable for the actuator. Pneumatic positioner shall have 3 gauges. All gauges shall have metric scales. The positioner input signal range shall be adjustable. Wherever applicable, it shall be possible to bypass the positioner by means of a switch. **Linearity and Hysteresis shall be as indicated in Data sheet-A**

3.3.10 Electro pneumatic Positioner

In place of separate E/P Converter and pneumatic positioner a combined electro pneumatic positioner can also be supplied. The electro pneumatic positioner shall have 2 gauges.



SPECIFICATION FOR CONTROL VALVE (WITH PNEUMATIC / ELECTRIC ACTUATOR)

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3.3.11 Junction Box

Wherever specified, an integral junction box with all electrical accessories conduited up to JB shall be supplied. The junction box shall have two (2) cable glands for outgoing cables. Junction box shall have enclosure class of IP-55.

3.4 Guarantee & Performance

3.4.1 The overall performance of the control valve with pneumatic actuator assembly shall be as follows:-

i)	Hysteresis	:	$\pm 1\%$ of span
ii)	Linearity	:	$\pm 2\%$ of span
iii)	Sensitivity	:	$\pm 0.5\%$ of span.
iv)	Repeatability	:	$\pm 1\%$ of span
v)	Accuracy (Overall)	:	$\pm 2\%$ of span

3.4.2 The guarantee for the control valve, pneumatic actuator & accessories shall be for 12 months continuous operation from the date of commissioning, unless specified otherwise in VOL-II B Section-B or Section-C.

3.5 Electric Actuator

The electric actuator shall be employed for modulating duty.

3.5.1 The actuator assembly shall be complete with drive motors, gears, hand wheel, signaling & switching units, associated control, integral starter, (when specified) and other accessories as required.

3.5.2 The Electric Actuator shall be capable of positioning the associated valve at the desired opening for all the operating conditions.

3.5.3 The motor shall meet the requirements of Current, torque, Axial thrust, Accelerating & stall time as imposed by the driven equipment.

3.5.4 The motor shall be suitable for direct on line starting.

3.5.5 Motors shall be suitable for inching & plugging duty operations.

3.5.6 The motors shall be capable of starting and accelerating to rated speed at 85% of rated voltage.

3.5.7 The motors shall be rated for continuous operations for modulating duty.

3.5.8 The motor shall operate satisfactorily under the following conditions:

- i) $\pm 10\%$ supply voltage variation at rated frequency.
- ii) -5% to $+3\%$ variation in frequency at rated supply voltage.

3.5.9 Simultaneous variation in voltage and frequency, the sum of absolute percentage not exceeding 10%. The Actuator shall be suitable for mounting directly on the valve and shall be suitable for mounting in any position. Supports required for inclined mounting shall form part of supply of valve assembly.

3.5.10 The actuator shall be capable of producing the required torque and thrust at the output shaft for satisfactory operation of the associated valve.



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- 3.5.11 Each actuator shall have a hand wheel for emergency operation. The hand wheel shall be designed such that it is declutched automatically when the power supply to the motor is restarted.
- 3.5.12 The hand wheel shall be so arranged that when looking from hand wheel, the valve is closed by rotating the hand wheel in clockwise direction.
- 3.5.13 Motor shall be totally enclosed conforming to IP-65 or better as per data sheet. The enclosure shall be suitable to protect the motor from leakage steam, water or oil from valve joints and glands.
- 3.5.14 Where flameproof enclosures are specified, it shall meet the specification IS-2148.
- 3.5.15 Insulation shall be at least class-B or better and shall be tropicalised to withstand the atmospheric condition.
- 3.5.16 The actuator shall be provided with antifriction bearing in grease filled cartridge.
- 3.5.17 Each actuator shall be provided with a mechanical position indicator to indicate accurately the valve position.
- 3.5.18 The integral starter, if specified in data sheet-A, shall be provided in weatherproof enclosure with protection class not less than IP-65 or better as per data sheet.
- The integral starter shall consist of:
- i) Mechanical & Electrically interlocked reversing contractors suitable for class AC4 duty or Thyristor as per data sheet.
 - ii) Thermal overload relay.
 - iii) Step down control transformer with fuses.
 - iv) Interposing relay.
 - v) Monitoring relay..
 - vi) Open, Close & Stop push buttons.
 - vii) Indicating lamps.
 - viii) Local-Remote lockable selector switch with spare potential free contacts, wired for remote interface.
 - ix) A potential free contact shall be provided for remote annunciation of power failure/overload condition. The contact shall be SPDT, rated for at 5A 240V AC or 0.2A at 220V DC.



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- 3.5.19 The actuator shall be suitably time rated for the duty cycle involved with the necessary number of starts per hour, but in no case, less than 1200 starts per hour.
- 3.5.20 The actuator shall be provided with a suitable control unit for receiving 4-20 mA signal from remote controller.
- 3.5.21 The servomotor gear should have self locking or suitable brake so as to maintain it's last position as and when the motor power is switched off.
- 3.5.22 Thermostat/Thermistor as specified in the data sheet shall be provided for sensing the winding temperature and giving trip command. The trip contact shall be change over type. The contact shall be wired up to the actuator terminal box.
- 3.6 Accessories for Control Valve with Electric Actuator
- 3.6.1 Torque Switches
- i) Each actuator shall be provided with at least one open and one close torque switches each with 2 NO+2 NC contacts. The contacts shall be rated for 5A at 240V AC or 0.2A at 220V DC.
 - ii) The torque switches shall have a minimum accuracy $\pm 3\%$ of set value.
 - iii) The torque switches shall be provided with calibrated knobs for setting desired torque. Separate knobs shall be provided for close and open torque switches.
 - iv) The torque switches shall be provided with mechanical latching device to prevent operation when unsealing from the positions. The latching device shall unlatch as soon as the valve leaves the end position. If such provision is not possible, the torque switches shall be bypassed by end position limit switches, which open on valve leaving end position. These limit switches are additional to the number of limit switches specified elsewhere.
 - v) The torque switches or worm gear shall be self-locking type so that when torque switch operates it remains operated until the actuator is operated in the reverse.
 - vi) The torque switch enclosure shall conform to IP-55.
- 3.6.2 Limit Switches
- Each limit switch shall have 2NO+2NC contact with contacts rated for 5A 240V AC/0.2A 220V DC unless otherwise specified. The switch enclosure shall conform to IP-55. Each limit switch shall be supplied with cable glands.
- 3.6.3 Space Heater
- A space heater shall be provided in limit switch and starter compartments to prevent condensation. This shall be suitable for the power supply specified in the data sheet. Where integral starters are provided the space heaters shall be wired to control supply within the actuator.



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3.6.4 Remote Position Transmitter

The position transmitter shall be supplied as indicated in Data Sheet-A. The electronic position transmitter shall be non-contact type with 4-20mA DC 2-wire output suitable for 12-50V DC supply. The resistance type position transmitter shall have 0- 100 ohm variation for valve position change of 0-100%. The position transmitters of both types shall have $\pm 1\%$ accuracy. The enclosure shall conform to IP-55. Necessary cable glands shall be supplied.

3.6.5 Wiring

- i) The actuator and the accessories will be neatly wired up to the terminal boxes.
- ii) The internal wiring shall be minimum of 1 mm² stranded PVC insulated copper conductor.
- iii) The wiring shall be identified by means of numbered ferrules on both ends of all wires.

3.7 Terminal and Terminal boxes

3.7.1 Motor Terminal Box

- i) The terminals, terminal boards, terminal boxes, winding tails and associated equipment shall be suitable for connection to supply system having short circuit capacity specified in data sheet and clearance time determined by the associated fuses.
- ii) The terminals shall be stud type insulated from the frame. The insulation shall not be porcelain. The studs shall be of brass or stainless steel or phosphor bronze of adequate size.
- iii) The terminal box shall be totally enclosed conforming to degree of protection IP-65.

3.7.2 Actuator Terminal Box

- i) All terminals of limit and torque switches, space heater, position transmitters, thermostat/thermister shall be brought to a common terminal box. The enclosure shall be to degree of protection IP-65.
- ii) Terminal board with plug in connector shall be provided. Alternatively stud type or insertion type may be considered. Pinch screw type however will not be accepted. All terminals shall be shrouded to prevent accidental contact. Where stud type terminals are offered, it shall be as per clause 3.7.1 (ii).
- iii) There shall be at least five terminals spare to terminate spare cores of cable.

3.7.3 Cable Glands

The motor terminal box and actuator terminal box shall be provided with required number of double compression nickel plated brass cable glands to suit cable type and associated size.

3.7.4 Earthing Terminal

Two earthing terminal shall be provided on either side of motor and actuator terminal box.

3.7.5 Painting

The Actuator shall be painted with epoxy-based paint.



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4.0 TESTING AND INSPECTION

- 4.1 The bidder shall adopt suitable quality assurance plan to ensure that the equipments offered will meet the specification requirements in full.
- 4.2 The bidder shall furnish the Quality Plan in the format enclosed in volume-III. In case the Quality Plan(s) is/are included in volume-IIB, the bidder shall furnish his Quality Plan strictly in line with the same. The Quality Plan shall be discussed and finalised with the technically accepted bidders before opening the price bid. The stages where purchaser would like to be associated for witnessing or verification of tests would be indicated by the purchaser in the Quality Plan before approval.
- 4.3 The following test shall be conducted as a minimum requirement.
- 4.3.1 Control Valve
- i) Radiographic tests on castings.
 - ii) Dye penetrant tests on machined surface.
 - iii) Ultrasonic tests for the forgings & bars of all valves with 60 Kg/cm² & higher ratings.
 - iv) Hydrostatic tests as per ANSI B 16.34 prior to seat leakage tests.
 - v) Valve closure and seat leakage tests as per ANSI B 16.104 / FCI-70.2.
- 4.3.2 Pneumatic Actuators
- Functional test of actuator and each accessory.
- 4.3.3 Electric Actuator
- i) Routine tests on motors as per IS: 325.
 - ii) Functional test on actuator and each accessory.
 - iii) Insulation resistance and high voltage test.
 - iv) Stall current & Stall torque test.
 - v) Output shaft speed and torque of actuator and corresponding current tests.
- 4.3.4 Control valve with Actuator & Accessories fully assembled
- i) Functional tests of control valve operation along with actuator & accessories.
 - ii) Dimension checks.
- 4.3.5 Type tests or Test Reports
- i) Valve lift vs. Flow test (Cv Test)
 - ii) Degree of protection tests for the enclosures
 - ii) Temperature rise test (applicable for Electrical Actuator only).
 - iii) Type test for motor as per IS: 325.
- 4.4 Inspection will be conducted by BHEL and/or their authorised representatives as per the agreed inspection schedule. The inspection schedule will be submitted by the bidder, for BHEL's approval at contract stage. The cost of all tests and inspections will be deemed to have been included in the bid. For all the type tests covered under 4.3.5 above, "Type Test Certificates" as per agreed Quality Plan shall be furnished. In the absence of the same, such Type Tests shall be arranged at the Vendor's works in the presence of BHEL and/or their authorised representatives or in independent Test House/Laboratory approved by BHEL.
- 4.5 The Standard QP is included in this specification to enable bidder to understand the extent of inspection and testing requirements to execute this job. The successful bidder has to follow the agreed QP, taking care of customer requirements mentioned in Sec-C and submit QP for final approval by BHEL / Customer.



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5.0 SPARES AND CONSUMABLES

5.1 Commissioning Spares and consumables

As part of the main equipment supply, the bidder shall supply all commissioning spares and consumables required during Start-up,

5.2 Mandatory Spares

The bidder shall offer along with main offer, the Mandatory Spares as specified in Volume IIB Section-C of the specification. The Mandatory Spares offered shall be of the same make and type as the main equipment.

5.3 Recommended Spares

The bidder shall furnish a list of Recommended Spares along with the normal service expectancy period and frequency of replacement; quantities recommended for 3 years operation along with unit rate against each item to enable BHEL / BHEL's Customer to place a separate order later, if required.

5.4 Special Tools & Tackles

The bidder shall furnish a list of Special Tools & Tackles included in the bid.

6.0 DRAWINGS AND DOCUMENTS

6.1 The bidder shall furnish the following documents in required number of copies along with the bid:

6.1.1 Data sheet-B, completely filled-up along with all enclosures.

6.1.2 Wiring diagrams for Electrical Actuators.

6.1.3 Hook up diagrams of Control Valve with Actuator & accessories.

6.1.4 Valve & actuator assembly dimensional drawings with weights.

6.1.5 Quality Plan

6.1.6 All relevant Catalogs with detailed technical information.

6.1.7 Bar-chart to indicate the time schedule for procurement, manufacture, testing and despatch.

6.2 The successful bidder shall furnish the following documents in required number of copies to BHEL during the contract stage:

6.2.1 For approval

- i) Dimensional drawings.
- ii) Installation drawings with overall dimensions of the completed equipment and clearances for operation and maintenance.
- iii) Data sheet-C, completely filled-up along with all the enclosures including the sizing calculations & noise calculations.
- iv) Quality Plan.
- v) Test Certificates.



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6.2.2 Final / As-built Drawings

Final / As-built drawings / CDs in required number of copies shall be submitted.

6.3 Operation & Maintenance Manuals

O&M Manuals in required number of copies shall be submitted. O&M manuals shall also contain storage and commissioning instructions.

7.0 MARKING AND PACKING

7.1 Marking

A stainless steel metal nameplate should be permanently fixed on each equipment giving its tag number and technical specifications.

7.2 Packing

All equipment / materials shall be suitably packed and protected for the entire period of dispatch, storage and erection against impact, abrasion, corrosion, incidental damage due to vermin, sunlight, high temperature, rain, moisture, humidity, dust, sea water spray (where applicable) as well as rough handling and delays in transit and storage in open.

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8.0 APPLICABLE DATA SHEET FORMS

This document shall be read with one or more of the following data sheet forms :

- Data sheet A&B for Control Valve with Pneumatic Actuator
- Data sheet C for Control Valve with Pneumatic Actuator
- Data sheet A&B for Control Valve with Electric Actuator
- Data sheet C for Control Valve with Electric Actuator



SPECIFICATION FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER (SMART)

SPECIFICATION NO.: PES – 145 – 06A

VOLUME

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1.0 Electrical :

Input Signal	4-20mA
Power Supply	Loop Powered from the output card of Control System (12-30 V DC)
Hart Protocol	Compatibility for Remote Calibration & Diagnostic (Super-Imposed HART Signal on Input Signal to positioner (4-20mA)
Valve Position Feedback	4-20mA output signal for Position Feedback is to be provided to control system.

2.0 Environment :

Operating Temperature	(-) 30 To 80 Deg.C
Humidity	0-95%
Protection Class	IP-65 (Minimum)

3.0 Diagnostic Features :

Diagnostic / Test Features (to be available in Smart Positioner and shall be accessible through any HMS software)	Minimum Diagnostic Features Like • Measurement of Valve positioning timing, • Detection of actuator leakage, • Display of fault alarm. • Logging of alarms and history. • Valve friction/jamming detection. • Detection of valve wear & tear, • Valve stroke length and timing.
	Advanced Diagnostic Features Like (OPTIONAL, if specified in customer's specification) • On line partial closure test. • Valve signature analysis (online graphical/tabular representation of input signal Vs valve travel). • Step response test.

4.0 Software :

Software (to be supplied alongwith smart positioner)	• Windows based software to meet the requirement for configuration, diagnostics, calibration and testing of Valve and actuator. • Easily up-gradable with same hardware and compatible with any Hart Management Systems (HMS). • Shall be capable to cater to all the tags in the specification at the same time.



SPECIFICATION FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER (SMART)

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5.0 Hardware :

Hardware (As required)	1. PC with software for configuring and accessing diagnostic features of the positioners.
	2. Multiplexers for interfacing smart positioner with PC.
	3. Communication cable for interconnecting multiplexers with PC.
	4. RS232/RS485 converter (if required)

Note : Power supply for Multiplexer shall be arranged by the owner.

6.0 Valve Action :

Valve Action	Direct & Reverse. (Same positioner for Single Acting or Double Acting And no separate relays required for changing from Single acting to double).
	During Failure of input Electrical signal (4-20 mA), valve to attain fail Freeze position without any external hardware. (Sol valve, Power Supply etc.)

7.0 Flow Characterization :

Flow Characterization	Possible to fit valve characteristic curve linear & Equal percentage

8.0 Performance:

Characteristic Deviation	$\leq 0.75\%$ of span
Ambient temp effect	$\leq 0.01\%$ /Deg C or better.
Dead Band	Adjustable 0.1 to 10%.
Scan Time	10ms
Resolution	$\leq 0.05\%$
Sensitivity/Linearity	0.3-0.4% of FS
Repeatability	0.32% of FS

9.0 Test Certificates:

Test Certificates/Test Reports for degree of protection, Accuracy and calibration test (as a minimum) to be submitted as per Manufacture Standard / Relevant Standard.

10.0 EMC & CE compliance

International Standard Like EN/IEC.

To EN 50081-2 & EN 50082 or equivalent



SPECIFICATION FOR MICROPROCESSOR BASED ELECTRONIC POSITIONER (SMART)

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11.0 Accessories

In Built Operator Panel	Display with push buttons for Configuration and display on the positioner itself
Hand Held Hart Calibrator (Optional)	Universal Hart Calibrator To Be Provided, One Per Unit.
Press Gauge Block	For Supply & Output Pr., Filter Regulator Other Accessories Shall Be Provided As per Control valve hook-up diagram.
Electrical cable entry	½ - NPT, side or bottom entry to avoid water Ingress.



Technical specification for Control Valves with Accessories (Pneumatically Operated)

Tag No..... Quantity.....

APPLICABLE FOR TAG Nos. WHEREVER STATEMENT "REQUIRED" INDICATED IN THE INDIVIDUAL CV DATA SHEETS

DATA SHEET – A & B for ACCESSORIES

DATA SHEET – A FOR CONTROL VALVE (WITH PNEUMATIC ACTUATOR)
(TO BE FILLED BY PURCHASER)DATA SHEET – B
(TO BE FILLED-UP BY BIDDER)

POSITIONER	MFR. & MODEL NUMBER					
	BYPASS	GAUGES	ENCL. CLASS	☐ YES ☐ NO	☐ THREE ☐ TWO	☐ IP-55
	INPUT SIGNAL (Kg / Cm ²)		☐ 0.2 – 1.0 ☐ 0.2 – 0.6 ☐ 0.6 – 1.0			
	OUTPUT SIGNAL (Kg / Cm ²)		TO SUIT ACTUATOR			
AIR FILTER REGULATOR TWO (2) Nos. PER CV	MFR. & MODEL NUMBER					
	AIR SUPPLY PRESS (Kg / Cm ² g)		☒ 7.0 ☐			
	OUTPUT PRESS (Kg / Cm ² g)		TO SUIT ACTUATOR			
	FILTER SIZE		5 MICRON			
AIR LOCK	OUTPUT GAUGE		☒ REQUIRED ☐ NOT REQUIRED			
	MFR. & MODEL NUMBER					
	SET PRESS (Kg / Cm ²)					
	SUPPLY PRESS (Kg / Cm ²)		☒ 7.0 ☐			
	RESET TYPE		AUTO			
LIMIT SWITCH	VENT PLUG		REQUIRED			
	MFR. & MODEL NUMBER					
	OPEN posn	INT posn	CLOSE posn	1 NO.	---	1 NO.
	CONTACT TYPE		SPDT 2 NO + 2 NC			
	RATING (AC / DC)		5A 240V AC AND 0.2A 220V DC			
POSITION TRANSMITTER	ENCLOSURE CLASS		☒ IP-64 ☐			
	MFR. & MODEL NUMBER		☒ Electronic (2-Wire) Contactless ☐ OTHER			
	TYPE		PART OF SMART POSITIONER			
	SUPPLY					
	OUTPUT RATING					
	ACCURACY					
SOLENOID VALVE	ENCLOSURE CLASS					
	MFR. & MODEL NUMBER					
	RATING		☒ 24V DC ☐ 220V DC ☐ 240V AC ☐			
	TYPE		3-WAY (UNIVERSAL OPERATION TYPE)			
	OPERATION	QUANTITY	☐ Stayput ☐ Interlock ☐ 1 ☐ 2			
	COIL INSULATION CLASS		CLASS - F			
HANDWHEEL	ENCLOSURE CLASS		☒ IP 65 ☐ NEMA 4 ☐			
	ORIENTATION		☐ TOP MOUNTED ☒ SIDE MOUNTED			
JUNCTION BOX	NO. OF WAYS		☐ 24-WAYS ☐ AS REQUIRED ☒ 36-Ways			
	SIZE		AS REQUIRED			
	CABLE GLANDS (Size / Quantity)		AS REQUIRED (Double Compression Type).			
	ENCLOSURE CLASS		☒ IP 65 ☐			
I/P CONVERTER	INPUT SIGNAL	POWER SUPPLY	PART OF SMART POSITIONER			
	SPLIT RANGE					
	ENCLOSURE CLASS					
	LINEARITY					
	HYSTERESIS					
Cu. Tubing & Fittings / per CV	This is in addition to cu. Tubing and fittings which are integral part of CV		25 Meters of 1/4" PVC coated Cu. Tubing, with 1 set of Fittings for each CV for connection to IA Header on one end and accessories on another end of CV.			
						COMPANY SEAL
						NAME
						SIGNATURE
						DATE

STANDARD HOOK UP DIAGRAM FOR PNEUMATICALLY OPERATED CONTROL VALVE

JOB NO. 999					PROJECT STANDARD														
STATUS STANDARD																			
PRINT SCALE 										BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA					DEPT. CODE I		NAME SIGN DATE		
REV	DATE	ALTD	CHKD	APPD											DESN PJ/RV		08.12.14		
															CHD CM		08.12.14		
															APPD DP		08.12.14		
					TITLE :- STANDARD HOOK UP DIAGRAM FOR PNEUMATICALLY OPERATED CONTROL VALVE														
										DEPT. SCALE					DRAWING/DOC. NO.				
										SIGN					PES-145-06B				
										DATE					SHEET 1 OF 7 REV. 00				

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LEGEND

PG	PRESSURE GAUGE
VB	VOLUME BOOSTER
SOV	SOLENOID OPERATED VALVE
I/P	CURRENT TO PNEUMATIC CONVERTER
JB	JUNCTION BOX
LS	LEVEL SWITCH
AIR SET	AIR FILTER REGULATOR



STANDARD

**DRG.
No.**

PES-145-06B

TITLE:-

CONTROL VALVE HOOK-UP DIAGRAM

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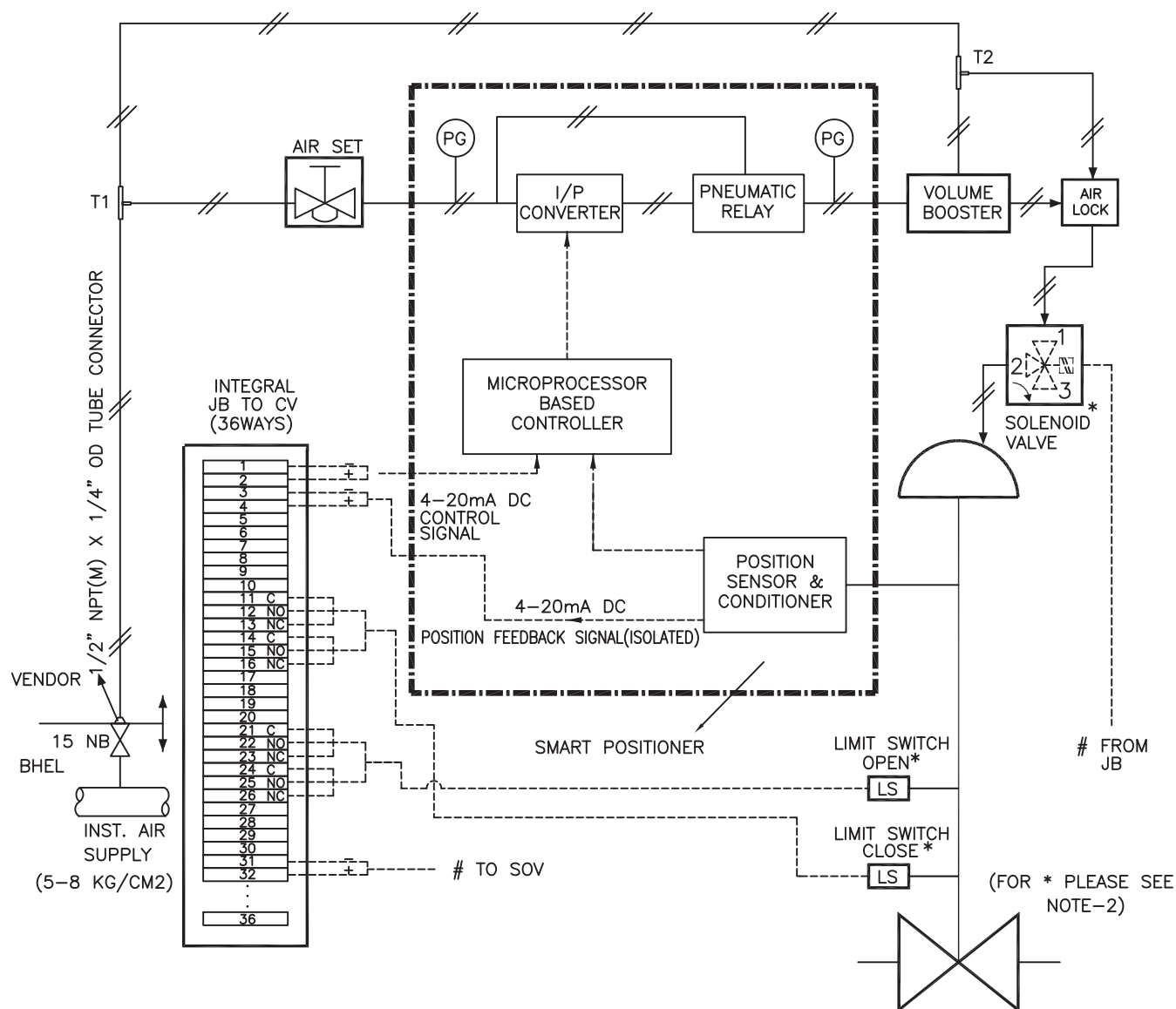
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STANDARD CONTROL VALVE HOOK-UP DIAGRAM (WITH SMART POSITIONER)



NOTES :-

1. POSITION OF EACH VALVE ON SUPPLY AIR FAILURE / ELECTRICAL SIGNAL FAILURE SHALL BE AS PER SPECIFICATION / DATA SHEET.
2. SOLENOID VALVE & LIMIT SWITCHES WILL BE PROVIDED ONLY FOR CONTROL VALVES IF INDICATED IN RESPECTIVE DATA SHEETS.
3. SOLENOID VALVES PORTS CONDITION:
PORT 1 AND 2 SHALL BE CONNECTED UNDER DE-ENERGISED CONDITION.
PORT 2 AND 3 SHALL BE CONNECTED UNDER ENERGISED CONDITION.
4. PRESSURE GAUGES REQUIRED FOR AIR SUPPLY & OUTPUT(S).
5. MOUNTING ACCESSORIES AS REQUIRED.
6. POSITION FEEDBACK SIGNAL SHALL BE 2 WIRE 4-20mA ISOLATED SIGNAL.
7. JB TERMINALS SHALL BE CAGE CLAMP TYPE SUITABLE FOR 2.5 SQ. MM COPPER WIRE. EXTERNAL CONNECTION, OF PLUG IN TYPE OR THROUGH CABLE GLAND, SHALL BE AS PER DATA SHEET
8. ALL APPLICABLE ACCESSORIES SHALL BE PROVIDED AS INDICATED IN THE INDIVIDUAL CONTROL VALVE DATA SHEET / ACCESSORIES DATA SHEET.
9. 12 METERS 1/4" PVC COATED COPPER / SS TUBING (AS PER ACCESSORIES DATA SHEET) & 1 SET OF FITTINGS TO BE SUPPLIED FOR EACH CONTROL VALVE FOR CONNECTION TO ISO VLV AT INST AIR HEADER ON ONE END AND TO AIR LOCK RELAY/AIR FILTER REGULATOR ON THE OTHER END. ALL THE BRASS / SS FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.
10. VOLUME BOOSTER (ALONG WITH TEE-T2 AND RELATED TUBING & CONNECTORS) SHALL BE PROVIDED IF REQUIRED. AIR CONNECTION TO VOLUME BOOSTER FROM TEE-T2 SHALL BE PROVIDED.



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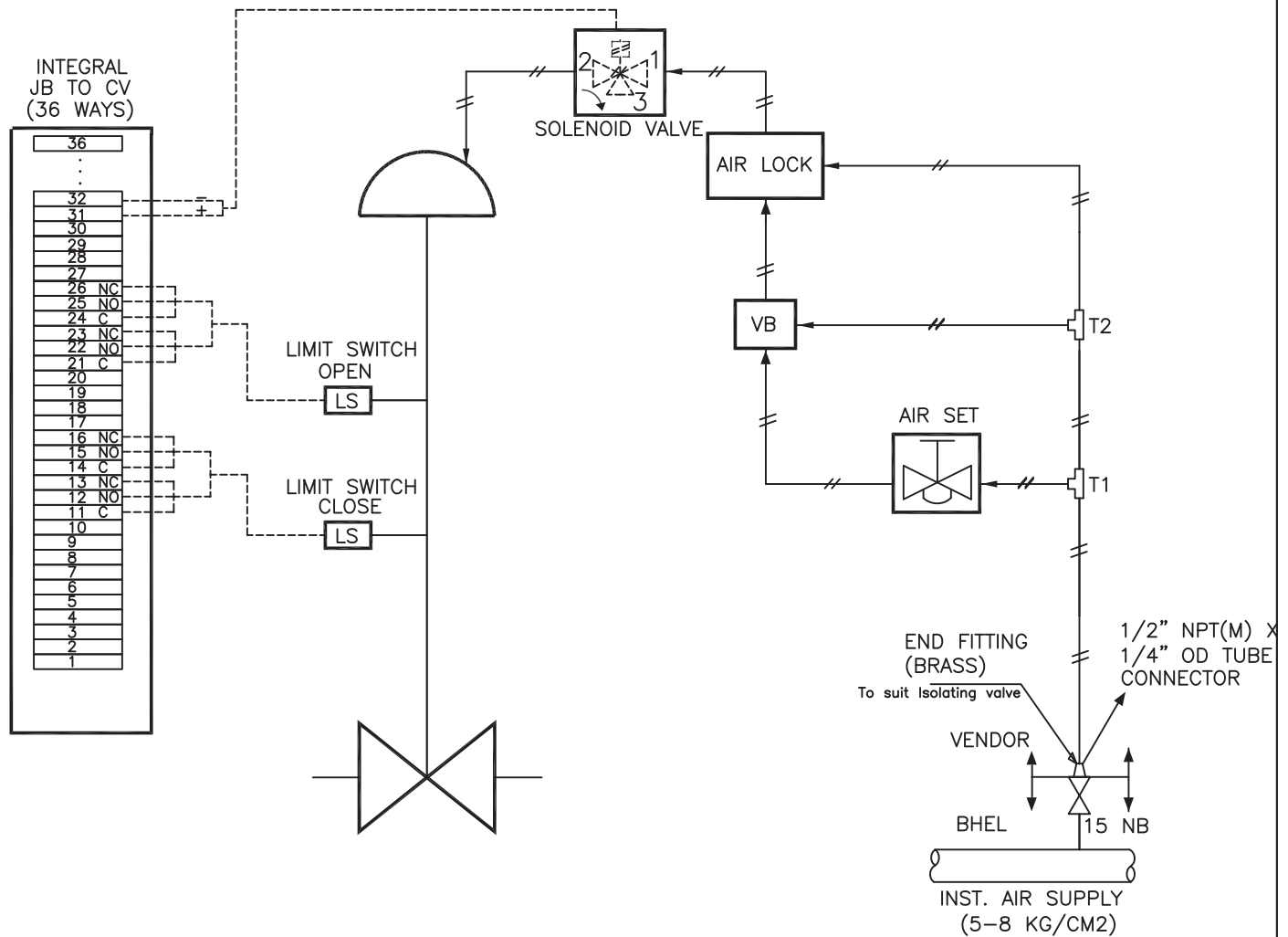
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STANDARD CONTROL VALVE HOOK-UP DIAGRAM (FOR ON / OFF TYPE)



NOTES :-

1. POSITION OF EACH VALVE ON SUPPLY AIR FAILURE / ELECTRIC SIGNAL FAILURE SHALL BE AS PER SPECIFICATION / DATA SHEET.
2. SOLENOID VALVES PORTS CONDITION:
PORT 1 AND 2 SHALL BE CONNECTED UNDER DE-ENERGISED CONDITION.
PORT 2 AND 3 SHALL BE CONNECTED UNDER ENERGISED CONDITION.
3. MOUNTING ACCESSORIES AS REQUIRED.
4. JB TERMINALS SHALL BE CAGE CLAMP TYPE SUITABLE FOR 2.5 SQ. MM COPPER WIRE. EXTERNAL CONNECTION, OF PLUG IN TYPE OR THROUGH CABLE GLAND, SHALL BE AS PER DATA SHEET.
5. ALL APPLICABLE ACCESSORIES SHALL BE PROVIDED AS INDICATED IN THE INDIVIDUAL CONTROL VALVE DATA SHEET / ACCESSORIES DATA SHEET.
6. 12 METERS 1/4" PVC COATED COPPER / SS TUBING (AS PER ACCESSORIES DATA SHEET) & 1 SET OF FITTINGS TO BE SUPPLIED FOR EACH CONTROL VALVE FOR CONNECTION TO ISO VLV AT INST AIR HEADER ON ONE END AND TO AIR LOCK RELAY/AIR FILTER REGULATOR ON THE OTHER END. ALL THE BRASS / SS FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.



STANDARD

TITLE:-

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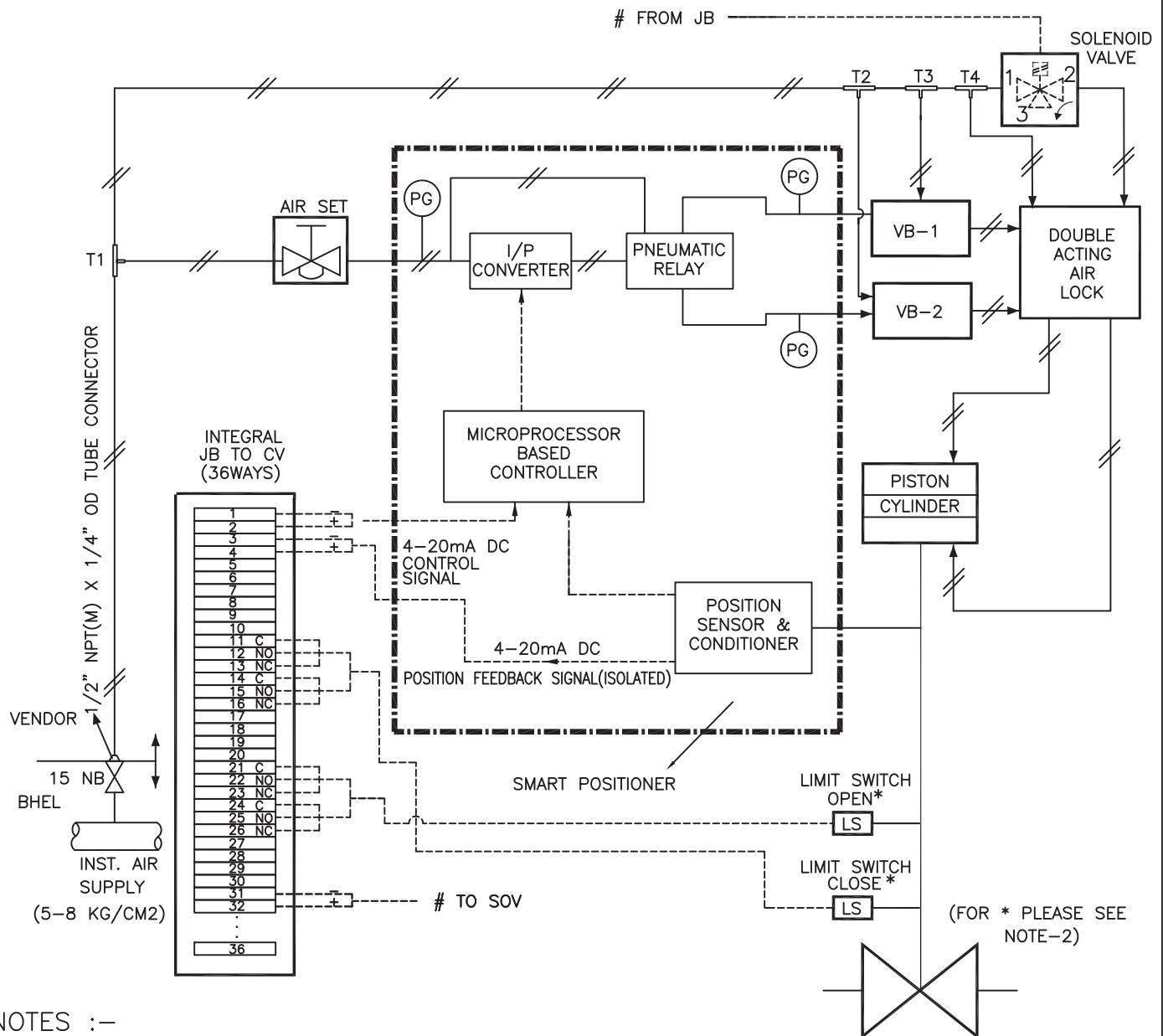
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STANDARD CONTROL VALVE HOOK-UP DIAGRAM (DOUBLE ACTING PISTON ACTUATOR WITH SMART POSITIONER)



NOTES :-

1. POSITION OF EACH VALVE ON SUPPLY AIR FAILURE / ELECTRICAL SIGNAL FAILURE SHALL BE AS PER SPECIFICATION / DATA SHEET. AIR LOCK SHALL BE PROVIDED ACCORDINGLY.
2. SOLENOID VALVE & LIMIT SWITCHES WILL BE PROVIDED ONLY FOR CONTROL VALVES IF INDICATED IN RESPECTIVE DATA SHEETS.
3. SOLENOID VALVES PORTS CONDITION:
PORT 1 AND 2 SHALL BE CONNECTED UNDER DE-ENERGISED CONDITION.
PORT 2 AND 3 SHALL BE CONNECTED UNDER ENERGISED CONDITION.
4. PRESSURE GAUGES REQUIRED FOR AIR SUPPLY & OUTPUT(S).
5. MOUNTING ACCESSORIES AS REQUIRED.
6. POSITION FEEDBACK SIGNAL SHALL BE 2 WIRE 4-20mA ISOLATED SIGNAL.
7. JB TERMINALS SHALL BE CAGE CLAMP TYPE SUITABLE FOR 2.5 SQ. MM COPPER WIRE. EXTERNAL CONNECTION, OF PLUG IN TYPE OR THROUGH CABLE GLAND, SHALL BE AS PER DATA SHEET
8. ALL APPLICABLE ACCESSORIES SHALL BE PROVIDED AS INDICATED IN THE INDIVIDUAL CONTROL VALVE DATA SHEET / ACCESSORIES DATA SHEET.
9. 12 METERS 1/4" PVC COATED COPPER / SS TUBING (AS PER ACCESSORIES DATA SHEET) & 1 SET OF FITTINGS TO BE SUPPLIED FOR EACH CONTROL VALVE FOR CONNECTION TO ISO VLV AT INST AIR HEADER ON ONE END AND TO AIR LOCK RELAY/AIR FILTER REGULATOR ON THE OTHER END. ALL THE BRASS / SS FITTINGS SHALL BE DOUBLE COMPRESSION TYPE.
10. VOLUME BOOSTER (ALONG WITH TEE-T2 AND RELATED TUBING & CONNECTORS) SHALL BE PROVIDED IF REQUIRED. AIR CONNECTION TO VOLUME BOOSTER FROM TEE-T2 & TEE-T3 SHALL BE PROVIDED.



STANDARD

DRG.
No.

PES-145-06B

TITLE:-

CONTROL VALVE HOOK-UP DIAGRAM

REV.
No.

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DATE

08.12.14

SHEET

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OF

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
1.0	MATERIAL											
1.1	Body & Bonnet casting / forgings, plug, valve stem, seat ring/cage.	1. Physical, Chemical properties	MA	Physical, Chemical tests	One/ Heat(HT Batch)	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3	---	2,1	
		2. Heat Treatment	MA	Review of H.T. Chart	Each H.T.	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Test Certificate	3/2	2	1	IBR Certification (if applicable) to be verified by BHEL
		3. Internal quality of castings	MA	RT for Body & UT for Bonnet(NDT)	100%	ASME B 16.34	ASME B 16.34	Test Report / FILM	3/2	2	1	Only for rating ANSI 900 and above. Applicable for Body and Bonnet only. For Lower rating only if called for in specification.
		4. Surface Quality	MA	1. Visual	100%	MSS-SP-55	MSS-SP-55	Test Certificate	3/2	---	2,1	
				2. MT/PT	100%	ASME B 16.34	ASME B 16.34	Test Certificate	3	2	1	After Machining on machined surface only

LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor											

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		5. Pressure test for shell	MA	Hyd. Test	100%	ISA-S-75.19/ ASME B 16.34	ISA-S-75.19/ ASME B 16.34	Test Certificate	2	2	1	For Body & Bonnet after machining
1.2	Diaphragm	1. Surface Quality	MA	Visual	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		2. Hardness	MA	Measurement	100%	Mfr. standard	Mfr. standard	Test Certificate	3/2	---	2,1	
		3. Endurance / Life cycle	MA	Cyclic test 10,000 cycles	One / Type	10,000 cycles/ Mfr. standard.	No damage	Test Certificate	3/2		2,1	
1.3	Spring	1. Composition	MA	Chemical-Analysis	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		2. Mech. Properties	MA	Mech. Test	One sample/ Heat	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
		3. Performance	MA	1. Stiffness ratio	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				2. Scragging	100%	Material spec. / Mfr. standard	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				3. Cyclic test (Endurance)	One / type	10,000 cycles	Material spec. / Mfr. standard	Test Certificate	3	---	2,1	
				4. Dimension (Measurement)	One sample/ Lot	Mfr. standard	Appd Drg	Record	3	---	2,1	

LEGEND: * CR - Critical characteristics
 MA - Major characteristics
 MI - Minor characteristics

RT- Radiographic Test
 UT – Ultrasonic Test

PT – Dye penetrant Test
 MT- Magnetic Test

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 W - Agency Witnessing the Test.
 V - Agency Verifying the Test.

1 - BHEL
 2 - Vendor
 3 - Sub-vendor

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Sl. No.	Component / operation	Characteristics Checked	* Cate gory	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks	
									P	W	V		
1.4	Electrical items [Limit switches, Solenoids, Position Transmitter(if provided externally)]	1. Routine Test	MA	HV, IR, Continuity function	100%	Rele. Standards	Rele. Standards	Test Certificate	3	---	2,1	In case TC is not available, Actual test shall be conducted	
		2. Degree of protection	MA	IP/NEMA Tests	One sample / type	Approved Data sheet	Approved Data sheet	Test Certificate	3	---	2,1		
1.5	Pressure Gauges	1. Performance	MA	Review of calibration certificates	100%	Mfr. Standard	Mfr. Standard	Test Certificate	3	---	2,1		
		2. Marking	MA	Visual	100%	Mfr. standard	Mfr. standard	Records	3	---	2,1		
2.0	IN PROCESS INSPECTION												
2.1	After machining, i, Body ii Bonnet iii Plug iv Valve Stem v seat ring/cage	1. Surface flaws	MA	Visual & MT/PT	100% (on accessible surfaces)	ASME B 16.34	ASME B 16.34	Test Records	2	---	1	Butt weld ends shall be included.	
		2. Dimensional checks	MA	Measurement	100%	Mfr. Standard	Mfr. Standard	Records	2	---	1		
		3. Hard facing (wherever applicable)	MA	Hardness Measurement	One sample/Lot	Mfr. Standard	Mfr. Standard	Records	2	---	1		
2.2	Lapping	Machining surface contact	MA	Blue Matching	One sample/lot	-----	Proper Physical Contact	---	2	---	---		
3.0	TESTS ON COMPLETED VALVE												
LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor													

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
3.1	Actuator Chamber	Leakage & Strength	MA	Pneumatic test	100%	Mfr. Standard	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.2	Body	Leakage and Pressure test (Body Mount Leakage)	MA	Hydro test	100%	ISA - S-75.19	No Leakage	Test Certificate	2	1	1	Refer Note-4
3.3	Seat leakage test for completed valve	Seat Leakage	MA	Pneumatic Test	100%	FCI-70.2	FCI-70.2	Test Certificate	2	1	1	Refer Note-4
4.0	OPERATION TEST ON COMPLETED VALVE (Final inspection)	1. Valve Travel	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		2. Opening/Closing time	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		3. Linearity/cam characteristic	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		4. Repeatability	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		5. Hysteresis	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		6. Sensitivity	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		7. Accuracy (Overall)	MA	Measurement	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Report	2	1	1	Refer Note-4
		8. Control Valve characteristics / CV Test	MA	♦ Measurement (Press. vs. discharge and discharge vs. opening 0-100% in steps of 10%)	One per type	As per specs/ Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	--	1	♦ Size = Body & port size Or Body size & CV for non std port. Refer Note 1.

LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test MI - Minor characteristics							\$ P - Agency Performing the Test. W - Agency Witnessing the Test. V - Agency Verifying the Test.		1 - BHEL 2 - Vendor 3 - Sub-vendor	

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
		9. Operation of limit switch & solenoids and other accessories	MA	Function	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Report	2	1	1	On assembled valve Refer Note-4
		10. Overall dimensions	MI	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Records	2	1	1	Refer Note-4
		11. Pre defined valve position in case of air failure	MA	Visual	100%	As per spec & Appd drg	As per spec & Appd drg	Test Certificate	2	1	1	
		12. Cleanliness, painting, stamping (for direction of flow), Tag No.	MA	Visual and dimensional	100%	Approved drg. / data sheet	As per specs/ Approved drg. / data sheet	Test Certificate	2	1	1	
5.0	AUXILIARY ITEMS (Performance test of auxiliary items shall be performed on the completely assembled valve)											
5.1	Positioner	Overall leakage after assembly including Nozzles leakage	MA	Leak Test (in the steady state input signal)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	Overall leakage including tubing
5.2	Air filter regulator	1. Normal air consumption	MA	Measurement	Each type	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
		2. Overall leakage	MA	Visual (soap solution)	100 %	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.3	Air lock relay	Performance Test	MA	Leakage test	100%	Mfr. Standard	No leakage	Test Certificate	3/2	---	1	
5.4	Electronic position transmitter(not applicable if provided integral to smart positioner)	1. Accuracy	MA	Operation	100%	Approved data sheet /	Approved data sheet /	Test Certificate	2	1	1	

LEGEND: * CR - Critical characteristics
MA - Major characteristics
MI - Minor characteristics

RT- Radiographic Test
UT - Ultrasonic Test

PT - Dye penetrant Test
MT- Magnetic Test

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1 - BHEL
2 - Vendor
3 - Sub-vendor

 PEM :: C&I		STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)						QUALITY PLAN NO.: PE-QP-410-145-I 006				
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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	
5.5	Current to Pneumatic converter(not applicable for smart positioner)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
5.6	Smart Positioner (As Applicable)	1. Physical Verification Make/Model	MA	Visual	100%	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	2	---	2,1	
		2. Degree of Protection	MA	IP/NEMA test	Each type	Relevant Standard	Relevant Standard	Test Certificate	3	---	2,1	
		3. Linearity	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		4. Hysteresis	CR	Measurement	100%	Approved drg. / data sheet / BHEL specn.	Approved drg. / data sheet / BHEL specn.	Inspection Report	2	---	1	
		5. Calibration with Hand Held Communicator	MA	Measurement	Each type	Approved data sheet / Mfr. Standard	Approved data sheet / Mfr. Standard	Test Certificate	2	1	1	
6.0	PAINTING	Soundness of Painting	MA	Visual and Measurement	100%	BHEL specn. / Mfr. Standard	BHEL specn. / Mfr. Standard	Inspection Report	2	---	---	Refer Note-2
7.0	PACKING	Soundness of Packing against transit damage	MA	Visual	100%	Mfr. Standard	Mfr. Standard	Inspection Report	2	---	---	Refer Note-3
LEGEND: * CR - Critical characteristics RT- Radiographic Test PT – Dye penetrant Test \$ P - Agency Performing the Test. 1 - BHEL MA - Major characteristics UT – Ultrasonic Test MT- Magnetic Test W - Agency Witnessing the Test. 2 - Vendor MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor												

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Sl. No.	Component / operation	Characteristics Checked	* Category	Type/Method of Check	Extent of Check	Reference documents	Acceptance Norms	Format of Records	Agency \$			Remarks
									P	W	V	

NOTES:

1. In case valid CV test certificate for a similar control valve(Same type, Same size, Same CV) is not submitted to BHEL by the vendor, CV test shall be conducted at FCRI/Any govt. approved laboratory/ BHEL approved Laboratory.
2. In the absence of BHEL spec. for painting, vendor to obtain BHEL's approval on their painting specification / procedure.
3. Sea worthy packing shall be provided, if applicable.
4. The quantum of check shall be 100% for manufacturer and 10% for BHEL/BHEL nominated inspection agency.
5. IBR certificates in Form III-C shall be submitted if called for in the specification/datasheet.
6. Copies of all TC's(Test Certificates) for materials duly correlated with Heat Nos., TC's for electrical items and mechanical tests(Leak/Operation) shall be submitted to BHEL for verification and acceptance.

LEGEND:	* CR	- Critical characteristics	RT- Radiographic Test	PT – Dye penetrant Test	\$ P	- Agency Performing the Test.	1 - BHEL
	MA	- Major characteristics	UT – Ultrasonic Test	MT- Magnetic Test	W	- Agency Witnessing the Test.	2 - Vendor
	MI	- Minor characteristics			V	- Agency Verifying the Test.	3 - Sub-vendor

- 6.07.00 Established Reliability & Availability
- 6.07.01 The minimum target reliability of each component/module shall be established by taking into consideration its Mean time between failure (MTBF) and Mean time to repair (MTTR), so that availability of the complete system is assured for 99.7%.
- 6.07.02 In order to establish the target reliability Bidder shall perform necessary availability tests and burn-in tests for major systems. Surge protection for solid state systems, selection of proper materials, manufacturing processes, quality controlled components and parts, adequate derating of electronic components and parts shall be ensured to meet the reliability and life expectancy goals.
- 6.07.03 Continuous self-checking features shall be incorporated in system design with automatic transfer to healthy/redundant circuits to enhance the reliability of the complete system.
- 6.08.00 Security and Failure Philosophy
- 6.08.01 General
- It is essential that interlock, protection, supervision and automatic control systems shall have high integrity. Control & Instrumentation system shall meet the following requirements:
- a) No single failure shall cause failure of the control.
 - b) No single fault shall cause the protection system to operate spuriously or cause the protection system to become inoperative.
 - c) Grouping of the control functions into system blocks shall be such that failure of any one block will only partly degrade the overall system.
 - d) Control system shall be structured with redundancy so that no single failure within the control system can cause the failure of plant on duty and at the same time cause the standby plant to be unavailable.
 - e) Due to control system failure if a final control element or plant item does not respond then the control element shall go into a fail safe status.
 - f) Field wiring for contact interrogation or device control shall be protected such that a fault on the cable does not cause loss of more than a minimum tolerable functionality of the system.
- 6.08.02 Measurement , Control & Channel Redundancy
- To meet the failure and self checking criteria for the control system, measurement redundancy shall be provided for all the critical parameters. Throughout the control system, the security and validity of signals are to be ensured based on the following design principles.
- a) Where a plant measurement is to be duplicated or triplicated such signals shall be separately fed to the different input modules.

- b) Signals, after due security and validity checking by means of voting, averaging, median, difference monitoring or similar technique shall be used for control functions.
- c) Where duplicated measurements are used, provision shall be there for selecting any one as the duty signal. Continuous monitoring of difference between the signals shall be made.
- d) For binary and analog inputs required for protection of SG , TG and major auxiliaries whose non availability may result in loss of generation triple sensing devices shall be provided . Binary and analog inputs , which are required for protection of more than one equipment as well as protection signals for important auxiliaries and HT drives etc. triple sensing devices shall be provided .Also other binary and analog inputs required for CLCS dual sensing devices shall be provided . However,for those binary and analog inputs which are also required for protection in addition to CLCS, triple sensing devices shall be provided.
- e) Measurement system, CLCS and OLCS shall all be configured with redundancy at processor modules,communication modules, data bus and power supply modules.Triple redundancy shall be followed as described elsewhere in the specification.All servers shall be dual redundant.
- f) Both CLCS & OLCS shall be configured with Redundant I/O channels for each sensor/signals. Where redundant sensors are provided redundant I/O channels shall be provided for each sensors/signals.
- g) Redundant sensors shall be provided for all control applications. For all closed loop controls (CLCS) triple redundant sensors shall be provided. This will include sensors provided for compensation also. Similarly for critical protection logic requirements triple redundant sensors for 2 out of 3 logic shall also be provided to avoid spurious tripping. For all other control application dual redundant sensors shall be provided.Dual and Triple redundant sensors shall also be provided as described elsewhere in the specification.
- h) Signals shall be verified against cable failure / non coincidence monitoring for critical trip signals for SG/TG/ all HT auxiliaries.

6.08.03 Redundancy in input / output modules

1. Redundancy

- a) Redundancy in input / output modules for close loop control systems, open loop control system, protection, interlocking and sequential control shall be provided as follows:
 - i) Wherever redundant sensors are employed each sensor shall be wired to a separate input module so that even if one input module fails, the parameter will be available from the other input module.
 - ii) If only one sensor is provided then redundant input cards shall be provided and wired accordingly.
 - iii) Redundant output card shall be provided for the signals from

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SECTION: D
STANDARD TECHNICAL SPECIFICATIONS



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS
(STANDARD TECHNICAL SPECIFICATIONS)**

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EQUIPMENT SELECTION & DESIGN CRITERIA/ DATA SHEET

A. LDO/HFO Storage Tank

- 1) LDO/HFO storage tank shall be constructed as per technical specification clause no. 6.02.00, Vol. IIB, Sec. 3B.
 - a) Minimum dimensions of LDO Tank provided: 9.0m (dia.) and 9.5 (ht)
 - b) Minimum dimensions of HFO Tank provided: 14.0m (dia.) and 15.0 m (ht).
 - c) Minimum thickness of the tank shell and roof shall be 6.0mm including corrosion allowance.
 - d) Thickness of the tank bottom shall be 8.0mm including corrosion allowance.
 - e) Width of the plate can be considered out of these 1250/1500/1800/2000. As per IS803, minimum course width is 1500mm unless agreed otherwise mutually. Due to non-availability of plates at the time of detail engineering, option of course width of 1250mm has been also kept.
 - f) Roof structure of tank shall be designed in Stadd. During detail engineering, mother format same to be submitted to BHEL for checking.
 - g) Tank low-low level shall be decided in a way that suction heater and floor coil heater is always submerged.
 - h) Additional height required to meet the effective capacity to be provided by the vendor without any commercial implication. Effective capacity shall be between low-low level and high-high oil level.
- 2) Drain oil tank:
 - a) Dimensions of Drain oil Tank: 4.5m x 2.5m x 2.0 m.
 - b) Minimum thickness of the plate: 6.0mm including corrosion allowance
 - c) Design Code: IS 800 / standard hand book

B. FLOOR COIL HEATER AND SUCTION HEATER

Floor Coil Heater shall be constructed as per technical specification Annexure-I, Vol. IIB, Sec. 3B. Page no. 15 except as agreed in post bid discussion.

C. UNLOADING PUMPS / SUMP PUMP & OIL RECOVERY PUMP

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

- a) HFO & LDO unloading pump will be designed for a viscosity of 50-500cst and 2-50cst respectively.
- b) Design capacity of pump shall be based on lowest viscosity plus 10%
- c) For selection of pump head and motor rating, the criteria shall be as follows:
 - Pump head will have 10% margin over the calculated pump head. Motor rating be arrived at by considering higher of the following
 - 15% margin over BHP at duty point (duty point means specified discharge at 1.1 times the calculated head) @ highest viscosity
 - RV set pressure (10% or 1 kg/cm² higher than duty point pressure whichever is higher) BHP @ highest viscosity



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FOR SUMP PUMP AND OIL RECOVERY PUMP:

S.No	Characteristics	Drain oil pump / Recovery oil pumps	Sump Pump in Oil Unloading Area	Sump Pumps in pump house
1	Type of Pumps	Vertical Single Screw positive displacement.	Vertical single screw type	Vertical single screw type
2	No. &Capacity of Pumps	As per scope of supply		
3	Type of Duty	Intermittent	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor		
5	Location	Indoor / Outdoor	Outdoor	Indoor
6	Nature of Fluid to be pumped	HFO/LDO	Water with traces of oil	Water with traces of oil
7	Design Viscosity range	2-500 cST	5-50cST	5-50cST
8	Sealing	Manufacturer Specific		
9	Design Code	Manufacturer specific.		
10	Bearings	Antifriction type	Manufacturer specific	
11	Material of Construction			
i)	Casing	Cast Iron to IS 210 Gr FG 260/ CS Fabricated		
ii)	Casing lining, if applicable	Manufacturer specific		
iii)	Rotor/ Impeller	13% chrome SS	Cast Iron to IS 210 Gr FG 260)	
iv)	Rotor housing, if applicable	CI AS PER IS 210 GR. 260	Manufacturer specific	
v)	Shaft	13% chrome SS	BS 970 EN-8 or equivalent	
vi)	Relief valve body	NA	NA	
vii)	Relief valve spring	NA	NA	
viii)	Base Plate	Fabricated from MS to IS 2062		
ix)	Coupling	Manufacturer specific		
x)	Hydrotest Pressure	1.5 Times maximum discharge pressure		
xi)	Hydrotest Duration	30 Minutes		

D. STRAINERS FOR LDO/HFO UNLOADING PUMPS

Strainers shall be provided as per following details.

S.No.	Characteristics	Value
01	Type	Simplex Type for unloading pumps & Drain oil pumps (Integral to pump)
02	Fluid	LDO/HFO
03	Flow Rate	To match pump flow rate
04	Operating Pressure, maximum kg/cm ² (g)	Bidder specific
05	Operating temperature, ° C	55
06	Design Pressure , kg/cm ² (g)	1.1 times the operating pressure , min.
07	Design Temperature, ° C	65
08	Fluid Viscosity	As per Fuel Oil Characteristics
09 a)	Pressure drop in clean condition	0.15 kg/cm2
09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm2
10	Screen basket data	
a)	Dia. of perforations	40 mesh
b)	Minimum thickness	Bidder specific



**TECHNICAL SPECIFICATION FOR
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11	Steam Jacket	Applicable for HFO unloading pump suction strainer.
12	Steam pressure for steam heating	4 kg/cm ² (a) or higher as decided during detail engineering
13	End Connection details	
a)	Inlet & outlet size	Shall match connected upstream and downstream pipe size
b)	Type	Flanged
c)	Details / Standard	IS: 6392 /ANSI B 16.5 /Equivalent.
14	Material of Construction	
a)	Body	Fabricated from IS 2062/ Seamless pipe to ASTM A 106
b)	Cover	Fabricated from IS 2062 PLATES
c)	Screen basket	SS 304
15	Hydrotest Pressure	1.5 Times Design Pressure
16	Hydrotest Duration	30 Minutes

E. PIPES, FITTINGS & FLANGES

- Oil Pipes shall be provided as per Volume IIB, Section #A, Annexure-III
- Pipe in oil lines shall be API 5L Gr. B (ERW).
- Steam and Condensate line shall conform to ASTM 106 GR. B, Schedule 40.
- IA line shall be MS ERW to IS1239 (1) Heavy Grade (GI), Screwed Ends, Galvanized.
- Additional details of the above specified item / other items are also covered below:

Minimum Pipe Thickness shall be as follow:

Pipe Size	Thickness (mm)	Pipe Size	Thickness(mm)
15 NB	2.77	100 / 80 / 65 NB	3.96
20 NB	2.87	150 NB	4.78
25 NB	3.38	200/250 NB	5.56
40 NB	3.68	300/350 NB	6.35
50 NB	3.91	400 NB NB	6.35

Pipe of size 400 NB and above shall be fabricated from IS2062 plate. Thickness of plate fabricated pipe shall be 8.0mm.

Fittings / flange / gasket details

<u>SR.</u>	SIZE	MATERIAL STANDARD/ OTHER DETAILS	DIMENSION STANDARD
<u>1</u>	FITTINGS & FLANGES		
<u>A.</u>	FUEL OIL		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
b.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard



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	All sizes	Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
B.	STEAM AND CONDENSATE SERVICE		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
b.	Slip on Flanges/Blind Flanges	Material Standard	Dimension Standard
	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class suitable for intended service.
C.	AIR LINE		
a.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	25 NB and below	IS 1239 (II) (Galvanized) Heavy Grade	IS 1239 (II) Heavy Grade
2	GASKETS		
A.	STEAM	Spiral wound SS316	
B.	FUEL OIL	Teflon	
C.	AIR LINE & BILGE WATER LINE	Grafoil	
3	Bolts / Studs / Anchor Bolt	ASTM A 193 Gr. B7	
4	Nuts	ASTM A 194 Gr 2H	

F. STEAM TRAPS

S.No.	Characteristics	Value
1	Design Features	
	Type	IB Type Traps for Floor Coil Heater & TD type or any other type as per trap vendor recommendation for other services
2.	Strainer	Integral
3.	End connection	Socket welded / Manufacturer standard.
3a	Design criteria	2 times the actual condensate load
4.	Material of construction	
a.	Body	Carbon steel/ SA105/ As per manufacture standard practice
b.	Trims	SS conforming to AISI-316/304/ Manufacturer's standard practice
c.	Strainer	SS conforming to AISI-316/304/ Manufacturer's standard practice

G. VALVES

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



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

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

H. HOSES

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

I. PRESSURE REDUCING STATION AND DESUPERHEATER

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

J. CONTROL VALVE FOR SUCTION AND FLOOR COIL HEATER

S. No.	Characteristics	Value
1	Type	Pneumatically operated control valve 1. Modulating SMART for Floor Coil heater 2. Modulating SMART type for Suction Heater 3. On-off type of Drain oil tank
2	Steam pressure at inlet	4kg/cm ² (a)
3	Controlling	Pneumatically controlled
4	Material of Construction	
a)	Body	Cast Steel
b)	Trim	SS 316



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**ANNEXURE-I
LIST OF MAKES OF SUB-VENDOR ITEMS**



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SL. NO.	ITEM	SUB-VENDOR	PLACE	REMARK
MECHANICAL				
1	CS GATE/GLOBE/ NR VALVES (UPTO 350NB FOR CLASS 150 & UPTO 300 NB FOR CLASS 600)	LEADER	JALLANDHAR	
		FOURESS ENGG	MUMBAI	
		FOURESS ENGG	AURANGABAD	
		WEIR BDK	HUBLI	
		L&T VALVES (AUDCO)	CHHENNAI	
		L&T VALVES	COIMBATORE	
		STEEL STRONG	NAVI MUMBAI	
		OSWAL INDUSTRIES	AHMEDABAD	
		HITECH	AHMEDABAD	
2	FS (CS) GATE/GLOBE/ NR VALVE UPTO 50NB (CLASS 800)	KBL	KONDHAPURI	
		LEADER	JALLANDHAR	
		WEIR BDK	HUBLI	
		L&T VALVES (AUDCO)	CHHENNAI	
		FOURESS ENGG	MUMBAI/ AURANGABAD	
3	CS BALL VALVES	STEEL STRONG	NAVI MUMBAI	
		PEC	NASHIK	
		L&T VALVES	COIMBATORE	
		L&T VALVES (AUDCO)	CHHENNAI	
		MICROFINISH	HUBLI	
		WEIR BDK	HUBLI	
4	FS BALL VALVES (UPTO SIZE 50 NB) CLASS 800	FLOW CHEM	AHMEDABAD	
		PEC	NASHIK	
		AKAY	HUBLI	
		L&T VALVES (AUDCO)	CHENNAI	
		WEIR BDK	HUBLI	
		FLOW CHEM	AHMEDABAD	
		MICROFINISH	HUBLI	
5	CS PLUG VALVES	L&T VALVES (AUDCO)	CHENNAI	
		MICROFINISH	HUBLI	
		WEIR BDK	HUBLI	
		FISHER XOMOX	CHENNAI	
6	SUMP PUMP (VERTICAL CENTRIFUGAL)	SAM TURBO INDUSTRY LTD	COIMBATORE	
		KISHORE	PUNE	
		SU MOTORS	MUMBAI	
		AQUA MACHINERY	AHMEDABAD	
		FLOWMORE PUMP	GHAZIABAD	
		B & C ENGG(BECON WEIR)	CHENNAI	
7	SCREW PUMPS	ROTO PUMPS	NOIDA	
		TUSHACO	MUMBAI	
		UT PUMPS	FARIDABAD	
8	API 5L ERW PIPE	SURYA ROSHNI	BAHADURGARH	
		JINDAL	GHAZIABAD	
		MSL	RAIGAD	
		SAIL	ROURKELA	



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		RATNAMANI	KUTCH	
		SURYA ROSHNI	BAHADURGARH	
		JINDAL	GHAZIABAD	
		MSL	RAIGAD	
		SAIL	ROURKELA	
9	IS:3589 ERW PIPE	WELSPUN	ANJAR	UP TO 400 NB
		INDUS TUBE	GAUTAM BUDDH NAGAR	UP TO 300 NB
10	IS:1239 ERW PIPE (BLACK/GI)UP TO 150NB	JINDAL	GHAZIABAD	
		SURYA ROSHNI	BAHADURGARH	
		TISCO	JAMSHEDPUR	
		INDUSE TUBE	GAUTAM BUDDH NAGAR	
		WELSPUN	ANJAR	
11	SPIRAL WELDED PIPE	PSL	CHENNAI/VIZAG/KUTCH/DAMAN	
		LALIT PROFILE	THANE	
		SAMSHI PIPES INDUSTRIES	VADODARA	
		MUKUT PIPES	RAJPURA	
		MANN IND	INDORE	
		SURENDRA ENGG	RAJPURA	
		PRATIBHA PIPES & STRUCTURE PVT LTD	THANE	
		JCO GAS PIPE	CHINDWARA	
		NUKAT TANKS AND VESSELS	TARAPUR	
		MAHARASHTRA SEAMLESS	RAIGAD	
12	ASTM A 106, CS SEAMLESS PIPE	ISMT	AHMED NAGAR	
		MSL	RAIGAD	
		JINDAL SAW LTD	NASHIK	
		ISMT	BARAMATI	
13	SUCTION HEATER	PARKAIRE	DELHI	
		MVS	DELHI	
		MELCON	DELHI	
		GASO ENERGY	PUNE	
		INDCON	DELHI	
		TEMASME	NOIDA	
14	PRESSURE REDUCING VALVE & CONTROL VALVES	CIRCOR (EARLIER MAZDA)	AHMEDABAD	
		DAUME REGELARMATUREN GMBH,	GERMANY	
		EMERSON PROCESS MANAGEMENT CHENNAI LIMITED	CHENNA	
		INSTRUMENTATION LTD.	PALLAKKAD	
		KOSO INDIA PRIVATE LIMITED,	NASHIK	
		LESLIE CONTROLS, INC / CIRCOR	USA	
		MIL CONTROLS LTD.	THRISSU	
		R.K.CONTROL INSTRUMENTS PVT. LTD.	THANE	
		SPIRAX MARSHALL	PUNE	
15	STRAINERS(SIMPLEX BASKET TYPE)	GENERAL MECHANICAL WORKS PVT LTD	VADODARA	



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		GRAND PRIX	FARIDABAD	
		GUJARAT OTOFILT	VATVA , AHMEDABAD	
		FILTRATION ENGRS	MUMBAI	
		MULTITEX	NOIDA	
16	STEAM TRAP	SPIRAX MARSHALL	PUNE	
		UNIKLINGER	PUNE	
		LEADER	JULLANDHAR	
		CRECENT VALVE MFG CO LTD	MUMBAI	
		PENNANT ENGINEERING	PUNE	
17	THERMAL INSULATION	LLOYD INSULATION (INDIA) LTD	BHILAI	
		ROCK WOOL	MEDAK	
		LOPINUS ROCKWOOL	GWALIOR	
		MINWOOL ROCK FIBER	RAJNAND GAON	
18	PLATES AND STRUCTURES	SAIL		
		JSPL		
		ESSAR		
		JSW		
		RINL		
		TISCO		
		LLOYD STEEL INDS. LTD.		
19	FITTING (MS/SS)	PIPE FIT	VADODRA	
		GUJRAT INFRA PIPES	BARODA	
		MS FITTINGS	KOLKATA	
		TUBE PRODUCTS	BARODA	
		SIDDARTH & GAUTAM	FARIDABAD	
		EBY	MUMBAI	
		NL HAZRA	KOLKATA	
20	SAFETY RELIEF VALVE	SPIRAX MARSHALL	PUNE	
		FISCHER SANMAR	CHENNAI	
		LEADER	JULLANDHAR	
ELECTRICAL AND C & I				
21	LEVEL TRANSMITTER (ULTRASONIC TYPE)	E & H	AURANGABAD	
		SIEMENS MILTRONICS	CANADA	
		NIVELCO	HUNGARY	
		HAWK	AUSTRALIA	
		EMERSON PROCESS MGT	PAWANE	
22	LT MOTORS	ABB	FARIDABAD / BANGALORE	
		KIRLOSKAR	BANGLORE/HUBLI	
		CROMPTON GREAVES LTD.	AHMEDNAGAR	
		BHARAT BIJLEE	MUMBAI	
		MARATHON	KOLKATA	
		LHP	SHOLAPUR	
		SIEMENS	MUMBAI	
		JYOTI	VADODARA	
		NGEF	BANGLORE	
23	LEVEL INDICATOR (FLOAT & BOARD)	SIGMA	MUMBAI	
		LEVCON	KOLKATA	
		SBEM	PUNE	
		DK INSTRUMENTS	KOLKATA	



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		V AUTOMAT	DELHI	
		SOR	USA	
		HERION	GERMANY	
		ITT BARTON	USA	
		DELTA CONTROL	UK	
		ASHCROFT	USA / GERMANY	
		TRAFAG	RANIPET	
		INDFOSS	GHAZIABAD	
		ASHCROFT	GANDHINAGAR	
		SWITZER	CHENNAI	EXCEPT 9000 SERIES
		H GURU (SI)	BANGALORE	
		H GURU INDUSTRIES	MUZAFFARPUR / RISHRA	
		AN INSTRUMENT	KOLKATA	
		GOA THERMOSTATIC	GOA	
		WAAREE	VAPI	
		MANOMETER	MUMBAI	
		GLUCK	MUMBAI	
		FORBES MARSHALL	HYDERABAD	
		ASHCROFT	GANDHINAGAR	
		WIKA	PUNE	
		GAGES BOURDON	MUMBAI / GOA	
		PYROELECTRIC	GOA	
		GIC(THERMAL INSTRUMENTS)	MAHARASHTRA	
		TEMPSENS	UDAIPUR	
		DETRIVE	MUMBAI	
		K TEK (ABB)	USA	
		E & H	GERMANY	
		MEGNETROL	BELGIUM	
		EMERSON PROCESS MGT	PAWANE	
		ROTORK	BANGALORE	
		ROTORK	CHENNAI	
		AUMA	BANGALORE	
		LIMITORK	FARIDABAD	
		TRAC	HYDERABAD	
		LEVCON	KOLKATA	
		DK INSTRUMENTS	KOLKATA	
		SBEM	PUNE	
		V AUTOMAT	DELHI	
		EMERSON PROCESS MGT	PAWANE	
		MOORE	USA	
		ABB	FARIDABAD	
		YOKOGAWA	BANGLORE	MAKE YOKOGAWA, JAPAN
		PLACKA INSTRUMENT	CHENNAI	
		SHAVO NORGEN	MUMBAI	
		FISHER SANMAR	CHENNAI	
		AVCON	MUMBAI	
		ROTEX	BARODA/VV NAGAR	



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		ASCO	CHENNAI	
		PYROTECH	UDAIPUR	
		POSITRONICS	VADODARA	
		JACKSON	NOIDA	
		CONTROL DEVICE	KOLKATA	
		ROCKWELL AUTOMATION INDIA LTD	GHAZIABAD	
		SIEMENS LIMITED	DELHI	
		SCHNEIDER ELECTRIC INDIA PVT.LTD.	DELHI	
		JOSPER	NOIDA	
		I C A	MUMBAI	
		INDIAN SWITCH GEAR	VADODARA	
		SWITCHING CKT	KOLKATA	
33	LOCAL CONTROL PANEL			
		PYROTECH	UDAIPUR	
		POSITRONICS	VADODARA	
		JACKSON	NOIDA	
		CONTROL DEVICE	KOLKATA	
		JOSPER	NOIDA	
		I C A	MUMBAI	
		SWITCHING CKT	KOLKATA	
34	JUNCTION BOX			
		3D	UMERGAON	
		DOWELL	MUMBAI	
		CHITRA	NASIK	
35	CABLE LUGS (NON FLAME PROOF)			
		ABB LIMITED	FARIDABAD	
		ENDRESS + HAUSER (INDIA)	NEW DELHI	
		MOORE INDUSTRIES INTERNATIONA	USA	
		EMERSON PROCESS MANAGEMENT	MUMBAI	
		SIEMENS LIMITED	MUMBAI	
		SMART INSTRUMENTS LTD	MUMBAI	
		V. AUTOMAT & INSTRUMENTS	NEW DELHI	
		YOKOGAWA INDIA LIMITED	BANGALORE	
		HONEYWELL AUTOMATION INDIA LIMITED	NEW DELHI	
		TOSHNIWAL INDUSTRIES PVT. LTD	AJMER	
36	PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER			
		EMERSON PROCESS	CHENNAI	
		ROCKWIN	GHAZIABAD	
		KROHNE MARSHALL	PUNE	
		E&H		
37	FLOW METER			
		ARUP	KOLKATA	
		SUNIL	KOLKATA	
		QPIE	KOLKATA	
		COMMET	MUMBAI	
38	CABLE GLANDS (NON FLAME PROOF)			
		AJMERA	MUMBAI	
		BALIGA	CHENNAI	
		FLEXPRO	NAVSARI	
39	CABLE GLAND, LUGS, JB (FLAME PROOF)			



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The tentative make of Sub-vendor items shall be generally as indicated above which is subject to customer / BHEL approval during detail engineering.

Make of any unlisted items shall be subject to customer / BHEL approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for Customer / BHEL's review and approval. Bidder shall furnish 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 has 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 two years 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.



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**ANNEXURE-II
MANDATORY SPARE LIST**

SI. NO.	PARTICULARS	QUANTITY
XII	Fuel Oil System	
1	Fuel Oil System	
1.1	Suction Heater Gaskets	
1.1.1	For HFO Day Tanks	4 sets
1.2	Suction Heater Nuts and Bolts	
1.2.1	For HFO Day Tanks	Lot
1.3	Pump suction Strainer Basket	3 Nos. for each type
1.4	Pump suction Strainer Gasket	6 Nos. for each type
1.5	Pump O-Ring and Gasket	12 Nos. for each type
1.6	Various types of Gland packing for valves	Lot for each type
1.7	Pump Screw	3 Nos. for each type
1.8	Pump and Motor Bearing	
1.8.1	For HFO & LDO transfer & pressurizing pump	4 sets for each pump
1.8.2	For Drain Oil Pump	2 sets
1.9	Plug valves for various sizes used	1 No. each
1.1	Temperature Switch	2 Nos.
1.11	Pressure Gauge	3 Nos.
1.12	Temperature Gauge	3 Nos.
1.13	Relief Valve Spring	2 sets
1.13.1	For HFO & LDO pump	3 nos.
1.13.2	For Drain Oil Pump	3 nos.
1.14	Flame Arrestor	2 Nos.
1.15	Hoses with end fittings	5 Nos. for each type
1.16	Adaptor	5 Nos. for each type
1.17	Suction Heater Heating Element	1 No.
1.18	Mat Coil Heater – Heating Element	20m pipe length
1.19	Thermodynamic traps	5 Nos.
1.20	Inverted Bucket type traps	2 Nos.
2	Electrical Items for 3.3KV, 415V System & DC	Items indicated below:
2.1.0	415 Volt Motor (above 30KW Rating upto 200KW)	
2.1.1	End Shield Cover Driving & Non-Driving End	1Set for each type and rating of Motor
2.1.2	Driving End & Non-Driving End Bearing	1Set for each type and rating of Motor
2.1.3	Cooling Fan	1Set for each type and rating of Motor
2.1.4	Motor Space Heater	1Set for each type and rating of Motor
2.1.5	Motor Terminal Block	1Set for each type and rating of Motor
2.1.6	Complete Set of Coupling	1Set for each Application



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2.2.0	415 Volt Motor (Upto 30KW Rating)	
2.2.1	Driving End & Non-Driving End Bearing	3 Set for each type and rating of Motor
2.2.2	Cooling Fan	2 No. for each type and rating of Motor
2.2.3	Motor Terminal Block	5 No. for each type and rating of Motor
2.2.4	Complete Set of Coupling	1 Set for each Application
3.0	C&I Items	
3.1	Control Panel/Desk Mounted Items	
3.1.1	Push Button	
3.1.2	Complete assembly	
3.1.3	Contact Element (1NO + 1NC) Block	
3.1.4	Selector Switch	
3.1.5	Indicating Lamps complete assembly	10Nos. for each Colour and type
3.1.6	Mimic Lamps	10Nos. for each Colour and type
3.1.7	MCB	2Nos. for each type and rating
3.1.8	Door Limit Switch	2Nos.
3.1.9	Annunciation system	
3.1.10	Lamp Box with Facia & Lamps (LED type)	25Nos.
3.1.11	Hooter	1No.
3.1.12	Each type of PCB (for non-PLC driven system)	1(one) no.



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ANNEXURE-III

PAINTING & COLOUR SCHEME

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SECTION-XIII

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

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TECHNICAL SPECIFICATION
FOR
PROTECTIVE LINING AND PAINTING

C O N T E N T S

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SECTION-XIII

TECHNICAL SPECIFICATION

FOR

PROTECTIVE LINING AND PAINTING

1.00.00 INTENT OF SPECIFICATION

- 1.01.00 This specification addresses the requirements of all labour, material, and appliances necessary with reference to preparations for lining / painting, application as well as finishing of all lining / painting for all mechanical and electrical equipment, piping and valves, structures etc. included under the scope of this Package.
- 1.02.00 The Bidder shall furnish and apply all lining, primers including wash primers if required, under-coats, finish coats and colour bands as described hereinafter or necessary to complete the work in all respects.

2.00.00 CODES & STANDARDS

- 2.01.00 The Bidder shall follow relevant Indian and International Standards wherever applicable in cleaning of surface, selection of lining material / paints and their application. The entire work shall conform to the following standards / specifications (latest revision or as specified).
- a) SSPC SP 10 / NACE 2 / : Near White Blast Cleaning
 - b) SSPC PA 2 : Measurement of dry film Coating Thickness with magnetic gauges.
 - c) ASTM D 4541 : Method for pull off strength using portable Adhesion Tester.
 - d) NACE RP 0274 – 2004 : High-Voltage Electrical Inspection of Pipeline Coatings
 - e) NACE SP 0188 – 2006 : Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates

- f) NACE RP 0169 – 2002 : Control of External Corrosion on Underground or Submerged Metallic Piping Systems
- g) AWWA C 210 – 2007 : Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines
- h) IS 3589:2001 Annexure B : Steel Pipes for Water and Sewage Specification.
- i) AWWA C222-2000 : Polyurethane Coating for the Interior and Exterior of Steel Water Pipe and Fittings.
- j) IS 13213 : 2000 : Polyurethane Full Gloss Enamel (Two pack)

3.00.00 GENERAL REQUIREMENTS

- 3.01.00** The steel surface preparation prior to actual commencement of coating shall conform to SSPC SP 10 / NACE 2 / Sa2½ (near white metal) with sand blasting.
- 3.02.00** The contractor shall submit a detailed written description in the form of a manual covering coating equipment, procedures, materials inspection test, and repair etc. to Owner/Consultant for approval.
- 3.03.00** The contractor shall also provide copies of test reports from NABL approved laboratory (like National Test House, Kolkata) in support of the paint/primer materials to be used shall conform to the specification requirement.
- 3.04.00** The contractor shall also provide certificates from paint/primer manufacturer mentioning the batch numbers, date of manufacture and shelf life etc. of the materials to be used. In addition to that Manufacturing Quality Plan (MQP) and Field Quality Plan (FQP) shall also be submitted prior to commencement of supply of material and field application.
- 3.05.00** Paint/coating application work at site shall be done either by paint manufacturer or by their authorized applicator. The authorized applicator shall have proper training & certification from manufacturer. Applicator shall possess all the necessary specialized equipment and manpower experienced in similar job.

- 3.06.00 Applied coating shall be tested for dry film thickness, holiday (electrical inspection for continuity) and adhesion as per relevant standard such as SSPC PA 2, NACE RP 0274 and ASTM D 4541.
- 3.07.00 If necessary, the material may be heated and applied by airless spray / plural component spray system.
- 3.08.00 Manufacturer's specific recommendation, if any, shall be followed during application of lining / paints.
- 3.09.00 In areas where there is danger of spotting automobiles or other finally finished equipment or building by wind borne particles from paint spraying, a Purchaser approved method shall be adopted.
- 3.10.00 The colour scheme of the entire Plant, covered under this specification shall be approved by the Purchaser in advance before application.
- 3.11.00 All indoor and outdoor piping, insulated as well as uninsulated will have approved colour bands painted on the pipes at conspicuous places throughout the system, as approved by Purchaser.
- 3.12.00 Inside surfaces of vessels / tanks shall be protected by anticorrosive paints or rubber lining as required / specified elsewhere in the specification. External surfaces of all vessels / tanks shall be protected by anti corrosive painting.
- 3.13.00 For vessels / tanks requiring lining and epoxy painting all inside surface shall be blast cleaned using non-siliceous abrasive after usual wire brushing.
- 3.14.00 Natural rubber lining shall be provided on the inside of vessels / tanks as required / specified elsewhere in the specification, in three layers resulting in a total thickness not less than 4.5 mm.
- 3.15.00 Surface hardness of rubber lining shall be 65 +/- 5 deg. A (shore).
- 3.16.00 After the lining is completed, the vessels / tanks shall not be subjected to any prolonged exposure to direct sunlight in course of its transportation, erection etc. They shall not be stored in direct sunlight. No further lining or burning shall be carried out on the vessel, after application of the lining.

- 3.17.00 All lining projecting outside of the vessel shall be protected adequately from mechanical damages during shipment, handling storage etc.
- 3.18.00 Suitable warnings, indicating the special care that must be taken with respect to these lined vessels shall be stenciled on their outside surface with the letters at least 12 mm high.
- 3.19.00 All insulated piping shall have aluminium sheet jacketing.
- 4.00.00 EQUIPMENT, MATERIAL AND SERVICES TO BE FURNISHED BY THE BIDDER**
- 4.01.00** After erection at site, the outside surfaces of all equipment having a shop coat shall be given further priming coat and finished coats of paint as detailed in following clauses. However, if the painting system is such that the shop coat and primer coat to be applied at site are not compatible, then shop coat has to be removed from the surface of equipment before application of primer coat with prior blasting.
- All factory finished paints shall be touched up at site as required.
- All uninsulated piping shall be finished with final paintings after use of proper wash primer and primer. Aluminium sheet jacketed piping need not be painted. Colour bands of Purchaser's approved shade shall however be applied on jacketed piping near walls or partitions, at all junctions, near valves and all other places as instructed by the Purchaser. All structures shall be painted with approved paint.
- 4.02.00 Surface Preparation**
- 4.02.01 Unless mentioned otherwise, all rust and mill scale shall be removed by blasting to Sa 2-1/2 Swiss Standard before applying the primer.
- 4.02.02 Special care shall be taken to remove grease and oil by means of suitable solvents like Trichloroethylene or Carbon Tetrachloride.
- 4.02.03 The minimum degree of surface preparations for all equipment, piping, fittings, valves, structures etc. shall be "Near White" according to Steel Structure, Painting Council-SSPC-SP-10 before application of any primer/paint.
- 4.03.00 Painting**

- 4.03.01 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc. to be installed indoor shall be as follows :
- a) Surface preparation shall be done either manually or by any other approved method.
 - b) Primer Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based zinc phosphate.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 50 microns) of chlorinated rubber paint of approved shade and colour with glossy finish.
 - e) Total DFT of paint system shall not be less than 150 microns.
- 4.03.02 Specification for application of paints for external surfaces protection of vessels / tanks / equipment / piping / fittings / valves etc to be installed **outdoor** shall be as follows :
- a) Surface preparation shall be done by means of sand blasting, which shall conform to Sa 2-1/2 Swiss Standard.
 - b) Primer Coat shall consist of one coat (minimum DFT of 100 microns) of epoxy resin based zinc phosphate primer.
 - c) Intermediate Coat (or Under Coat) shall consist of one coat (minimum DFT of 100 microns) epoxy resin based paint pigmented with Titanium Dioxide.
 - d) Top Coat shall consist of one coat (minimum DFT of 75 microns) of epoxy paint of approved shade and colour with glossy finish. Additional one coat (minimum DFT of 25 microns) of Finish Coat of polyurethane shall be provided.
 - e) Total DFT of paint system shall not be less than 300 microns.
- 4.03.03 Specification for application of paints for external surfaces protection of steel pipes and fittings which are **buried underground / laid inside a hume pipe & or submerged Under Water and laid under Pipe Trenches** (in road/rail/pipe or trench crossings) shall be as follows :

External surface of the pipe, fittings, specialties etc. handling raw water/clarified water/filter water shall be painted with one coat of two part chemically cured polyurethane primer of min 50 micron dry film thickness followed by three or maximum four coats of two part solvent less polyurethane to build up coating of dry film thickness of 2000 micron including primer coat.

4.03.04 Specification for application of paints for **internal surface protection of large diameter pipes** (sizes above 600 mm NB and above) if any, shall be as follows :

- a) All Internal surfaces of steel pipes, fittings, specialties etc. buried underground or located within pipe trenches shall be given epoxy coating to protect them from (except for drinking water service, where the compatible painting shall be so selected to meet relevant quality standards) corrosion.
- b) Internal surface of the pipe should be coated with one coat of two part epoxy primer with not less than 50 micron DFT (dry film thickness) followed by two part polyamide cured solvent less epoxy.
- c) The minimum dry film thickness (DFT) of internal lining shall be 600 micron.

4.03.05 Specification for application of paints for protection of **internal surfaces of DM Water Storage Tank(s)** shall be as follows :

- a) Primer - One coat of epoxy primer containing high level of Zinc Phosphate anticorrosive pigment. Total Dry Film Thickness (DFT) of primer shall not be less than 125 microns.
- b) Finish Paint - Three (3) coats Polyamine HB Epoxy Paint. Total Dry Film Thickness (DFT) of finish paint shall not be less than 125 microns per coat.
- c) Total thickness of primer and paint should not be less than 500 microns.

4.03.06 All motors, local push button stations, cable racks, structures used for supports etc. are to be painted with acid proof paint.

4.03.07 The following surfaces shall not be painted - stainless steel, galvanized steel, aluminum, copper, brass, bronze and other nonferrous materials.

4.03.08 No painting or filler shall be applied until all repairs, hydrostatic tests and final shop inspection are completed.

4.03.09 All machined surfaces shall have two (2) coats of water repellant grease after thorough cleaning.

5.00.00 COATING PROCEDURE AND APPLICATION

5.01.00 Surface Preparation :

Pipe shall be blast cleaned by sand. The cleanliness achieved prior to application shall be in accordance with the requirement of SSPC SP 10 / NACE 2 / Sa2½ of ISO 8501 (near white metal)

- a) The blast pattern or profile depth shall be 40 to 100 micron and shall be measured by dial micrometer.
- b) Before sand blasting is started or during blasting or coating, temperature of the pipe surface should be more than 3°C above dew point temperature. Blast cleaned surface should be primed within 4 hours and shall be protected from rainfall or surface moisture and shall not be allowed to flash rust. If the rust occurs, the surface again to be prepared by sand blasting or wire brushing.

5.02.00 Application of Epoxy Coating

- a) Coating shall be applied when
 - i) When the pipe surface temperature shall be atleast 3°C above dew point temperature.
 - ii) The temperature of mixed coating material and the pipe at the time of application shall not be lower than 10°C or greater than 50°C.
- b) Material preparation shall be in accordance with manufacturer's recommendations.
- c) Application of epoxy coating system :

The epoxy coating system shall be applied as per recommendation of the manufacturer and shall be applied by airless spray / plural component spray machine. For more than one coat, the second shall be applied with the time limits as recommended by the manufacturer.

5.03.00 Application of PU Coating

- a) PU coating shall be applied when the pipe surface temperature atleast 3°C above dew point temperature (when R.H is more than 85%).
- b) Material preparation and application shall be done as per manufacturer recommendation.

6.00.00 TEST REQUIREMENTS :

6.01.00 Measurement of dry film thickness

Measurement of dry film thickness of coating : Coating thickness shall be in the range of $\pm 20\%$ and as per SSPC PA 2.

6.01.01 Apparatus / Instrument:-

The instrument used for dry film thickness may be Type 1 pull of gauges or Type 2 electronic gauges.

6.01.02 Procedures:-

- a) Number of measurements:
For 100 square feet (9.29 square meters), five (5) spots per test area (each spot is 3.8 cm) in diameter. Three gauge readings per spot (average becomes the spot measurement).
- b) If the structure is less than 300 square feet, each 100 square feet should be measured.
- c) If the structure is between 300 and 1000 sq ft, select 3 random 100 square feet test areas and measure.
- d) For structure exceeding 1000 square feet, select 3 random 100 square feet testing areas for the first 1000 sq ft and select 1 random 100 square feet testing area for each additional 1000 square feet
- e) Coating thickness Tolerance: Individual reading taken to get a representative measurement for the spot are unrestricted (usually low or high readings are discarded). Spot measurements (the average of 3 gauge readings) must be within 80% of the minimum thickness and 120% of the maximum thickness. Area measurement must be within specified range.

6.02.00 Electrical Inspection (Holiday) Test

- 6.02.01 All the coated / lined pipes shall be tested with an approved high voltage holiday detector preferably equipped with an audio visual signaling device to indicate any faults, holes, breaks or conductive particles in the protective coating.
- 6.02.02 The applied output voltage of holiday detector shall have a spark discharge of thickness equal to at least twice the thickness of the coating to assure adequate inspection voltage and compensate for any variation in coating thickness. The electrode shall be passed over the coated surface at approximately half the spark discharge distance from the coated surface only one time at the rate of approximately 10 to 20m/min. The edge effect shall be ignored. Excessive voltage shall be avoided as it tends to induce holiday in the coated surface thereby giving erroneous readings.
- 6.02.03 While selecting test voltages, consideration should be given to the tolerance on coating thickness and voltage should be selected on the basis of maximum coating thickness likely to be encountered during testing of a particular pipe.
- The testing voltage shall be calculated by using following formula. (as per NACE 0274 : 2004)
- Testing Voltage $V = 7900 \sqrt{T} \pm 10$ percent where T is the average coating thickness in mm.
- 6.02.04 Any audio visual sound or spark leads to indicate pinhole, break or conductive particle.
- 6.03.00 Adhesion Pull off Test :**
- After holiday the coated surface is subjected to adhesion pull off test as per ASTM D 4541.
- 6.03.01 Apparatus / Instrument: Adhesion tester consists of three basic components:
- A hand wheel, a black column containing a dragging indicator pin and scale in the middle and a base containing three legs and a pulling "Jaw" at the bottom and also dollies.
- 6.03.02 Prepare the test surface :
- Once test area is selected, test area shall be free of grease, oil, dirt, water. The area should be flat surfaces and large enough to accommodate the specified number of replicate test.
- 6.03.03 Prepare Dolly (Test Pull Stub) :

The dolly is a round, two sided aluminium fixture. Both sides of the dolly looks same, however, one side sloped on top surface while flat on bottom surface. As the surface of the dolly is polished aluminium, roughen the same using a coarse sand paper.

6.03.04 Select an adhesive:

Use araldite, a 100% solid epoxy adhesive. This adhesive requires at least 24 hours at room temperature to cure.

6.03.05 Attach the dolly to the surface.

- a) Using a wooden stick, apply an even layer of adhesive to the entire contact surface area of the dolly.
- b) Carefully remove the excessive adhesive by using a cotton swab. Allow the adhesive to fully cure before performing the adhesion test.
- c) Attach the dolly to the coated surface and gently push downward to displace any excessive adhesive.
- d) Push the dolly inward against the surface, then apply tape across the head of the dolly.

6.03.06 Adhesion Test Procedure

- a) Attach the adhesion tester to the dolly by rotating the hand wheel counter clockwise to lower the jaw of the device.
- b) Slide the jaw completely under the head of the dolly. Position the three legs of the instruments so that they are sitting flat on the coated surface.
- c) Slide the dragging indicator pin on the black column to zero by pushing it downward.
- d) Firmly hold the base of the instrument in one hand and rotate the handwheel clockwise to raise the jaw of the device that is attached to the head of the dolly. The dragging indicator pin will move upward on the black column as the force is increased and will hold the reading. Apply the tension using a moderate speed. Continue to increase the tension on the head of the dolly until (a) the minimum PSI/MPa/Kg/cm² required by project specification is exceeded and the test is discontinued, (b) the maximum PSI/MPa/Kg/cm² of adhesion tester has been achieved and dolly is still attached, (c) The force applied by the adhesion tester causes the dolly to dislodge.

- e) Read the scale and record the adhesion value.

6.04.00 Coating Repair

Defective Coating shall be repaired in accordance with the following subsections.

6.04.01 Surface Preparation:

Accessible areas of pipe requiring coating repairs shall be cleaned to remove debris and damaged coating using surface grinders or other means. The adjacent coating shall be feathered by sanding, grinding or other method. Accumulated debris shall be removed by blowing with contaminant free air or wiping with clean rags.

6.04.02 Areas not accessible for coating repair such as interior surfaces of small diameter pipe shall be reprocessed and recoated.

6.04.03 Coating Application :

The coating system shall be applied to the prepared areas in accordance with procedure.

6.04.04 Repair Inspection :

Repaired portion shall be electrically inspected using a holiday detector.

6.05.00 Welded Field Joints

6.05.01 Preparation :

The weld joints shall be cleaned so as to be free from mud, oil, grease, welding flux, weld spatter and other foreign contaminants. The cleaned metal surfaces of the weld joint shall then be blasted or abraded using rotary abrading pads. The adjacent liquid Epoxy / PU coating shall be feathered by abrading the coating surface for a distance of 25 mm.

6.05.02 Electrical Inspection :

After curing the coating system applied to the welding joints shall be holiday tested. Any holidays indicated by the detector shall be marked with chalk to identify the area of repair.

7.00.00 INFORMATION/DATA REQUIRED

The Bidder shall submit complete list of paints and primers proposed, giving detail information, such as, chemical composition, drying time etc. and also unit rates for application of each type of paint along with supply shall be furnished.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

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ANNEXURE-V, FUEL OIL ANALYSIS

HEAVY FUEL OIL (HFO) ANALYSIS AS PER IS 1593, 1982 (GRADE-HV)

Sl no.	Characteristics	Heavy Furnace Oil IS-1593,(Latest Revision)- Grade HV
1.1	Total Sulphur content Max. (By Weight)	4.5% Max
1.2	Gross calorific value (Kcal/kg)	10,000
1.3	Flash point (Min.)	66°C
1.4	Water content by volume (Max.)	1.00%
1.5	Sediment by weight (Max.)	0.25%
1.6	Density at 15° C(Approximate), Kg/m ³	890-950
1.7	Kinematic viscosity in centistokes at 50°C (Max.)	370
1.8	Ash content by weight (Max.)	0.10%
1.9	Pour Point (Max.)	20°C - 25°C (max)
	Total Sulphur percent by mass, Max.	4.5

* - assumed value: to be confirmed by customer / consultant

LIGHT DIESEL OIL (LDO) ANALYSIS AS PER IS 15770: 2008

Sl No.	Characteristics	Light Diesel Oil (LDO)
1.1	Kinematic Viscosity in centistokes at 40° C	2.5 to 15.7
1.2	Acidity (inorganic)	Nil
1.3	Waste content percent by volume (Max.)	0.25
1.4	Sediment percent by mass (Max.)	0.10
1.5	Total Sulphur percent by mass, Max.	1.5
1.6	Ash percentage by mass (Max.)	0.02
1.7	Water Content Max, % Volume	0.25
1.8	Density at 15°C(approximate), Kg/m ³	850-870
1.9	a) Flash point, Min- Pensky Martens	66°C
	b) Pour point:	21°C in Summer and 12°C in Winter
1.10	Gross calorific value (Kcal/kg)	10000-10500
1.11	Carbon Residue (Ramsbottom) percent by mass (Max.)	1.5



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**ANNEXURE-VI
DRAWINGS / DOCUMENTS SUBMISSION PROCEDURE**



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DRAWING/DOCUMENT DISTRIBUTION LIST

All documents & drawings shall be in English and in metric units

SI		DCPL	TSGENCO- EC	TSGENCO -SITE/ DCPL SITE	BHEL SITE	PMG BHEL	PEM/ UNITS/ PSSR	REMARKS
1	Master list of drawings / doc (duly indicating sch of submission)	Soft copy	Soft copy	Soft Copy	-	Soft copy	S	
2	Drawings / doc for Approval/Information (First Submission & After major changes)	Soft copy	Soft copy + 1 print	Soft copy + 1 print	-	Soft copy	S	
3	Return with comments/approval	S	Soft copy	Soft copy	-	Soft copy	Soft copy	
4	Drawings / Documents for approval (second & subsequent submissions till approval)	Soft copy	Soft copy	Soft copy	-	Soft copy	S	
5	Drawings / documents for distribution (Approved by TSGENCO)	1 print + Soft copy	1 print + Soft copy	2 print + Soft copy	6 prints + Soft copy	Soft copy	S	
6	Erection Drawings / documents	-	1 print	3 prints	6 prints	-	S	
7	FINAL Erection / Installation Manual for distribution	-	1 print+ Soft copy	2 prints+ Soft copy	3 prints+ Soft copy	Soft copy	S	
8	As built Drawings / documents	-	1 print+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	S (As applicable)	
9	Operation & Maintenance Manual	-	1 print + Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	S	
10	Performance & functional Guarantee test reports	Soft copy	1 print + Soft copy	3 prints + Soft copy	2 prints + Soft copy	Soft copy	S	
11	Type Test Certificate	Soft copy	1 print + Soft copy	Soft copy	Soft copy	Soft copy	S	
12	Commissioning & Performance Procedure Manual	Soft copy	1 print+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	S	
13	Project Completion Report	Soft copy	1 print+ Soft copy	3 prints+ Soft copy	2 prints+ Soft copy	Soft copy	S	

NOTES:

- The above schedule of submission does not include Docs/Drgs. of quality assurance/inspection and delivery/dispatches.
- Date of submitting soft copy is to be taken as date of submission.
- S – Source for generation of document.

After final approval, BHEL UNITS/ PEM will provide 1 no. hard copy to TSGENCO, Hyderabad Office and 3 nos. hard copies to Kothagudem Office.



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ANNEXURE-VIII

MASTER DRAWING LIST WITH SCHEDULE OF SUBMISSION



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S. No.	DOCUMENT NO.	DOCUMENT TITLE	SCHEDULE OF SUBMISSION
1	PE-V0-410-166-A001	P&ID'S OF FOHS	28-Aug-15
2	PE-V0-410-166-A002	CONTROL PHILOSOPHY OF FOHS	28-Aug-15
3	PE-V0-410-166-A003	DESIGN CALCULATION OF TANKS FOR FOHS	11-Sep-15
4	PE-V0-410-166-A004	SIZING CALCULATION OF UTILITIES OF FOHS	28-Aug-15
5	PE-V0-410-166-A005	DATASHEET & GAD OF SCREW PUMPS & MOTORS FOR FOHS	23-Oct-15
6	PE-V0-410-166-A006	NPSH AND PUMP HEAD CALCULATION OF PUMPS FOR FOHS	11-Sep-15
7	PE-V0-410-166-A007	DESIGN CALCULATION AND GAD OF SUCTION HEATER FOR FOHS	09-Oct-15
8	PE-V0-410-166-A009	STRESS ANALYSIS OF LINES FOR FOHS	09-Oct-15
9	PE-V0-410-166-A010	DESIGN CALCULATION AND GAD OF OWS FOR FOHS	06-Nov-15
10	PE-V0-410-166-A012	PAINTING SCHEDULE OF FOHS	09-Oct-15
11	PE-V0-410-166-A013	DS AND GAD OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	06-Nov-15
12	PE-V0-410-166-A014	DATASHEET OF FOHS INSTRUMENTS	09-Oct-15
13	PE-V0-410-166-A016	PIPING LAYOUT IN TANK FARM AREA OF FOHS	25-Sep-15
14	PE-V0-410-166-A017	PIPING LAYOUT IN UNLOADING PUMP HOUSE OF FOHS	09-Oct-15
15	PE-V0-410-166-A018	GAD OF FOHS (COMPOSITE LAYOUT)	23-Oct-15
16	PE-V0-410-166-A019	SUGGESTIVE ELECTRICAL LAYOUT DRAWING OF FOHS	09-Oct-15
17	PE-V0-410-166-A021	GAD OF FOHS TANKS INCLUDING ROOF STRUCTURE & NOZZLE ORIENTATION	09-Oct-15
18	PE-V0-410-166-A023	FABRICATION DRAWING OF FOHS TANKS INCLUDING ACCESSORIES	04-Dec-15
19	PE-V0-410-166-A024	DESIGN CALCULATION & GAD OF MISCELLANEOUS TANKS FOR FOHS	09-Oct-15
20	PE-V0-410-166-A025	CIVIL INPUT DRAWING IN TANK FARM AREA FOR FOHS	20-Nov-15
21	PE-V0-410-166-A026	QAP OF SCREW PUMP & MOTORS FOR FOHS	06-Nov-15
22	PE-V0-410-166-A027	QAP OF PRS, TCV, TRAP, INSULATION AND CLADDING FOR FOHS	20-Nov-15
23	PE-V0-410-166-A028	QAP OF SUMP PUMP & MOTORS FOR FOHS	06-Nov-15
24	PE-V0-410-166-A029	QAP OF FOHS INSTRUMENTS	20-Nov-15
25	PE-V0-410-166-A030	QAP OF CONTROL PANEL	23-Oct-15
26	PE-V0-410-166-A031	EQUIPMENT SCHEDULES OF FOHS	18-Dec-15
27	PE-V0-410-166-A032	CABLE SCHEDULE OF FOHS	04-Dec-15
28	PE-V0-410-166-A033	ELECTRICAL LOAD DATA OF FOHS	20-Nov-15
29	PE-V0-410-166-A035	SUB-VENDOR LIST WITH INSPECTION CATEGORIZATION LIST FOR FOHS	28-Aug-15
30	PE-V0-410-166-A036	INSTRUMENT INSTALLATION DIAGRAM OF FOHS	18-Dec-15
31	PE-V0-410-166-A039	INSULATION I& CLADDING INSTALLATION PROCEDURE FOR FOHS EQUIPMENTS	18-Dec-15
32	PE-V0-410-166-A040	STEAM TRACING INSTALLATION PROCEDURE	18-Dec-15
33	PE-V0-410-166-A043	PG TEST PROCEDURE OF FOHS	20-Nov-15
34	PE-V0-410-166-A044	O&M MANUAL OF FOHS	18-Dec-15
35	PE-V0-410-166-A045	ANALOG & BINARY I/O LIST, BOM, HMI PICTURES/ PLANT SCHEMATICS FOR FOHS (DCS BASED)	20-Nov-15
36	PE-V0-410-166-A046	CONTROL SCHEME/ LOGIC DIAGRAM FOR FOHS (DCS BASED)	20-Nov-15
37	PE-V0-410-166-A047	PROCESS MANUSCRIPT FOR IMPLEMENTATION IN DCS FOR FOHS	20-Nov-15
38	PE-V0-410-166-A048	DATASHEET & GAD OF SUMP PUMPS & MOTORS IN FOHS	06-Nov-15
39	PE-V0-410-166-A049	DS AND GAD OF VALVES, HOSE AND STRAINER	09-Oct-15
40	PE-V0-410-166-A050	DS AND GAD PIPES, PLATES AND FITTINGS ETC FOR FOHS	25-Sep-15



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41	PE-V0-410-166-A051	PIPING LAYOUT IN UNLOADING AREA OF FOHS	23-Oct-15
42	PE-V0-410-166-A052	PIPING LAYOUT IN YARD AREA OF FOHS	30-Oct-15
43	PE-V0-410-166-A053	CIVIL INPUT DRAWING IN UNLOADING PUMP HOUSE OF FOHS	20-Nov-15
44	PE-V0-410-166-A054	CIVIL INPUT DRAWING IN UNLOADING AREA OF FOHS	04-Dec-15
45	PE-V0-410-166-A055	CIVIL INPUT DRAWING IN YARD AREA OF FOHS	18-Dec-15
46	PE-V0-410-166-A056	QAP OF VALVES, HOSE AND STRAINER FOR FOHS	23-Oct-15
47	PE-V0-410-166-A057	QAP OF PIPES, PLATES AND FITTINGS ETC FOR FOHS	25-Sep-15
48	PE-V0-410-166-A062	DS OF FLOWMETER FOR FOHS	06-Nov-15
49	PE-V0-410-166-A063	QAP OF FLOWMETER FOR FOHS	06-Nov-15
50	PE-V0-410-166-A064	ERECTION PROCEDURE OF ALL EQUIPMENT IN FOHS SCOPE	18-Dec-15

Submission schedule given considered LOI placed on vendor on 15th August 2015. Submission dates will be modified based on date of LOI.

Notes:

1. Non submission of the document as per attached schedule will attract LD.
2. Drawing / Document shall be uploaded by the successful bidder on WRENCH /DMS. Procedure for the same will be informed after award of contract. Document submission through mail is not acceptable.
3. Submission and approval of all documents as mentioned above are linked with payment against engineering completion.
4. Any other drawings and documents as required by BHEL / Customer / Consultant shall be furnished by the successful bidder during detail engineering stage for which no commercial implication shall be entertained by BHEL.



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Other points to be considered while preparing drawings:

- a) GA drawing covering all details shown in data sheets like design data, dimensions, material of construction, list of appurtenances, lists of specifications, details of paints, standards & codes, general notes including details of test to be conducted on tank in accordance with specification and brand-name of welding electrodes to be used etc.
- b) Field quality plan / quality assurance plan / check list shall be prepared by the bidder for storage tanks / each instrument / item and shall be submitted to BHEL / customer / consultant for approval after placement of order and any changes required by BHEL / customer / consultant for the same shall be incorporated and adhered by the bidder without any commercial implications.
- c) All possible efforts shall be made by the bidder to get the approval of drawings and documents from BHEL / customer / consultant at the earliest and the documents prepared / generated by them or their sub-vendors shall be checked by their competent authority before submission to BHEL.
- d) Revision made by the bidder in any drawings and documents shall be highlighted by indicating the no. of revisions in a triangle without fail so that the minimum time is required by BHEL to review the drawings and documents.
- e) Any other drawings and documents in addition to the list of drawings and documents indicated in the NIT specification as required by BHEL for the execution of the project shall be furnished by them during detailed engineering stage and no commercial implication shall be entertained by BHEL for the same.
- f) Bidder to do 3D modelling of the package and review model in compatible format to be provided to BHEL on different stages as asked by BHEL. Bidder is required to prepare PIDs, Electrical drawings and all layout drawings using intelligent software with capability for transfer of data to and from corresponding Software being used by PEM. Details of the software compatible with BHEL software is given elsewhere in the specification.
- g) Bidder to extract 2-D drawings (AutoCAD) from the 3-D software and soft copy of the same to be provided for interfacing with other agency drawings.
- h) Data sheets of various items shall be prepared by the bidder for fuel oil system and shall be submitted to BHEL / customer / consultant for approval after placement of order and any changes required by BHEL / customer / consultant for the same shall be incorporated and adhered by the bidder without any commercial implications.
- i) Civil works will be done by BHEL based on civil inputs furnished by the bidder during detail engineering. In case of any changes in the civil input drawing after civil work is completed. Necessary prices on account of modification of the civil work shall be deducted from bidder's account.
- j) Bidder to furnish the civil pedestal details drawing indicating.
 - Scope of work by BHEL and bidder shall be indicated with different legend or in the form of note.
- k) Recommended locations of insert plates / embedment plates.
- l) All drawings and documents including general arrangement drawing, data sheet, calculation etc. shall be furnished to BHEL during detailed engineering stage and shall include / indicate the following details for clarity w.r.t. inspection, construction, erection and maintenance etc.:-
 - All drawings and documents shall bear BHEL's title block and drawing / document number. However, BHEL's drawing / document numbering scheme shall be furnished to the successful bidder after the placement of L.O.I.
 - All drawings and documents shall indicate the list of all reference drawings including general arrangement.
 - All drawings shall include / show plan, elevation, side view, cross - section, skin section, blow - up view, all major self-manufactured and bought out items shall be labelled and included in BOQ / BOM in tabular form.
 - Specification / schedule of painting shall be made as a part of general arrangement drawing of each item indicating at least 3 make.
 - All text/ numeric in the document / drawings to be generated by the successful bidder will be in English language only.



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ANNEXURE-IX**

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ANNEXURE-IX

FORMAT FOR OPERATION AND MAINTENANCE MANUAL



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Check List for Operation & Maintenance Manual

Project name :
Project number :
Package Name :
PO reference :
Document number :
Revision number :

Sl.no. & Sections	Description	Tick (√)if included in Manual			Remarks
		Yes	No	NA	
1	Cover page				
1.1	Project Name				
1.2	Customer/consultant Name				
1.3	Name of Package				
1.4	Supplier details with phone, FAX ,email address , Emergency Contact number				
1.5	Name and sign of prepared by , checked by & approved by				
1.6	Revision history with approval Details				
2	Index				
2.1	Showing the sections & related page nos All the pages should be numbered section wise				
3	Description of Plant/System				
3.1	Description /write up of operating principle of system equipment/ associated sub-systems & accessories/controls system , operating conditions, performance parameters under normal , start up and special cases				
3.2	Equipment list and basic parameter with Tag numbers				
3.3	Data sheets approved by Customer/for information and catalogues provided by original manufacturer				
3.4	Associated other packages and Interface /terminal points				
3.5	P&ID & Process Diagrams				
3.6	GA Layout drawings, As-built drawings , Actual photograph of items/system (Drawings of A2 & bigger sizes are to be attached in the last)				
3.7	Single line/wiring diagrams				
3.8	Control philosophy /control write-ups				
4	Commissioning Activities (if not covered in separate document i.e. erection manual, commissioning manual)				
4.1	Pre-Commissioning Checks				



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4.2	handling of items at site				
4.3	Storage at site				
4.4	Unpacking & Installation procedure				
5	Operation Guidelines for plant personal/user/operator				
5.1	Interlock & Protection logic along with the limiting values of protection settings for the equipment along with brief philosophy behind the logic, drawings etc. to be provided.				
5.2	Start up, normal operation and shut down procedure for equipment's along with the associated systems in step by step mode. Valve sequence chart, step list, interlocks etc. with Equipment isolating procedures to be mentioned.				
5.3	Do's & Don't of the equipment's.				
5.4	Safety precautions to be taken during normal operation. Safety symbols, Emergency instructions on total power failure condition/lubrication failure/any other condition				
5.5	Parameters to be monitored with normal values and limiting values				
5.6	Trouble shooting with causes and remedial measures				
5.7	Routine operational checks, recommended logs & records				
5.8	Changeover schedule if more than one auxiliary for the same purpose is given				
5.9	Painting requirement and schedule				
5.10	Inspection, repair, Testing and calibration procedures				
6	Maintenance guidelines for plant personal				
6.1	List of Special Tools and Tackles required for Overhaul/Trouble shooting including special testing equipment required for calibration etc.				
6.2	Stepwise dismantling and re-assembly procedure clearly specifying the tools to be used, checks to be made, records to be maintained, clearances etc. to be mentioned. Tolerances for fitment of various components to be given.				
6.3	Preventive Maintenance & Overhauling schedules linked with running hours/calendar period along with checks to be given				
6.4	Long term maintenance schedules especially for structural, foundations etc.				
6.5	Consumable list along with the estimated quantity required during commissioning, normal running and during maintenance like Preventive Maintenances and Overhaul. Storage/handling requirement of consumables/self-life.				



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6.6	List of lubricants with their Indian equivalent, Lubrication Schedule, Quantity required for each equipment for complete replacement is to be given				
6.7	List of vendors & Sub-vendors with their latest addresses, service centres ,Telephone Nos., Fax Nos., Mobile Nos., e-mail IDs etc.				
6.8	List of mandatory and recommended spare parts list				
6.9	Tentative Lead time required for ordering of spares from the equipment supplier				
6.1	Guarantee and warranty clauses				
7	Statutory and other specific requirements considerations.				
8	List of reference documents				
9	Binding as per requirement				



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ANNEXURE-X

SITE STORAGE AND PRESERVATION

SITE STORAGE AND PRESERVATION GUIDELINES

FOR

MECHANICAL BOPs

(Doc No: PE-DC-SSG-A001 REV.00)



PROJECT ENGINEERING MANAGEMENT, POWER SECTOR
BHARAT HEAVY ELECTRICALS LIMITED-NOIDA

CONTENT

- 1 SCOPE OF THE DOCUMENT
- 2 PURPOSE OF STORAGE & PRESERVATION
- 3 MEASURES TO BE TAKEN FOR STORAGE AND PRESERVATION
 - a) GENERAL STORAGE REQUIREMENTS
 - b) GENERAL PRESERVATION REQUIREMENTS
 - c) GENERAL INSPECTION REQUIREMENTS
- 4 TYPE OF STORAGE FOR VARIOUS EQUIPMENT
5. CONCLUSION
6. STACKING ARRANGEMENT FOR PLATES AND STRUCTURAL STEEL

1. SCOPE OF THE DOCUMENT

This guideline is prepared in intent to provide proper site storage and preservation of the Mechanical, Electrical and C & I items / equipment supplied under various bought out packages/items. This storage procedure shall be followed at different power plant sites by concerned agency for storage and preservation from the date of equipment received at site until the same are erected and handed over to the customer.

2. PURPOSE OF STORAGE & PRESERVATION

Many of the items may be required to be kept in stores for long period. It shall therefore be essential that proper methods of storage and preservation be applied so that items do not deteriorate, loose some of their properties and become unusable due to atmospheric conditions and biological elements.

3. MEASURES TO BE TAKEN FOR STORAGE, HANDLING & PRESERVATION

a) GENERAL STORAGE REQUIREMENTS

1. To the extent feasible, materials should be stored near the point of erection. The storage areas should have adequate unloading and handling facilities with adequate passage space for movement of material handling equipment such as cranes, fork lift trucks, etc. The storage of materials shall be properly planned to minimise time loss during retrieval of items required for erection.
2. The outdoor storage areas as well as semi-closed stores shall be provided with adequate drainage facilities to prevent water logging. Adequacy of these facilities shall be checked prior to monsoon.
3. The storage sheds shall be built in conformity with fire safety requirements. The stores shall be provided with adequate lights and fire extinguishers. 'No smoking' signs shall be placed at strategic locations. Safety precautions shall be strictly enforced.
4. Adequate lighting facility shall be provided in storage areas and storage sheds and security personnel positioned to ensure enforcement of security measures to prevent theft and loss of materials.
5. Adequate number of competent stores personnel and security staff shall be deployed to efficiently store and maintain the equipment / material.
7. The equipment shall be stored in an orderly manner, preserving their identification slips, tags and instruction booklets, etc., required during erection. The storage of materials shall be equipment-wise. Loose parts shall be stored in sheds on racks,

preserving the identification marks and tags in good condition. The group codes shall be displayed on the racks

6. At no time shall any materials be stored directly on ground. All materials shall be stored minimum 200 mm above the ground preferably on wooden sleepers

b) GENERAL PRESERVATION REQUIREMENTS

1. All special measures to prevent corrosion shall be taken like keeping material in dry condition, avoiding the equipment coming in contact with corrosive fluid like water, acid etc.
2. Materials which carry protective coating shall not be wrapped in paper, cloth, etc., as these are liable to absorb and retain moisture. The material shall be inspected and in case of signs of wear or damages to protective coating, that portion shall be cleaned with approved solution and coated with an approved protective paint. Complete record of all such observations and protective measures taken shall be maintained.
3. Generally equipment supplied at site are properly greased or rust protective oil is applied on machined/ fabricated components. However periodic inspection shall be carried out to ensure that protection offered is intact.
4. While handling the equipment, no dragging on the ground is permitted. Avoid using wire rope for lifting coated components. Use polyester slings (if possible) otherwise protective material (e.g. clothes, wood block etc.) should be used while handling the components with rope / slings
5. For Equipment supplied with finished paint, touch paint shall be done in case any surface paint gets peeled off during handling. Otherwise such surfaces shall necessarily be wrapped with polythene to avoid any corrosion. Further for equipment wherein finish coat is to be applied at site, site to ensure that equipment is received with primer coat applied.
6. It shall be ensured by periodic inspection that plastic inserts are intact in tapped holes, wherever applicable.
7. Pipes shall be blown with air periodically and it shall be ensured that there is no obstruction.
8. Silica gel or approved equivalent moisture absorbing material in small cotton bags shall be placed and tied at various points on the equipment, wherever necessary.
9. Heavy rotating parts in assembled conditions shall be periodically rotated to prevent corrosion/jamming due to prolonged storage.

10. All the electrical equipment such as motors, generators, etc. shall be tested for insulation resistance at least once in three months and a record of such measured insulation values shall be maintained.
11. Following preservatives/preservation methods can be used depending upon type of equipment
 - a. Rust preventive fluid (RPF)
 - b. Rust protective paints
 - c. Tarpaulin covers, in case of outdoor storage
 - d. De-oxy aluminate for weld-ments

c) GENERAL INSPECTION REQUIREMENTS

1. Period inspection of materials with specific reference to –
 - Ingress of moisture and corrosion damages.
 - Damage to protective coating.
 - Open ends in pipes, vessels and equipment -
 - In case any open ends are noticed, same shall be capped.
2. Any damages to equipment / materials.
 - In case of any damages, these shall be promptly notified and in all cases, the repairs / rectification shall be carried out.
 - Any items found damaged or not suitable as per project requirements shall be removed from site. If required to store temporarily, they shall be clearly marked and stored separately to prevent any inadvertent use.

4. TYPE OF STORAGE FOR VARIOUS EQUIPMENT

The types of storage are broadly classified under the following heads:

i **Closed storage with dry and dust free atmosphere. (C)**

The closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated asbestos sheets / galvanised iron sheets for roofing. Brick walls / asbestos sheets can be used to cover all the sides. The floor of the shed can be finished with plain cement concrete suitably glazed. The shed shall be provided with proper ventilation and illumination.



ii **Semi-closed storage. (S)**

The semi closed shed can be constructed by using cold-rolled / tubular components for structure and corrugated / asbestos sheets for roofing. The floor shall be brick paved. If required a small portion of sides can be covered to protect components from rainwater splashing onto the components.





iii Open storage (O)

The open yard shall be levelled, well consolidated to achieve raised ground with the provision of feeder roads for crane approach along with access roads running all sides. One part of the open yard shall be stone pitched, levelled and consolidated with raised ground suitable for storing / stacking heavier and critical components with due space to handle them by cranes etc . Adequate number of sleepers, concrete block etc. to be provided to make raised platforms to stack critical materials.

A separate yard to be identified as “scrap yard” slightly away from main open yard to store wooden/steel scraps, which are to be disposed off. This is required to avoid mix up with regular components as well as to avoid fire hazard.

Some of the components, which are having both machined & un-machined surfaces and are bulky, shall be stored in open storage area on a raised ground and suitably covered with water proof / fire retardant tarpaulin.



The equipment listed below shall be stored and inspected as per requirement mentioned in the table below.

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
Raw material /mechanical items like pipes, plates, structure sections etc.)				
1.	Steel pipes (lined/unlined)	S	Damage , paint, corrosion, rubber lining peeling	Provide end cap
2.	MS Plates	S	Damage, paint, corrosion	
3.	SS Plates	S	Damage	
4.	Non-metallic pipes	S	Damage, cracks	Provide end cap
5.	Stainless steel pipes	S	Damage ,	Provide end cap
6.	MS sections, beams	S	Damage, paint, corrosion	
7.	Cable trays	S	Damage, condition of preservations	
8.	Insulation sheets	S	Damage	
9.	Insulation	C	Damage, packing	
10.	Hangers Rods	S	Damage, paint, packing	
11.	Tubes	S	Damage, paint , packing	Provide end cap
12.	Hume pipes	O	Damage	
13.	Castings	O	Damage, paint, corrosion	
Fabricated mechanical items (pressure vessels, tanks etc.)				
14.	Pressure vessels (unlined)	O	Damage, paint, corrosion,	Covered nozzles
15.	Atmospheric storage tanks (unlined)	O	Damage, paint, corrosion	Covered nozzles

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
16.	Pressure vessels (lined)	S	Damage, paint, corrosion, rubber lining	
17.	Atmospheric storage tanks(lined)	S	Damage, paint, corrosion, rubber lining	
18.	Support structures	O	Damage , paint, corrosion	
19.	Flanges	C	Damage , paint, corrosion	
20.	Fabricated pipes	S	Damage , paint, corrosion	Provide end cap
21.	Vessels internals	C	Damage , paint, corrosion ,packing	
22.	Grills	S	Damage , paint, corrosion	
23.	Angles	S	Damage , paint, corrosion	
24.	Bridge mechanism/clarifier mechanism	O	Damage , paint, corrosion	
25.	Cranes, rails	S	Damage , paint, corrosion	
26.	Stair cases	O	Damage , paint, corrosion	
27.	Ladders/handrails	O	Damage , paint, corrosion	
28.	Fabricated ducts	S	Damage , paint, corrosion	
29.	Isolation Gates	O	Damage , paint, corrosion	
30.	Fabricated boxes/panels	S	Damage , paint, corrosion	
Mechanical components like valves, fittings, cables glands, spares etc.)				
31.	Valves	S	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
32.	Fittings	S	Damage , packing	Provide end cap
33.	Cable glands	C	Damage , packing	
34.	Tools & tackles	C	Damage , packing	
35.	Nut , bolts, washers,	C	Damage , packing	
36.	Gasket & Packings	C	Damage , packing	
37.	Copper tubes	C	Damage , packing, corrosion	Provide end cap
38.	SS tubing	C	Damage , packing	Provide end cap
Rotating assemblies (pumps, blowers, stirrers, fans, compressors etc.)				
39.	Pumps	S	Damage , packing, corrosion	Shaft rotation
40.	Blowers/Compressors	S	Damage , packing, corrosion	Shaft rotation
41.	Agitators/stirrers/radial launders	C	Damage , packing, corrosion	Shaft rotation
42.	Rollers for chlorine tonner mounting	C	Damage , packing, corrosion	
43.	Centrifuge	S	Damage , packing,	
44.	Gear box	C	Damage , packing, corrosion	
45.	Bearings	C	Damage , packing, corrosion	
46.	Fans	S	Damage , packing, corrosion	
47.	Dosing skids	S	Damage , packing, corrosion	
48.	Pump assemblies	S	Damage , packing, corrosion	
49.	Air washers(INTERNALS)	S	Damage , packing	
50.	Air conditioners (split)	C	Damage , packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
51.	Elevators(CONTAINERIZED)	O	Damage , packing, corrosion	
52.	Chillers/VA machines	S	Damage , packing	
53.	Air handling Unit/Package unit	S	Damage , packing	
54.	Chlorinators & Evaporators	C	Damage , packing	
55.	Ejectors	C	Damage , packing	
56.	Electrolyser	C	Damage , packing	
Miscellaneous items like chain pulley blocks, hoists etc.				
57.	Chain pulley blocks	S	Damage, Packing	
58.	Electric hoists	S	Damage, Packing	
59.	Fire extinguishers	C	Damage, expiry date	
60.	Fork Lift Truck	S	Damage, Packing	
61.	Hydraulic Mobile Crane	O	Damage, Packing	
62.	Mobile Pick Up & Carry Crane	O	Damage, Packing	
63.	Motor boats	O	Damage, Packing	
64.	Safety showers	S	Damage, Packing	
65.	Diffusers/dampers	S	Damage, Packing	
Chemicals and consumables (acid, alkali, paints, oils, reagents and special chemicals)				
66.	Hydro Chloric Acid (HCl)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical
67.	Sulphuric acid (H ₂ SO ₄)	Store in canes/ storage tank in dyke area	Date of production/ leakage/fumes	hazardous chemical

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
68.	Sodium hydroxide (NaOH)	Store in canes/ storage tank in dyke area	Date of production/ leakage/ fumes/ breather	hazardous chemical ,breather to be checked for air ingress
69.	Sodium hypo chlorite	To be stored under shed	Date of production/ leakage/ fumes	hazardous chemical ,self-life normally 15-30 days after which strength of chemical decays
70.	Ammonia	S	Date of production/ leakage/ fumes	Store in closed storage tanks, hazardous chemical
71.	CW treatment chemicals	S	Date of production , Self-life	Store in closed canes
72.	RO/UF cleaning chemicals	S	Date of production , Self-life	Store in closed canes
73.	Lime	C	Damage to packing , seepage	Prevent moisture, rain
74.	Alum bricks	C	Damage to packing	Prevent moisture, rain
75.	Poly electrolyte	S		Store in closed storage tanks
76.	Laboratory chemicals(powder)	C	Damage, Packing self-life	
77.	Laboratory chemicals(liquid)	C	Damage, Packing self-life	
78.	Lubrication oils	C	Leakage	
79.	Paints	S	Leakage ,air tightness	
80.	Sand	O	Damage of packing	No hooks
81.	Salt (NaCl)	C	Damage of packing, water ingress	Prevent moisture, rain
82.	Anthracite	S	Damage of packing	
83.	Activated carbon	S	Damage of packing	

Sl. No.	Description of the equipment	Type of Storage	Check for	Remarks
84.	Thermal insulation	S	Damage of packing	
85.	Cement	C	Damage of packing	Prevent moisture, rain
86.	Gravels	O	Damage of packing	
87.	ION exchange resins	C	Damage , packing	Refer manufacturer guidelines
88.	RO membranes	C	Damage , packing	Refer manufacturer guidelines
89.	UF membranes	C	Damage , packing	Refer manufacturer guidelines
90.	Cleaning chemicals	C	Damage , packing	Refer manufacturer guidelines
91.	Chemicals for analysers/calibration	C	Damage , packing	Refer manufacturer guidelines
Electrical and C & I items (motors, cables etc.)				
92.	Motors	C	Damage , packing	
93.	Cable drums	O	Damage	
94.	Control Panel /control desk, UPS ,JB	S	Damage, Packing	
95.	Instruments(gauges/analysers)	C	Damage	
Special items		As per Manufacturer's item, like Hydrogen cylinders, Ozonator, Analyser, Chlorine dioxide generators etc.		

5. CONCLUSION

Concerned storage agency at site should make sure that loss in equipment performance and wear & tear are minimised through proper storage and preservation. The above are broad guidelines and cover major equipment / materials. However specific storage practices shall be followed as per manufacturer recommendation. All the necessary measures even in addition to the ones mentioned above, if found necessary, should be taken to achieve the objective.

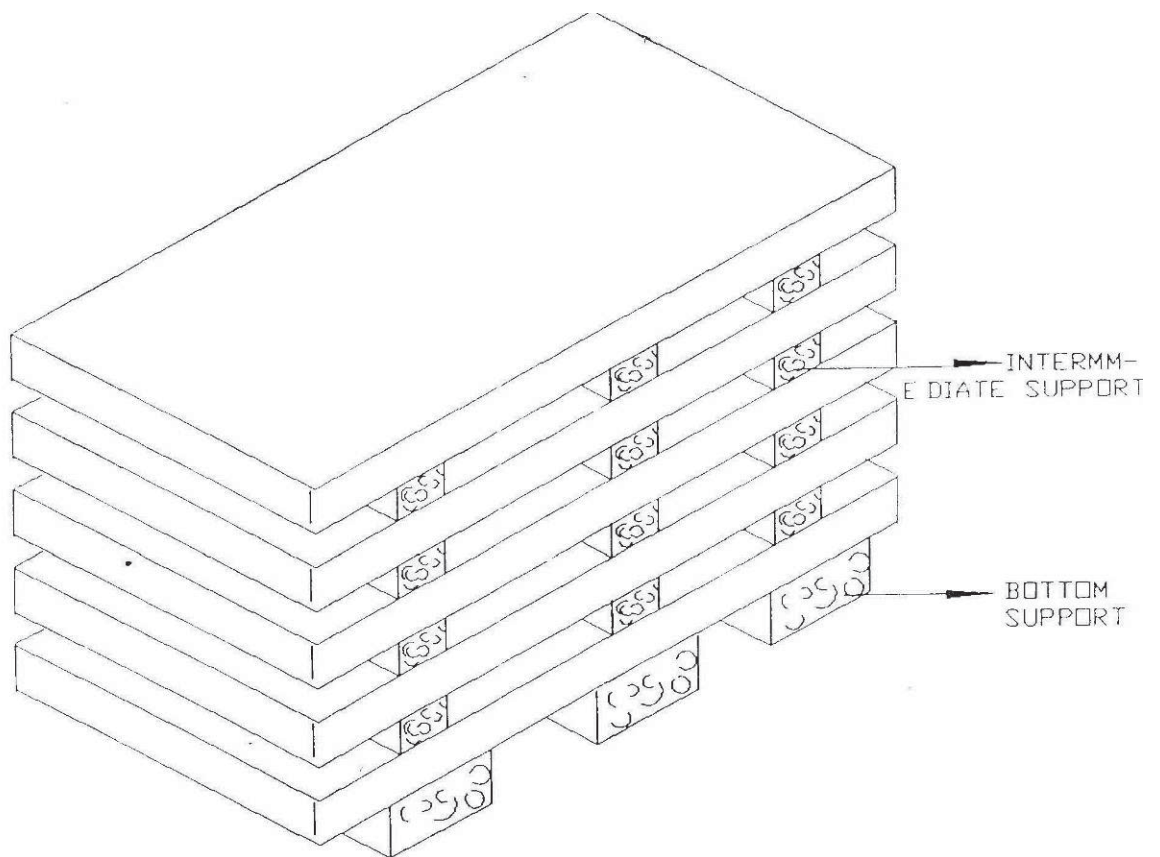


Figure – 1 – PLATE STACKING ARRANGEMENT

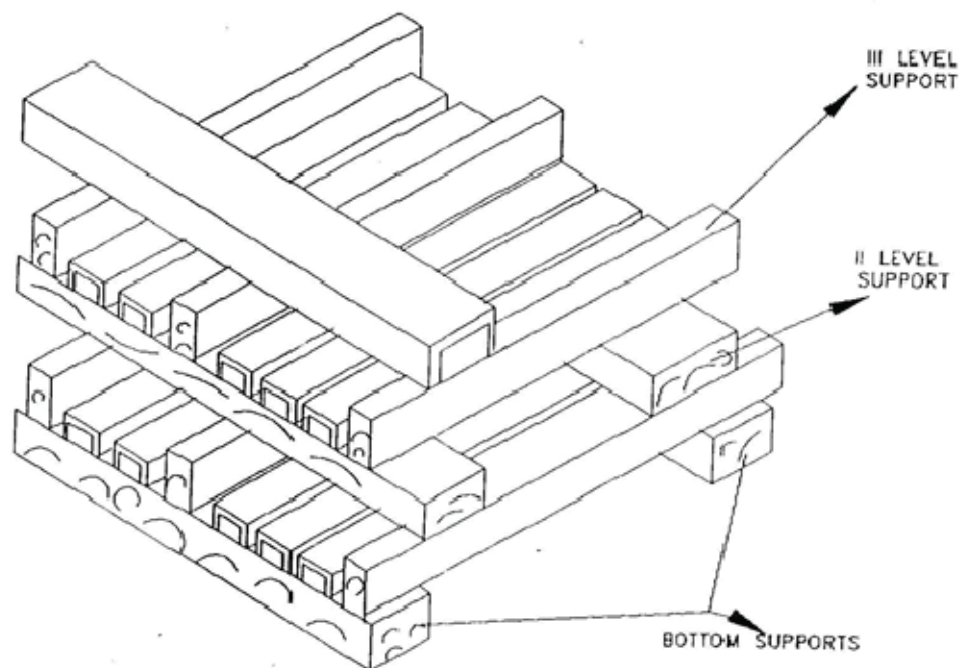


Figure – 2 – STRUCTURAL STEEL STACKING ARRANGEMENT



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

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VOLUME III

SECTION '1'

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DRAWING / DOCUMENTS TO BE SUBMITTED WITH THE BID

Bidder should submit the signed and stamped copy of the following documents:

- a) Signed and stamped copy of Compliance cum Confirmation Certificate
- b) Signed and Stamped copy of pre-bid clarification
- c) Signed and stamped copy of Deviation Schedule strictly as per format
- d) Signed and stamped copy of Electrical Load Data for confirmation of loads.
- e) Unpriced-price format mentioning Quoted / Not Applicable as the case may be against each column and row.
- f) Signed and stamped copy of building drawings enclosed at the end of the specification for the confirmation of building sizes.

Offer will be considered as incomplete in absence of any of the above documents. Bidder to ensure that all above documents are available in their offer, failing to which bidder offer is liable to be rejected.

Any other document apart from above submitted along with bid will not be taken cognizance off and will not make any part of the contract and accordingly will not be considered for bid evaluation.

	TECHNICAL SPECIFICATION FOR FUEL OIL HANDLING SYSTEM 1X800 MW KOTHAGUDEM TPS (COMPLIANCE CUM CONFIRMATION CERTIFICATE)		SPECIFICATION NO. PE-TS-410-166-A001
			VOLUME III SECTION '2'
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COMPLIANCE CUM CONFIRMATION CERTIFICATE

The bidder shall confirm compliance with following by signing / stamping this compliance certificate (every sheet) and furnish same with the offer.

- a) The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusions, other than those mentioned under "exclusion and those resolved as per 'Schedule of Deviations', with regard to same.
- b) There are no other deviations w.r.t. specifications other than those furnished in the 'Schedule of Deviations'. Any other deviation, stated or implied, taken elsewhere in the offer stands withdrawn unless specifically brought out in the 'Schedule of Deviations'
- c) Bidder shall submit QP in the event of order based on the guidelines given in the specification & QP enclosed therein. QP will be subject to BHEL / CUSTOMER approval & customer hold points for inspection / testing shall be marked in the QP at the contract stage. Inspection / testing shall be witnessed as per same apart from review of various test certificates/ Inspection records etc. This is within the contracted price without any extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets / calculations etc. submitted along with the offer shall not be taken cognizance off.
- e) The offered materials shall be either equivalent or superior to those specified in the specification & shall meet the specified / intended duty requirements. In case the material specified in the specifications is not compatible for intended duty requirements then same shall be resolved by the bidder with BHEL during the pre-bid discussions, otherwise BHEL / Customer's decision shall be binding on the bidder whenever the deficiency is pointed out.

For components where materials are not specified, same shall be suitable for intended duty, all materials shall be subject to approval in the event of order.

- f) The commissioning spares shall be supplied on 'As Required Basis' & prices for same included in the base price itself.
- g) All sub vendors shall be subject to BHEL / CUSTOMER approval in the event of order.
- h) Guarantee for plant/equipment shall be as per relevant clause of GCC / SCC / Other Commercial Terms & Conditions
- i) In the event of order, all the material required for completing the job at site shall be supplied by the bidder within the ordered price even if the same are additional to approved billing break up, approved drawing or approved Bill of quantities within the scope of work as tender specification. This clause will apply in case during site



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUEDEM TPS
(COMPLIANCE CUM CONFIRMATION CERTIFICATE)**

SPECIFICATION NO. PE-TS-410-166-A001

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commissioning, additional requirements emerges due to customer and / or consultant's comments. No extra claims shall be put on this account

- j) Schedule of drawings submissions, comment incorporations & approval shall be as stipulated in the specifications. The successful bidder shall depute his design personnel to BHEL's / Customer's / Consultant's office for across the table resolution of issues and to get documents approved in the stipulated time.
- k) As built drawings shall be submitted as and when required during the project execution.
- l) The bidder has not tempered with this compliance cum confirmation certificate and if at any stage any tempering in the signed copy of this document is noticed then same shall be treated as breach of contract and suitable actions shall be taken against the bidder.
- m) Successful bidder shall furnish detailed erection manual for each of the equipment 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.
- n) 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.
- o) In case vendor submits revised drawing after approval of the corresponding drawing, any delay in approval of revised drawing shall be to vendor's account and shall not be used as a reason for extension in contract completion.

SIGNATURE : _____

NAME : _____

DESIGNATION : _____

COMPANY : _____

DATE : _____

COMPANY SEAL



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS
(PRE-BID CLARIFICATION SCHEDULE)**

SPECIFICATION NO. PE-TS-410-166-A001

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PRE-BID CLARIFICATION SCHEDULE

S. NO.	SECTION/CLAUSE/PAGE NO.	STATEMENT OF THE REFERRED CLAUSE	CLARIFICATION REQUIRED

The bidder hereby clarifies that above mentioned are the only clarifications required on the technical specification for the subject package.

Signature: _____

Name: _____

Designation: _____

Company: _____

Date: _____

Company Seal

	TECHNICAL SPECIFICATION FOR FUEL OIL HANDLING SYSTEM 1X800 MW KOTHAGUDEM TPS (SCHEDULE OF TECHNICAL DEVIATION)	SPECIFICATION NO. PE-TS-410-166-A001	
		VOLUME – III	SECTION - 4
		REVISION 00	DATE: 24/04/2015
		PAGE 1 of 1	
NO DEVIATION CERTIFICATE			

	TECHNICAL SPECIFICATION FOR FUEL OIL HANDLING SYSTEM 1X800 MW KOTHAGUDEM TPS (SCHEDULE OF TECHNICAL DEVIATION)	SPECIFICATION NO. PE-TS-410-166-A001	
		VOLUME – III	SECTION - 4
		REVISION 00	DATE: 24/04/2015
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SCHEDULE OF TECHNICAL DEVIATION										
NAME OF VENDOR:-										
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
TECHNICAL DEVIATIONS										
COMMERCIAL DEVIATIONS										
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE										
NAME				DESIGNATIONS			SIGN & DATE			

NOTES:

1. For self-manufactured items of bidder, cost of withdrawal of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.
2. For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawal of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.
6. Bidder shall furnish price copy of above format along with price bid.
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawal of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawal of deviation shall be taken as NIL.
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.
12. Cost of withdrawal is to be given separately for each deviation. In no event bidder should club cost of withdrawal of more than one deviation else cost of withdrawal of such deviations which have been clubbed together shall be considered as NIL.
13. In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001	
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**SECTION 5
ELECTRICAL LOAD DATA**

LOAD TITLE	RATING (KW / A)		UNIT (U)/STN (S)	Nos.		VOLTAGE CODE*	FEEDER CODE**	EMER. LOAD (Y)	CONT.(C)/INTT.(I)	STARTING TIME >5 SEC (Y)	LOCATION	BOAR D NO.	CABLE		BLOCK CABLE DRG. No.	CONTROL CODE	REMARKS	LOAD No.
	NAME PLATE	MAX. CONT. DEMAND (MCR)		RUNNING	STANDBY								SIZE CODE	Nos				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Sump Pumps in FO U/L area (10 cum/hr.)	5.5 KW		S	1	1	D	U		I		FO Unloading Area							
HFO U/L Pumps (150 cum/hr.)	75 KW		S	2	1	D	U		I		FO Unloading Pump House							
HFO U/L Pumps (25 cum/hr.)	11 KW		S	1	1	D	U		I									
LDO U/L Pumps (150 cum/hr.)	55 KW		S	2	1	D	U		I									
LDO U/L Pumps (25 cum/hr.)	11 KW		S	1	1	D	U		I									
Drain Oil Pumps (5 cum/hr.)	5.5 KW		S	1	1	D	U		I									
Sump Pumps in U/L Pump House (10 cum/hr.)	5.5 KW		S	1	1	D	U		I									
Motor operated valve (unloading pump discharge) with open close push button	0.55 KW		S	2	8	D	S		I								Integral starter in vender scope	
Recovery Oil Pumps (OWS) (5 cum/hr.)	5.5 KW		S	1	1	D	U		I		Near Tank farm Area Transfer							
Motor operated valve (on tank) with open close push button	0.55 KW		S	2	2	D	S		I								Integral starter in vender scope	
Note: - Bidder to confirm that the system provided by them would be catered by the above loads considered by BHEL. In case there is any variation; the same should be clearly stated in the technical offer. No changes would be admissible during detailed engineering stage. - Bidder to note that for the system being supplied by them, only the above loads will be provided. In case any other load is required the same would be derived /multiplied by bidder on their own from these feeders only.																		
NOTES: - COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL) - ABBREVIATIONS : * VOLTAGE CODE (7):- (ac) A=11 KV, B=6.6 KV, C=3.3 KV, D=415 V, E=240 V (1 PH), F=110 V (cc): G=220 V, H=110 V, J=48 V, K=+24V, L=-24 V : ** FEEDER CODE (8):- U=UNIDIRECTIONAL STARTER, B=BI-DIRECTIONAL STARTER, S=SUPPLY FEEDER, D=SUPPLY FEEDER (CONTACTOR CONTROLLED)																		
	LOAD DATA (ELECTRICAL)		JOB NO.		410					ORIGINATING AGENCY			BIDDER SIGN AND STAMP					
			PROJECT TITLE		1 x800 MW KOTHAGUDEM TPS					NAME		VIPIN NAUNI		DATA FILLED UP ON		24/04/2015		
			SYSTEM / S		FUEL OIL UNLOADING & STORAGE SYSTEM					SIGN.		-SD-		DATA ENTERED ON				
			DEPTT. / SECTION		MAUX/MH					SHEET 1 OF 1		REV. 00		DE'S SIGN. & DATE				



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUEDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

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**SECTION 7
SUGGESTIVE PRICE FORMAT**

SCHEDULE-1								
1 X 800 MW KOTHAGUDEM TPS - FUEL OIL UNLOADING & STORAGE SYSTEM								
SUGGESTIVE PRICE FORMAT (MAIN PRICE)								
S.No	Details of Works or Equipment/System	Total ex-works Price	ED	CST /VAT	FREIGHT	E&C Charges	Service tax/ Any other taxes /duties	TOTAL (For site price)
1	2	3	4	5	6	7	8	9 = 3 + 4 + 5 + 6 + 7 + 8
1.0	Lumpsum prices							
1.1.0	Lumpsum firm price for SUPPLY comprising design, engineering, manufacturing, inspection and testing at vendor's / sub-vendor's works, painting, forwarding, proper packing, shipment and delivery at project site, including freight in line with drawings / documents / test procedures to be approved by Customer / consultant, inclusive of all prevailing taxes, duties and other levies for Fuel Oil Unloading & Storage System with all accessories including electricals, control & instrumentation items, start up & commissioning spares, Mandatory spares as required for the total scope defined as per technical specification PE-TS-410-166-A001 .						NA	
1.2.0	Lumpsum firm price for Erection & commissioning comprising unloading, storage, handling and transportation at site, erection and commissioning, minor civil work as required, trial run at site, functional/demonstartion Test at site and handing over to the customer in line with drawings / documents / test procedures to be approved by Customer / consultant, inclusive of all prevailing taxes, duties and other levies for Fuel Oil Unloading & Storage System as required for the total scope defined as per technical specification PE-TS-410-166-A001 .	NA						
1.3.0	Total (1.1.0 +1.2.0)							
	Notes:							
a)	Bidder to note that total (for site price) indicated above at 1.3.0 shall be considered for evaluation and hence should be complete in all respect for the full scope defined under tehnnical specification.							
b)	Any item not included in the price quoted above and shown separately will not be taken cognizance of and the offer shall be liable for rejection.							
c)	Total (FOR site supply price) indicated at S.N.1.1.0 above should match with the total of item wise break-up of S.N.1.4 of SCHEDULE-2 .							
d)	Bidder shall furnish the price of all items as indicated in the price SCHEDULE 1, 2, 3, 4 & 5 . Bidder's offer is liable to be rejected in case bidder does not furnish the same. For SCHEDULE-2 , pls refer next page.							
e)	Bidders are requested to obtain clarifications in case of any doubt before filling the price schedule in the prebid clarification stage. It is requested not to make any assumption.							

SCHEDULE-2							
1 X 800 MW KOTHAGUDEM TPS - FUEL OIL UNLOADING & STORAGE SYSTEM							Items price %age w.r.t total supply price
SUGGESTIVE PRICE FORMAT (SUPPLY BREAK-UP)							
S.No	Details of Works or Equipment/System	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)	
1	2	3	4	5	6	7 = 3 + 4 + 5 + 6	8
1.4	Break - up of Total (for site supply price) given at S.N 1.1.0 of SCHEDULE-1						
1.4.1	Lump sum price for steel plates for HFO Tanks, LDO tanks and drain oil tank including floor coil heater						18-25
1.4.2	Lump sum price for structural steels including flanges, hand rails, gratings etc for FOHS.						2 - 4
1.4.3	Lump sum price for HFO & LDO flexible metallic/ neoprene unloading hoses with all accessories						2 - 4
1.4.4	Lump sum price for Valves (Ball / Plug / Gate / check / Globe / others) in HFO & LDO line						6 - 8
1.4.5	Lump sum price for Valves (Gate / check / Globe / others) in steam & condensate line						2 - 3
1.4.6	Lump sum price for Valves in Water and air line						0.5 - 1
1.4.7	Lump sum price for Steam Trap						2 - 4
1.4.8	Lump sum price for Twin Screw Pumps with motor						8 -12
1.4.9	Lump sum price for Strainers for Unloading Pumps						2 - 3
1.4.10	Lump sum price for Suction Heater in HFO tanks						3 - 5
1.4.11	Lump sum price for Pressure Reducing and Desuperheating station complete in all respect						4-7
1.4.12	Lump sum price for Single Screw pump and Sump Pumps with motors						2 - 3
1.4.13	Lump sum price for Control valves in steam line (Suction heater, floor coil heater and Drain oil tank)						5 - 8
1.4.14	Lump sum price for Instruments (Gauges, Transmitters, Switches etc)						9 -12
1.4.15	Lump sum price for Flowmeter in HFO and LDO lines						8 -9
1.4.16	Lump sum price for Insulation & Cladding						3 - 5
1.4.17	Lump sum price for Painting						3 - 5
1.4.18	Lump sum price for Local Control panel						1 - 1.5
1.4.19	Lump sum price for Equipment and accessories of OWS including pipings,bends,heating arrangement,skimmer pipe,butterfly valve,rung ladder etc.						less than 1
1.4.20	Lump sum price for any other items not included above,but required to complete Fuel oil unloading & storage package as per system requirement.						less than 1
1.4.21	Total price for special tools & tackles for maintenance, if any						less than 1
1.4.22	Total price for startup and commissioning spares						less than 1
1.4.23	Total price for Mandatory spares as per SCHEDULE-3						7-10
1.4.24	Total of 1.4 (sum of 1.4.1 to 1.4.24)						100

Notes:

- Total (for site supply price) of mandatory spares indicated at **S.N.1.4.23 above** shall match with the total of item wise break-up of **S.N.1.5 of SCHEDULE-3**.
- Items price %age w.r.t total FOR SITE supply price is indicated under last column of **each row from 1.4.1 to 1.4.23**. Bidder to strictly fill the prices of each item under column no.8 as per indicated percentage only.

SCHEDULE-3

1 X 800 MW KOTHAGUDEM TPS - FUEL OIL UNLOADING & STORAGE SYSTEM

SUGGESTIVE PRICE FORMAT (MANDATORY SPARES)

S.No	Details of Works or Equipment/System	Unit Ex-works price	Unit & Qty	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)
1	2	3	4	5	6	7	8	9=5+6+7+8
1.5	<u>Break - up of Total (for site supply price) given at S.N 1.4.23 of SCHEDULE-2</u>							
AA	Fuel Oil System							
1	Fuel Oil System							
1.1	Suction Heater Gaskets							
1.1.1	For HFO Day Tanks		4 sets					
1.2	Suction Heater Nuts and Bolts							
1.2.1	For HFO Day Tanks		Lot					
1.3	Pump suction Strainer Basket		3 Nos. for each type					
1.4	Pump suction Strainer Gasket		6 Nos. for each type					
1.5	Pump O-Ring and Gasket		12 Nos. for each type					
1.6	Various types of Gland packing for valves		Lot for each type					
1.7	Pump Screw		3 Nos. for each type					
1.8	Pump and Motor Bearing							
1.8.1	For HFO & LDO transfer & pressurizing pump		4 sets for each pump					
1.8.2	For Drain Oil Pump		2 sets					
1.9	Plug valves for various sizes used		1 No. each					
1.1	Temperature Switch		2 Nos.					
1.11	Pressure Gauge		3 Nos.					
1.12	Temperature Gauge		3 Nos.					
1.13	Relief Valve Spring		2 sets					
1.13.1	For HFO & LDO pump		3 nos.					
1.13.2	For Drain Oil Pump		3 nos.					
1.14	Flame Arrestor		2 Nos.					

1.15	Hoses with end fittings		5 Nos. for each type					
1.16	Adaptor		5 Nos. for each type					
1.17	Suction Heater Heating Element		1 No.					
1.18	Mat Coil Heater – Heating Element		20m pipe length					
1.19	Thermodynamic traps		5 Nos.					
1.2	Inverted Bucket type traps		2 Nos.					
2	Electrical Items for 3.3KV, 415V System & DC		Items indicated below:					
2.1.0	415 Volt Motor (above 30KW Rating upto 200KW)							
2.1.1	End Shield Cover Driving & Non-Driving End		1Set for each type and rating of Motor					
2.1.2	Driving End & Non-Driving End Bearing		1Set for each type and rating of Motor					
2.1.3	Cooling Fan		1Set for each type and rating of Motor					
2.1.4	Motor Space Heater		1Set for each type and rating of Motor					
2.1.5	Motor Terminal Block		1Set for each type and rating of Motor					
2.1.6	Complete Set of Coupling		1Set for each Application					
2.2.0	415 Volt Motor (Upto 30KW Rating)							
2.2.1	Driving End & Non-Driving End Bearing		3 Set for each type and rating of Motor					
2.2.2	Cooling Fan		2 No. for each type and rating of Motor					
2.2.3	Motor Terminal Block		5 No. for each type and rating of Motor					
2.2.4	Complete Set of Coupling		1 Set for each Application					
3	C&I Items							
3.1	Control Panel/Desk Mounted Items							
3.1.1	Push Button							
3.1.2	Complete assembly							
3.1.3	Contact Element (1NO + 1NC) Block							

3.1.4	Selector Switch							
3.1.5	Indicating Lamps complete assembly		10Nos. for each Colour and type					
3.1.6	Mimic Lamps		10Nos. for each Colour and type					
3.1.7	MCB		2Nos. for each type and rating					
3.1.8	Door Limit Switch		2Nos.					
3.1.9	Annunciation system							
3.1.10	Lamp Box with Facia & Lamps (LED type)		25Nos.					
3.1.11	Hooter		1No.					
3.1.12	Each type of PCB (for non-PLC driven system)		1(one) no.					
4.0	Total							
	Notes:							
a)	Unless stated otherwise, a 'set' means item or sub-items required for each type/ size, range of assembly/ sub- assembly required for complete replacement in one equipment system; it is further intended that the assembly/ sub-assembly which have different orientation (like left hand or right hand, top or bottom), different							
b)	Wherever quantity has been specified as percentage(%), the quantity of mandatory spares to be provided by the vendor shall be the specified percentage (%) of total population required to meet the specification requirements. In case the quantity of mandatory spares so calculated happens to be in fraction, the same shall be rounded off to next higher whole number.							
c)	Wherever the quantities have been indicated for each type, size, thickness, material, radius, range etc, these shall cover all the items supplied and installed and the breakup of these shall be furnished by the vendor during detail engineering.							
d)	In case spares indicated in the list are not applicable to the particular design offered by the bidder, the bidder should offer spares applicable to the offered design with quantities generally in line with the approach followed in the above list.							
e)	Wherever bidder has indicated an item as not applicable, the same will have to be supplied free of cost, in case it is found applicable during detail engineering.							

SCHEDULE-4							
1 X 800 MW KOTHAGUDEM TPS - FUEL OIL UNLOADING & STORAGE SYSTEM							
UNIT RATES							
S.No	Details of Works or Equipment/System	Ex-works price	ED	CST /VAT	FREIGHT	INSURANCE	TOTAL
1	2	3	4	5	6	7	3 to 7
1	LDO unloading pump, 25 m3/Hr (twin screw) with motor						
2	LDO unloading pump, 150 m3/Hr (twin screw) with motor						
3	HFO unloading pump, 25 m3/Hr (twin screw) with motor						
4	HFO unloading pump, 150 m3/Hr (twin screw) with motor						
5	Simplex Strainer, 25 m3/Hr						
6	Simplex Strainer, 150 m3/Hr						
7	Vertical single screw pump set, 5 m3/Hr with motor						
8	Vertical Sump pump set, 10 m3/Hr with motor						
9	Suction Heater for HFO Tank						
10	Pressure Reducing and Desuperheater Station						
11	Hose for LDO & HFO unloading (1 no)						
12	Flowmeter (Coriolis type - LDO)						
13	Flowmeter (Coriolis type -HFO)						
14	Control valve (SMART Type) - Floor coil heater / Suction Heater						
15	Control valve (On-off type) - Drain oil tank						
16	IB Type trap module						
17	TD Type Trap module						
18	Local control panel (Annunciation / push buttons)						
19	Gate Valves						
a	400 NB						
b	350 NB						
c	300 NB						
d	250 NB						
e	200 NB						
f	150 NB						
g	100 NB						
h	80 NB						
i	50 NB						
j	25 NB						
20	Ball / Plug Valves						
a	350 NB - Motorized						
b	350 NB						
c	300 NB - Motorized						
d	300 NB						
e	250 NB						
f	200 NB - Motorized						
g	200 NB						
h	150 NB						
i	100 NB - Motorized						
j	100 NB						
k	80 NB						
l	50 NB						
m	25 NB						
21	Check Valves						

a	200 NB						
b	150 NB						
c	100 NB						
d	80 NB						
e	50 NB						
22	Instruments & Control						
a	Pressure gauge						
b	Differential pressure Indicator Transmitter						
c	Pressure Transmitter						
d	Level indicator Float and board Type						
e	Level transmitter (Tanks)						
f	Level transmitter (for Sump Pit)						
g	Temperature element with TT						
h	Temperature indicator						
23	Insulation Per metre square basis						
24	Cladding Per metre square basis						
25	Paints Per metre square basis						
26	IS 2062 Gr. B Plate (Per tonne)						
27	Structural Steel IS2062 Gr. A						

Note: Bidder shall furnish the unit price of all items as indicated above. Bidder's offer shall liable to be rejected in case bidder does not furnish the same.

		SCHEDULE-5								
		1 X 800 MW KOTHAGUDEM TPS : FUEL OIL UNLOADING & STORAGE SYSTEM								
NAME OF VENDOR:-										
SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION / TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF DEVIATION	PORTION OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWL OF DEVIATION (POSITIVE/ NEGATIVE)	WHETHER COST OF DEVIATION INCLUDED/ EXCLUDED IN PRICE BID	REMARKS
TECHNICAL DEVIATIONS										
COMMERCIAL DEVIATIONS										
PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE										
NAME				DESIGNATIONS		SIGN & DATE				
NOTES:										
1. For self manufactured items of bidder, cost of withdrawl of deviation will be applicable on the basic price (i.e. excluding taxes, duties & freight) only.										
2. For directly dispatchable items, cost of withdrawl of deviation will be applicable on the basic price including taxes, duties & freight.										
3. All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.										
4. Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.										
5. Bidder shall submit duly filled unpriced copy of above format indicating "quoted" in "cost of withdrawl of deviation" column of the schedule above along with their Techno-commercial offer, wherever applicable.										
6. Bidder shall furnish price copy of above format along with price bid.										
7. The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.										
8. Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.										
9. For deviations w.r.t. Payment terms, Liquidated damages, Firm prices and submission of E1/ E2 forms before claiming 10% payment, if a bidder chooses not to give any cost of withdrawl of deviation loading as per Annexure-VIII of GCC, Rev-06 will apply. For any other deviation mentioned in un-priced copy of this format submitted with Part-I bid but not mentioned in priced copy of this format submitted with Priced bid, the cost of withdrawl of deviation shall be taken as NIL.										
10. Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.										
11. All techno-commercial terms and conditions of NIT shall be deemed to have been accepted by the bidder, other than those listed in unpriced copy of this format.										
12. Cost of withdrawl is to be given seperately for each deviation. In no event bidder should club cost of withdrawl of more than one deviation else cost of withdrawl of such deviations which have been clubbed together shall be considered as NIL.										
13. In case nature of cost of withdrawl (positive/negative) is not specified it shall be assumed as positive.										
14. In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.										



**TECHNICAL SPECIFICATION FOR
FUEL OIL HANDLING SYSTEM
1X800 MW KOTHAGUDEM TPS**

SPECIFICATION NO. PE-TS-410-166-A001

VOLUME III

SECTION '8'

REVISION 00

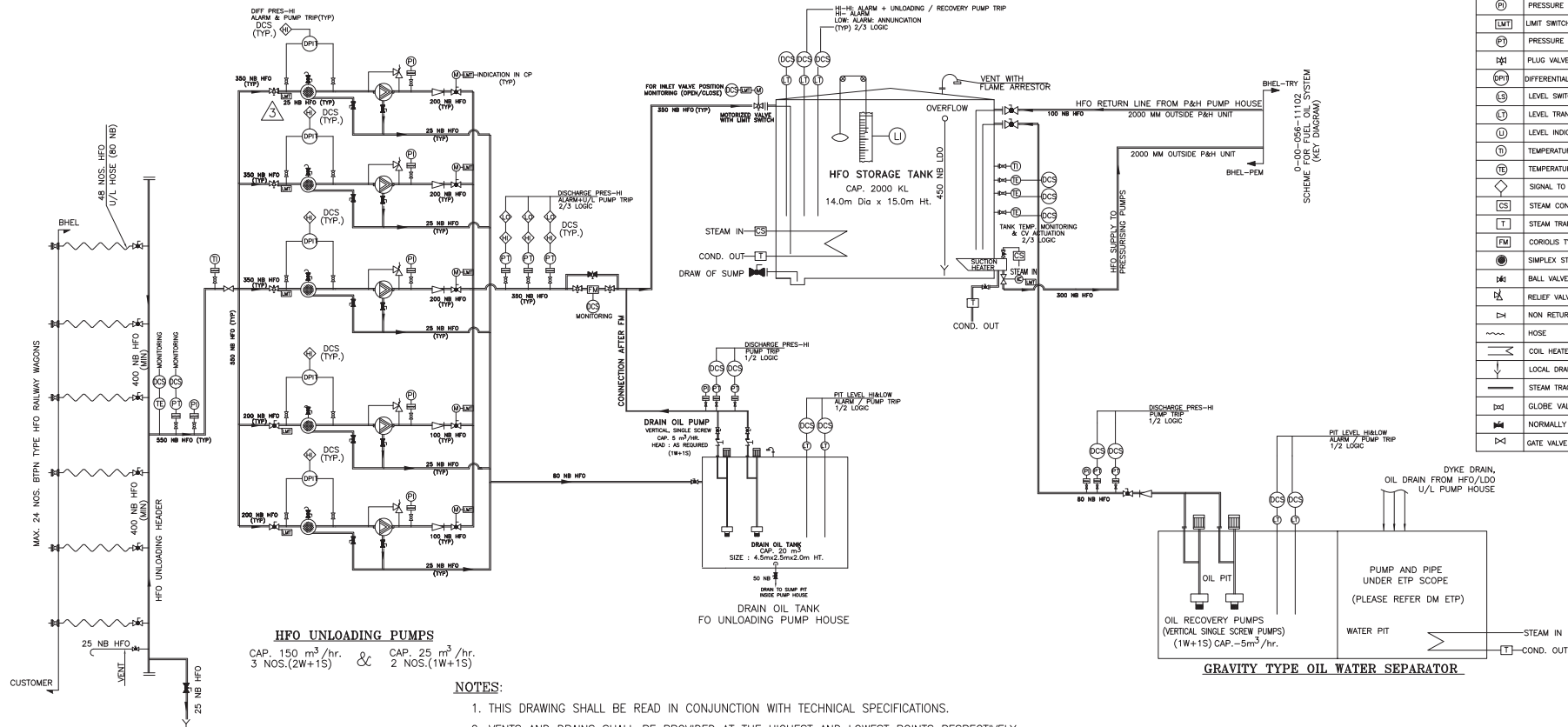
DATE: 24/04/2015

PAGE 1 of 1

**SECTION 8
DRAWINGS ATTACHED**

DRAWING NO. PE-DG-410-166-A001

ALL DIMENSIONS ARE IN MM



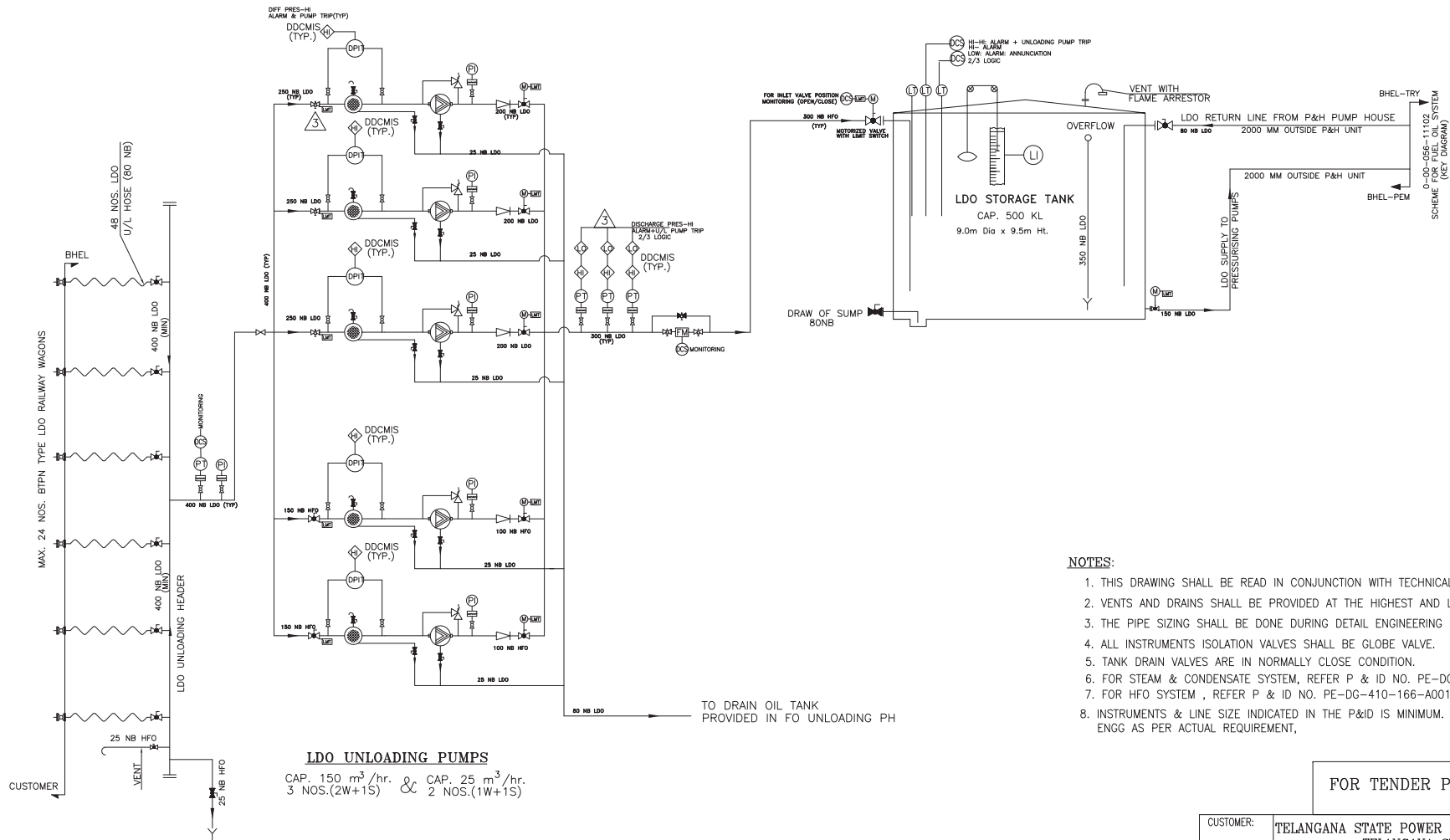
LEGEND	
SYMBOL	DESCRIPTION
(PI)	PRESSURE INDICATOR
[LMT]	LIMIT SWITCH: OPEN-CLOSE INDICATION TO CP
(PT)	PRESSURE TRANSMITTER
[PV]	PLUG VALVE
(DPI)	DIFFERENTIAL PRESSURE INDICATOR TRANSMITTER
[LS]	LEVEL SWITCH
[LT]	LEVEL TRANSMITTER
[LI]	LEVEL INDICATOR
[TI]	TEMPERATURE INDICATOR
[TE]	TEMPERATURE ELEMENT
[SIGNAL TO DCS (LO OR HI)]	SIGNAL TO DCS (LO OR HI)
[SCV]	STEAM CONTROL VALVE
[ST]	STEAM TRAP
[FM]	CORIOLIS TYPE FLOWMETER
[S]	SIMPLEX STRAINER
[BV]	BALL VALVE
[RV]	RELIEF VALVE
[NRV]	NON RETURN VALVE
[H]	HOSE
[CH]	COIL HEATER
[LD]	LOCAL DRAIN
[STP]	STEAM TRACED HFO PIPE
[GV]	GLOBE VALVE
[NCV]	NORMALLY CLOSED VALVE
[G]	GATE VALVE

FOR TENDER PURPOSE ONLY

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA 1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA				
OWNER'S CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI				
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA				
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		DEPT CODE	NAME	SIGN	DATE
		M	DRN VN DESIN VN CHKD HK APPR PK		24/04/15 24/04/15 24/04/15 24/04/15
TITLE					
PROCESS & INSTRUMENTATION DIAGRAM FOR HFO SYSTEM					
		DEPT.	SCALE	DRAWING NO. PE-DG-410-166-A001	
		SIGN			
		SHEET 1		REV. 00	

FORMAT SIZE A3

DRAWING NO. PE-DG-410-166-A002



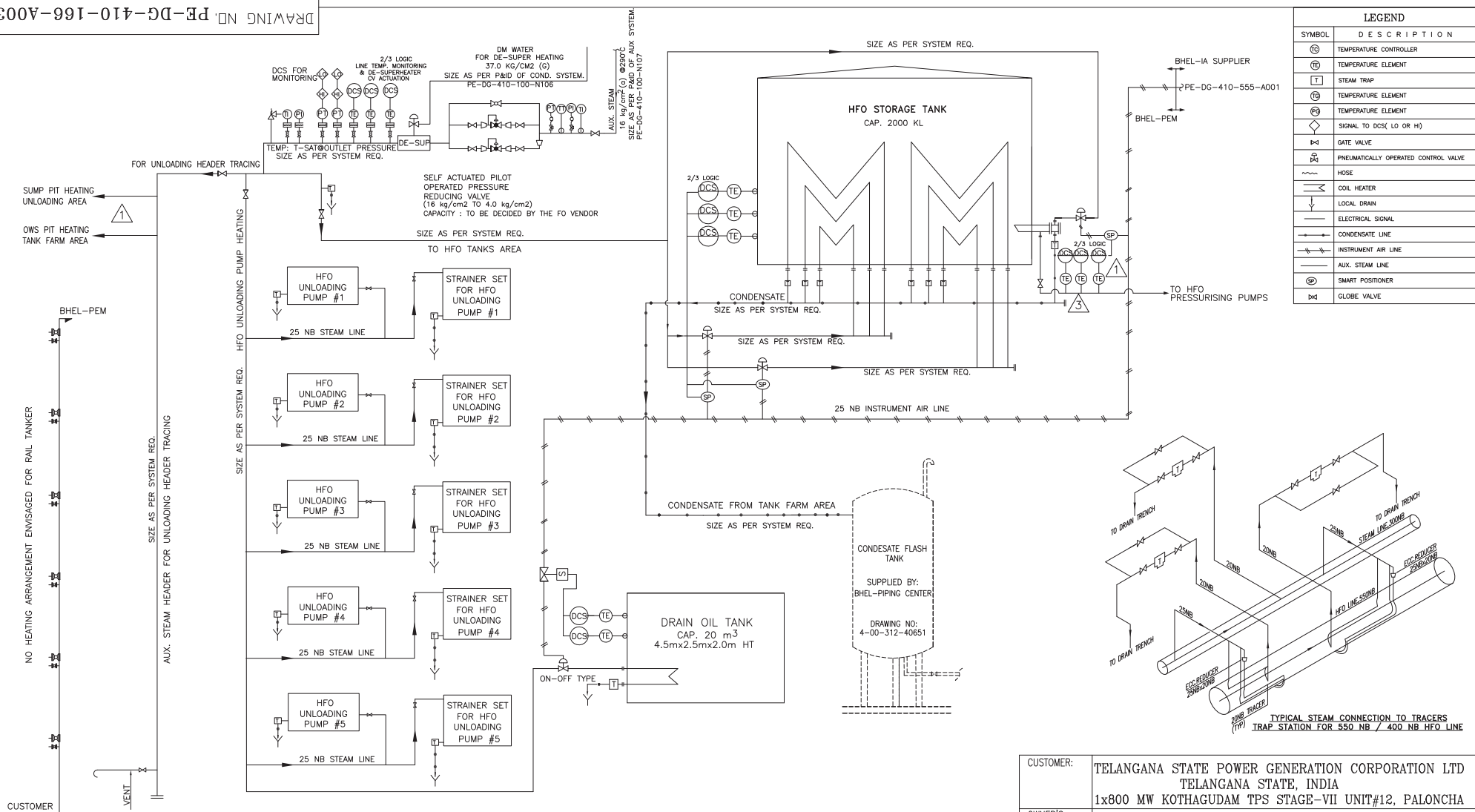
LEGEND	
SYMBOL	DESCRIPTION
(PI)	PRESSURE INDICATOR
(PS)	PRESSURE SWITCH
(PT)	PRESSURE TRANSMITTER
(HV)	PLUG VALVE
(DPT)	DIFFERENTIAL PRESSURE INDICATOR TRANSMITTER
(LS)	LEVEL SWITCH
(LT)	LEVEL TRANSMITTER
(LI)	LEVEL INDICATOR
(TI)	TEMPERATURE INDICATOR
(TE)	TEMPERATURE ELEMENT
(S)	SIGNAL TO DCS(LO OR HI)
(SCV)	STEAM CONTROL VALVE
(T)	STEAM TRAP
(FM)	CORIOLIS TYPE FLOWMETER
(S)	SIMPLEX STRAINER
(BV)	BALL VALVE
(RV)	RELIEF VALVE
(NRV)	NON RETURN VALVE
(H)	HOSE
(CH)	COIL HEATER
(LD)	LOCAL DRAIN
(STP)	STEAM TRACED LDO PIPE
(GV)	GLOBE VALVE
(NCV)	NORMALLY CLOSED VALVE
(GV)	GATE VALVE
(LMT)	LIMIT SWITCH: OPEN-CLOSE INDICATION TO CP

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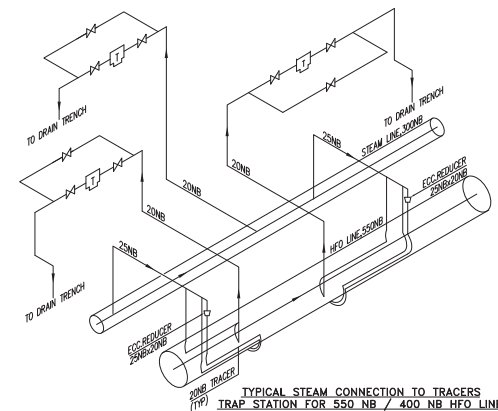
CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA 1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA				
OWNER'S CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI				
	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA				
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	BESN	VN	24/04/15		
	CHD	HK	24/04/15		
	APPD	PK	24/04/15		
TITLE					
PROCESS & INSTRUMENTATION DIAGRAM FOR LDO SYSTEM					
DEPT.	SCALE	DRAWING NO. PE-DG-410-166-A002			
SIGN					
SHEET 1		REV. 00			

DRAWING NO. PE-DG-410-166-A003

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LEGEND	
SYMBOL	DESCRIPTION
TC	TEMPERATURE CONTROLLER
TE	TEMPERATURE ELEMENT
ST	STEAM TRAP
TE	TEMPERATURE ELEMENT
TE	TEMPERATURE ELEMENT
TE	TEMPERATURE ELEMENT
◇	SIGNAL TO DCS (LO OR HI)
◇	GATE VALVE
◇	PNEUMATICALLY OPERATED CONTROL VALVE
—	HOSE
—	COIL HEATER
—	LOCAL DRAIN
—	ELECTRICAL SIGNAL
—	CONDENSATE LINE
—	INSTRUMENT AIR LINE
—	AUX. STEAM LINE
SP	SMART POSITIONER
dx	GLOBE VALVE

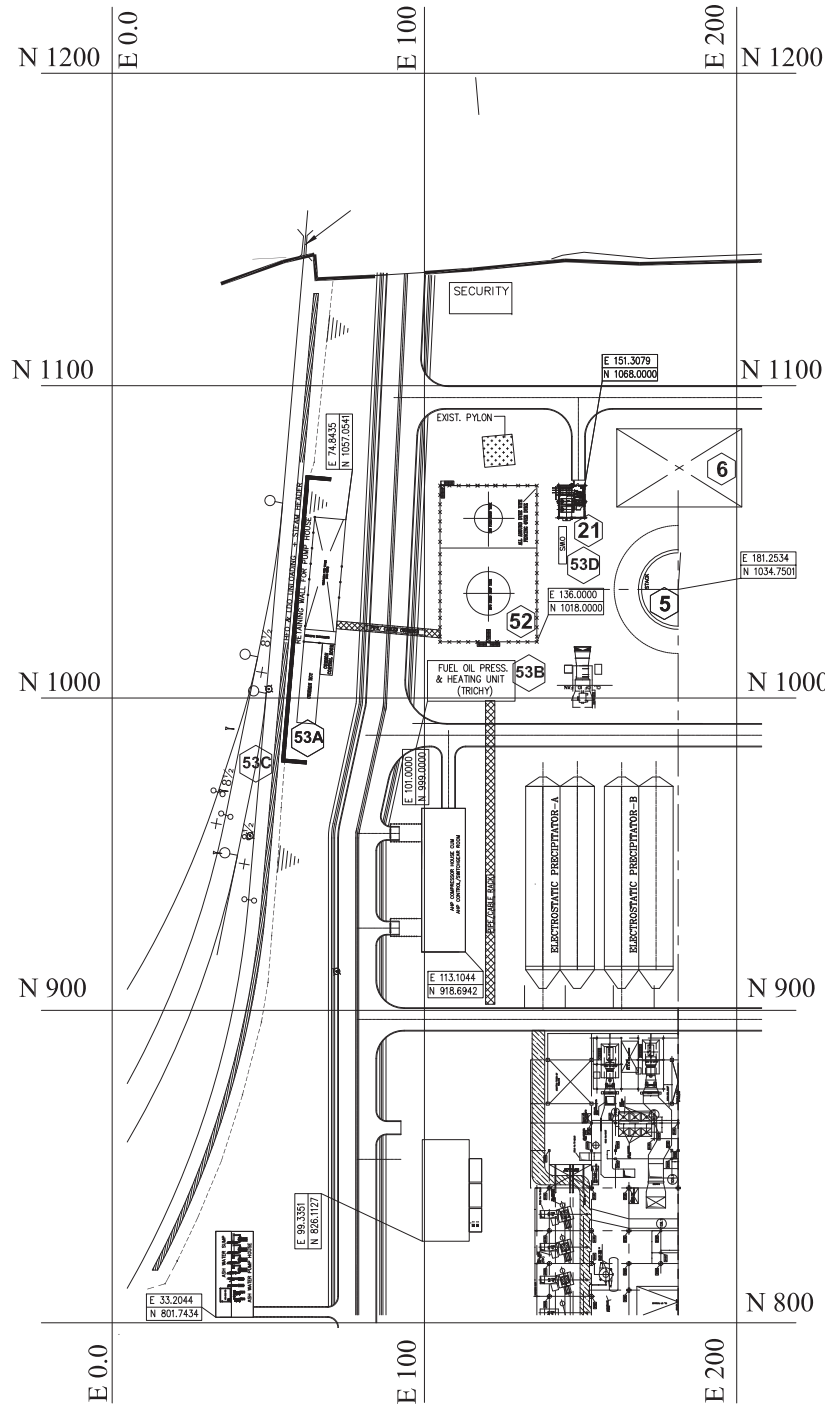
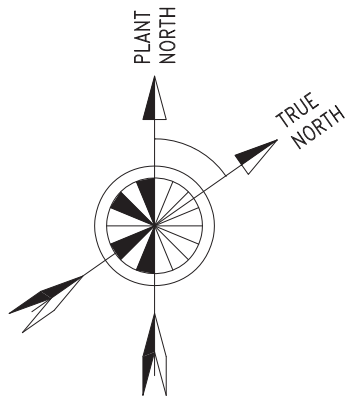


NOTES:

- ALL STEAM/CONDENSATE LINES SHALL BE INSULATED.
- STEAM TRAPS FOR SUCTION HEATER & FLOOR COIL HEATER OF STORAGE TANKS SHALL BE OF IB TYPE. ALL OTHER STEAM TRAPS SHALL BE OF TO TYPE.
- FOR STEAM LINES & TRACER LINES, TRAPS SHALL BE PROVIDED AT EVERY 40 TO 45 MTR.
- SHELL SURFACE OF F.O. STORAGE TANKS & ENTIRE FLASH TANK ARE INSULATED.
- AUX. STEAM WILL BE SUPPLIED TO AT 16KG/SQ. CM (G) & 290 °C. FURTHER IT SHALL BE REDUCED TO 4KG/SQ. CM (G) OR AS PER SYSTEM REQUIREMENT.
- PIPE SIZES FOR ALL STEAM LINES, TRACER LINES, CONTROL STATIONS, CONDENSATE LINES ETC. SHALL BE PROVIDED AS PER APPROVED CALCULATION.
- DRAIN FROM FLASH TANK SHALL BE DISCHARGED TO OIL WATER SEPARATOR.
- FOR OTHER DETAILS, REFER P & ID FOR HFO SYSTEM, PE-DG-410-166-A001.
- BTPN WAGONS ARE NOT EQUIPPED WITH HEATING FACILITY, SO NO HEATING ARRANGEMENT IS PROVIDED FOR WAGON HEATING. ONLY UNLOADING HEADER TRACING WILL BE DONE IN U/L AREA.
- ON OFF TYPE CONTROL VALVE FOR FLOOR COIL HEATER AND MODULATING TYPE CONTROL VALVE FOR SUCTION HEATER WILL BE PROVIDED.
- INSTRUMENTS & LINE SIZE INDICATED IN THE P&ID IS MINIMUM. SAME SHALL BE FINALIZED DURING DETAIL ENGG AS PER ACTUAL REQUIREMENT.

FOR TENDER PURPOSE ONLY

CUSTOMER:	TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA 1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA				
OWNER'S CONSULTANT:	DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI				
 Bharat Heavy Electricals Company	BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT NOIDA				
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M		DEPT CODE	NAME	SIGN	DATE
		DRN	VN		24/04/15
		DES	VN		24/04/15
		CHD	HK		24/04/15
		APPD	PK		24/04/15
TITLE					
P&ID FOR STEAM & CONDENSATE FOR HFO HEATING & TRACING					
			DEPT. SCALE	DRAWING NO. PE-DG-410-166-A003	
			SIGN		
				SHEET 1	
				REV. 00	



2

LEGEND:	
S. No.	DESCRIPTION
52	HFO & LDO STORAGE TANK DYKE AREA.
53A	HFO & LDO UNLOADING PUMP HOUSE
53B	HFO & LDO FORWARDING PUMP HOUSE
53C	HFO & LDO UNLOADING AREA (RAILWAY)
53D	OIL WATER SEPARATOR
21	FOAM PUMP HOUSE
5	CHIMNEY

DIMENSIONS OF VARIOUS FACILITIES ARE AS UNDER.

- 1) HFO TANK :1 NO., 14.0M DIA, 15.0 M Ht
- 2) LDO TANK :1 NO., 9.0M DIA, 9.5 M Ht
- 2) DYKE AREA 50M X 31M, Ht: 2.0M
- 3) DISTANCE BETWEEN SHELL TO SHELL OF ADJACENT TANKS = 12 M
- 4) FUEL OIL UNLOADING PUMP HOUSE=AS SHOWN
- 5) FUEL OIL FORWARDING PUMP HOUSE=AS SHOWN
- 6) OIL WATER SEPARATOR=12M X 2M (APPROX.)
- 7) UNLOADING HEADERS AND STEAM HEADERS WILL BE PEDESTAL ROUTED.
- 8) FGL OF HFO & LDO UNLOADING AREA IS APPROX. 4.5M ABOVE FGL OF UNLOADING PUMP HOUSE

NOTE :

- 1) BASED ON ABOVE LAYOUT DETAIL ENGINEERING WILL BE DONE.
- 2) COORDINATES SHALL BE AS PER PLOT PLAN.
- 3) FENCING WILL BE DONE OVER THE DYKE WALL

CUSTOMER:		TELANGANA STATE POWER GENERATION CORPORATION LTD TELANGANA STATE, INDIA 1x800 MW KOTHAGUDAM TPS STAGE-VII UNIT#12, PALONCHA					
OWNER'S CONSULTANT:		DEVELOPMENT CONSULTANTS PVT. LTD. CONSULTING ENGINEERS KOLKATA MUMBAI CHENNAI NEW DELHI					
		BHARAT HEAVY ELECTRICALS LTD POWER SECTOR PROJECT ENGINEERING MANAGEMENT Noida					
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		DES	UN			12/11/2014	
		CHK	HK			12/11/2014	
		APPR	PK			12/11/2014	
TITLE							
FUEL OIL HANDLING SYSTEM LAYOUT							
		DEPT.	SCALE	DRAWING NO. PE-DG-410-166-A004			
		SIGN					
		SHEET	1	REV.		00	

