

NEYVELI LIGNITE CORP. LTD.

2X500MW LIGNITE FIRED UNITS AT NEYVELI

VOLUME IIB & III

**TECHNICAL SPECIFICATION
FOR
FUEL OIL UNLOADING SYSTEM**

SPECIFICATION NO.: PE-TS-400-166-A001



BHARAT HEAVY ELECTRICALS LTD

**POWER SECTOR PROJECT ENGINEERING MANAGEMENT
PPEI, NOIDA-INDIA**

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2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

VOLUME-IIB

SECTION – A

(INTENT OF SPECIFICATION)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORGAE SYSTEM
2X500MW LIGNITE FIRRED UNITS, NEYVELI**

SPECIFICATION NO. PE-TS-400-166-A001

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1.0 SCOPE OF INQUIRY / INTENT OF SPECIFICATION

- 1.1 The specification is intended to cover design, engineering, manufacture, inspection and testing at vendor's/ sub-vendor's works, painting, forwarding, proper packing and shipment and delivery at site, unloading, handling & transportation at site , Erection & Commissioning including commissioning spares(if applicable),minor civil works as required on FOR site basis, functional guarantee testing and handing over **of FUEL OIL UNLOADING & STORAGE SYSTEM** as per details in different sections / volumes of this specification for **2X500MW LIGNITE FIRED UNITS AT NEYVELI.**
- 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 of **FUEL OIL UNLOADING & STORAGE 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 high 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.
- 1.5 The general term and conditions, instructions to tenderer 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 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.



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- 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 in the enclosed schedule; otherwise, it will be presumed that the vendor's offer is strictly in line with NIT specification.
- 1.9 In case all above requirements are not complied with, the offer may be considered as incomplete and would become liable for rejection.
- 1.10 Unless specified otherwise, all through the specification, the word contractor shall have same meaning as successful bidder /vendor and Customer/ Purchaser/Employer will mean **BHEL and /or NLC** including their consultant as interpreted by BHEL in the relevant context.

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FOR
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VOLUME-IIB

SECTION – B

(PROJECT INFORMATION)



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



SALIENT FEATURES OF THE SITE & GENERAL PROJECT INFORMATION

1.1 Introduction

The project site at Neyveli has distinct location advantages, being at pit-head distance from the source of lignite supply from Mines, making it convenient for transportation of lignite by belt conveyor. Water source is readily available from the nearby mines lake. Besides, other infrastructure such as access road, railway connection etc, already exist.

1.2 Power Plant Site

The power plant site is located at Neyveli, opposite to the now defunct Fertilizer and Briquetting & Carbonization Plant, near TPS-I Expansion and TPS-II.

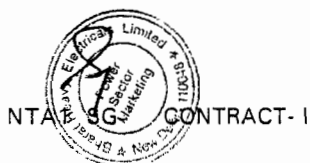
1.3 Project & Site Information

- | | | |
|------------------------------------|---|--|
| (i). Owner / Purchaser | : | Neyveli Lignite Corporation Limited (NLC Ltd), Neyveli, Cuddalore District, Tamil Nadu State, India |
| (ii). Consultant | : | Lahmeyer International (India) Pvt. Ltd (LII), Gurgaon, NCR, India. |
| (iii). Project Title | : | 2x500 MW Neyveli New Thermal Power Project (NNTPP) |
| (iv). Location | : | 200 kms south of Chennai and 50 kms south-west of Cuddalore |
| (v). Latitude | : | 11° 34' 00" N to 11° 35' 00" N |
| (vi). Longitude | : | 79° 26' 00" E to 79° 27' 00" E |
| (vii). Elevation above MSL | : | (+) 67 m |
| (viii). Nearest Railway Station | : | Neyveli, |
| (ix). Nearest Sea Port | : | Chennai, at a distance of 200 km |
| (x). Nearest Airport | : | Chennai, at a distance of 200 km |
| (xi). Road Access/Approach to Site | : | Connected by Chennai-Thanjavur NH 45C road and state highway connecting Cuddalore - Virudhachalam via Neyveli. Both NH and state high way roads are well connected to NLC township roads. The approach road is approximately 15 kms from Chennai-Thanjavur NH - 45C road |
| (xii). Site Meteorological Data | | |
| • Max ambient temperature | : | 42.8° C |
| • Min Ambient Temperature | : | 26.9° C |





- Wet bulb temp : 29° C
- Max. Relative Humidity : 92 % in the month of September
- Min. Relative Humidity : 23 % in the month of May
- Rainfall : About 1265.7 mm annually (average)
- Wind direction : South West to North East direction
- Wind Speed : 97.2 km/hr (maximum recorded)
4.3 km/hr (average wind speed)
- Seismicity : As per IS: 1893 (part 4) (Zone-II)
Importance factor: 1.75.



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SECTION – C

(SPECIFIC TECHNICAL REQUIREMENT)



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1.0.0 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, functional guarantee, testing and handing over of Fuel Oil System shall be as per details in different sections of this specification.

P&I Diagrams 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.

1.1.0 SCOPE OF SUPPLY

Scope of supply by bidder shall comprise of but not necessarily limited to the following. P&I Diagrams mentioned in clause No. 15 of this section may pls be referred.

- a) **Two(2) nos.** of vertical cylindrical, fixed roof type HFO storage tanks each of net **capacity 2000 cum** dully fitted with steam heated floor coil heaters and other appurtenances, accessories, instrumentation, controls and fittings etc.
- b) **Two (2) nos.** of vertical cylindrical, fixed roof type LDO storage tank of net **capacity 200 cum** dully fitted with appurtenances, accessories, instrumentation, controls and fittings etc.
- c) **Two (2)** numbers twin screw LDO unloading pump motor set of **capacity 25m³** each with matching simplex strainer at their suction.
- d) **Three (3)** numbers of capacity **25m³ each**, twin screw HFO unloading pump motor set with matching simplex strainer at their suction. These pumps & strainers shall be steam traced/heated.
- e) **One (1)** no of Condensate Flash Tank near tank farm area of capacity **6.0m³** dully insulated and cladged near tank farm area.
- f) **One (1)** number drain oil tank (with steam heating coils) of **10m³** capacity to be located in the fuel oil unloading pump house , including its all the accessories.
- g) **Two (2)** numbers vertical single screw drain oil pumps motor set with all accessories of capacity **10m³/hr** each to transfer oil from drain oil tank to HFO tanks.
- h) **Two (2)** numbers vertical single screw pumps motor set with all accessories of capacity **5m³/hr** to transfer **recovered oil** from Oil water separator's (OWS) oil pit located near tank farm area to HFO tanks/drain oil tank.
- i) **One (1)** no. vertical Non clog centrifugal pump motor set of capacity **10m³/hr** with all accessories in OWS to transfer separated oil water mixture to ETP.
- j) **Two (2)** number vertical centrifugal sump pump motor sets with all accessories of capacity **10m³/hr** in Fuel oil U/L Pump House to transfer bilge water from pump house to OWS.
- k) **One (1)** no. self-actuated pressure reducing station near tank farm area for reducing aux. steam pressure from 16 ata. to 4 ata.
- l) **Six (6)** Nos. HFO unloading flexible neoprene/ metallic hoses. **three (3)** nos LDO unloading flexible neoprene/ metallic hoses , **Six(6)** nos. flexible hoses each for Steam heating & receiving condensate respectively. Length of each hose shall be to suit the layout in unloading area. However minimum length shall be 8 m.
- m) **One (1)** no. LDO day tank of capacity 50 m³ to cater to the Auxiliary Boiler.



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- n) **Two (2)** , 1W+1S, twin screw LDO transfer pump motor set each of **capacity 25 m³/Hr** with simplex type strainer at their suction.
- o) **All piping**, fittings, etc. required for LDO day tank system.
- p) Complete piping, valves, fittings, flanges, traps, fasteners, gaskets, with suitable hangers, supports, pipe trestle within dyke and pump house as required etc. as applicable within the terminal point.
- q) Complete steam tracing, Insulation and cladding material along with all accessories for HFO tanks, HFO lines, pumps, strainers etc.
- r) 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 during detailed engineering for welding supports for water piping and hydrant piping.
- s) Platform and approach ladder to the platform for foam pourer.
- t) Sump pumps (W+S) where ever required due to layout constraints with in terminal point. Type and capacity of these pumps will be decided during detailed engineering stage without and commercial implication.
- u) **All mechanical items for oil water separator pit including skimmer pipe, butterfly valve, heating arrangement, rung ladder etc. for OWS.**
- v) Buried MS pipes as required along with their wrapping and coating and /or cathodic protection as required.
- w) Pipe-supporting structures over the insert plates for pedestal supported pipes and also on pipe rack supported pipe.
- x) All MS structures for cross overs, valve / instruments/ equipment operating & maintenance platforms, approach ladders for access to platforms, trench/pit.
- y) Painting of equipment along with their accessories within battery limit.
- z) Electrical scope as per enclosure elsewhere in the specification.
- aa) Instrumentation & control System including control panel, 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.
- bb) C&I Scope as per enclosure elsewhere in the specification.
- cc) Erection & commissioning spares as required for the complete system.
- dd) 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.
- ee) **Mandatory spares** as per **Annexure-V** of specification.
- ff) Initial charge of all lubricants and fluids except HFO and LDO
- gg) All valves, counter- flange with nuts, bolts and gaskets at all the terminal points.
- hh) All equipment Foundation bolts/ Anchor bolts etc.
- ii) Flow able non- shrink grout of one grade higher than concrete used for civil work grouting below base plate for all structure/ equipment & for grouting of foundation / anchor bolts..
- jj) Relevant scope of supply as per GTR, GCC & SCC.



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- kk) Valves in pit outside dyke as required as per latest OISD recommendation complying to requirement whichever is more stringent.
- ll) Any changes required to take care of temperature effect to be considered by bidder as part of total cost quoted.
- mm) Any other instrument, item required for making the installation complete in all respect and for satisfactory operation of the system for the scope within the terminal point, as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of supply.

1.2.0 SCOPE OF SERVICES

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

- a) Unloading, Storage, handling and transportation at site.
- b) 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.
- c) 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.
- d) Erection & Commissioning of Fuel Oil System.
- e) 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.
- f) Inspection & testing, Performance Requirements and functional guarantees.
- g) Painting of tank and all other items within scope of supply.
- h) Making Good/Repairing/replacement of and damaged done by bidder to adjacent structure, pipes etc. while erecting equipment's related to Fuel Oil system
- i) Electrical scope as per enclosure elsewhere in the specification
- j) Preparation of drawing showing common facilities, if any, between BHEL & Vendor supplied equipment.
- k) 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.
- l) Preparation of all drawings as per list enclosed under **Annexure VII.**
- m) 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



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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.

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., Khasra No, Plot No. etc.

- n) Training of plant Owner's personnel, O&M operators' personnel on plant operation and maintenance.
- o) Relevant requirements as per GTR, GCC, ECC & SCC.
- p) Any other service required for making the installation complete in all respect within battery limits and for satisfactory erection & commissioning of the system as well as to meet any statutory requirement relevant to the package, unless specifically EXCLUDED from scope of services.

2.0.0 EXCLUSION

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

- i) Road tanker unloading platform
- 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.

- b) Fire Protection system for storage tank.
- c) Air Conditioning / ventilation of Fuel Oil pump house.
- d) Control/IO panel for Fuel Oil pump houses
- e) Lifting equipment for unloading pump house for maintenance purpose of these pumps. Capacity of lifting equipment is envisaged as 1.5 T with lift as 8.5 m. Bidder to confirm adequacy of the same.
- f) DCS control. However, all logic for implementation of control and monitoring from DCS shall be provided by successful bidder during detail engineering.
- g) Exclusion as indicated in Electrical & C&I portion of technical specification
- h) Relevant exclusion as per GTR, GCC, SCC & ECC.

3.0.0 SERVICES TO BE PROVIDED BY THE CUSTOMER

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



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4.0.0 TERMINAL POINT

LDO : **Near oil unloading area:**
LDO Road Tanker nozzle connections towards LDO U/L Pump suction side.

Near fuel oil unloading & pressurizing pump house:
Up to 2000 mm outside Pump house wall for suction & return line of LDO. Further routing shall be in BHEL-Try scope.

HFO : **Near oil unloading area:**
HFO Road Tanker nozzle connections towards HFO U/L Pump suction side.

Near fuel oil unloading & pressurizing pump house:
2000mm outside pump house towards suction of HFO pressurizing pumps. Further, routing shall be in BHEL-Try scope.

Aux. Steam : Steam header at 16 kg/cm² by BHEL-PC at 2000mm from FO unloading & pressurizing building.
At the TP BHEL shall supply 4 MT/hr of steam. Bidder shall check the adequacy of the same. In case this is not adequate, bidder to inform the maximum aux. steam requirement at this TP along with manual calculation for the same.

Effluent from Oil Water Separators : Shall be terminated at the guard pond in ETP area

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.

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.

5.0.0 PERFORMANCE REQUIREMENTS

This will comprise of:

5.0.1 PERFORMANCE requirement at shop:

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

5.0.2 Functional Guarantees at site:



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- a. Capacity, total dynamic head and power consumption, noise & vibration level of all operating pumps in parallel. The capacity of pumps while operating in parallel will be verified by indication in tank level difference.
- b. Noise level for safety valve to be limited to 105 dBa
- c. Entire piping & support for smooth operation
- d. All other machines / components / system shall be acoustically designed for a surface sound pressure level of $L_p < 85$ dB (A), measured in accordance with ISO 3746 / IEC 651 / BS: 5969 / IS:9779 respectively at a distance of 1.0 m from equipment surface and at a height of 1.5m above ground level. The surface sound pressure level (L_p) shall be averaged over the measurement surface and corrected for effect of background noise and the influence of reflected sound at measurement surface (environmental correction). With sound pressure levels of 85 dB (A) or less according ISO it shall be ensured that maximum surface noise levels of any item of plant of less than 85 dB (A) at 1.0 m from outline and a height of 1.5m from the floor shall be met during normal operating conditions.
- e. In case during test it is found that the equipment/system has failed to meet the guarantees, the contractor shall carry out all necessary modifications and/or replacements to make the equipment/system comply with the guaranteed requirements at no extra cost to the Employer. However, if the contractor is not able to demonstrate the guarantees, even after the above modifications/replacements within ninety (90) days or a reasonable period allowed by BHEL, after the tests have been completed, BHEL will have the right to Reject the equipment / system / plant and recover the payments already made or accept the equipment / system after assessing the deficiency in respect of the various ratings, performance parameters and capabilities and recover from the contract price an amount equivalent to the damages as determined by BHEL.
- f. **The successful bidder will prepare a document titled "HANDLING OVER PROTOCOL" consisting various activities to be demonstrated by them for handing over of the package.**

6.0.0 LAYOUT REQUIREMENTS

- a) System layout shall conform to the requirements of the Petroleum Act 1934 & Petroleum Rules 2002, OISD 118 latest edition whichever is more stringent. The layout shall also conform to all other relevant OISD specifications
- b) All established engineering practices with regard to layout of various equipment & piping shall be followed and the same shall be subject to Customer approval during detail engineering without any commercial implication.
- c) The pipes between storage tank, fuel oil unloading area shall be running on Pipe rack and pedestal as applicable.
- d) Tentative Location of items related to Fuel Oil handling System is shown in enclosed PLOT PLANS. This will be finalized during detail engineering based on equipment dimensions and other layout related requirements. There will however be no cost implication on account of the same.
- e) For road tanker unloading of fuel oil, LDO/HFO pumps will be located above ground. Further, while selecting pipe size, velocity inside the pipe shall not overshoot the velocity criteria indicated elsewhere in the specification.
- f) 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



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shall be given by the bidder. The platform and walkways will be designed by considering load of at least 750Kg/M2.

- g) 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.
- h) 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.
- i) 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.
- j) Layout shall be prepared in a way to avoid the buried piping to the maximum possible extent.
- k) Oily water collected in storage tank area, oil unloading area will normally be collected in OWS pit by gravity either through trench (limited to a depth of 0.5 m) or through buried pipe (limited to a depth of 1.0 m) . However, in case depth of pipe between the pit and OWS pit exceeds 1 m or gravity flow is not possible due to layout constraints (which can be reviewed during detail engineering), the oily water waste shall be collected by pumping to OWS pit. Necessary pumps, valves, pipes, pipe supports, and instruments etc. for the same shall be in the bidder's scope.
- l) Straight length required before and after control valve s, flow element/ flow meters, shall be provided as per latest standard/ applicable codes.
- m) 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.
- n) 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.
- o) Signals from all field instruments shall be first terminated in Junction boxes before transmitting this signal either to Control panel or to I/O rack or to DCS. Junction box is included in bidder's scope. Erection of cable between field instruments to Junction Box is also included in bidder's scope. Scope of cable supply shall be as per project specific scope split sheet given under electrical portion of this specification.
- p) 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.
- q) Instrument/ LIE/LIR shall not be located in space meant for walkway & maintenance space across the equipment, maintenance bay of building. Location of all instruments shall be marked in layout drawing to ensure correct location of the same.



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7.0.0 EQUIPMENT SELECTION & DESIGN CRITERIA

The minimum design criteria/ technical details to be followed for various equipment shall be as per Data Sheets / Design criteria under given under **Annexure-II & Annexure-VIII to section-C**. If there is any contradiction between design requirements given under Annex-II & Annex-IX, the later shall prevail. Also, contradictory requirement for specification of particular equipment, and clarifications not having been sought by the bidders, the most stringent requirement as per interpretation of the BHEL will prevail. Successful bidder will furnish detailed data sheets/ specifications / design calculations for various equipment for customer's/ consultant's approval during detail engineering. For items for which specific technical specification is not enclosed, data sheet / dwgs / design calculations for such items shall be subject to customer/ consultant approval during detail engineering. All comments made by customer/ consultant shall be incorporated by the successful bidder without any commercial and delivery implication.

8.0.0 PAINTING / CORROSION PROTECTION REQUIREMENT

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

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

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

11.0.0 SUB-VENDOR ITEMS

The tentative make of Sub-vendor items shall be generally as per **Annexure-IV** enclosed which is subject to customer approval during detail engineering. Make of any unlisted items shall be subject to customer



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approval during detail engineering. For such items, bidder to furnish list of sub-vendors during detail engineering stage for BHEL's review and approval. Bidder shall furnish along with his offer the following supporting documentation within 1 month of placement of LOI. Thereafter no request for additional sub-vendor shall be entertained.

- a) Documentation to show that the equipment /system have been supplied for a plant of similar or higher capacity.
- b) Documentation in the form of certificate that the equipment/system has been operating satisfactorily for 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.

12.0.0 DRAWINGS AND DOCUMENTS TO BE SUBMITTED WITH THE BID

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

13.0.0 DRAWINGS/ DOCUMENTS REQUIRED DURING DETAIL ENGINEERING

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

14.0.0 DRAWINGS DISTRIBUTION SCHEDULE

Vendor needs to submit 10 sets of hard copies of each drawing/document during detail engineering along with editable soft copy of the same. However, exact no. of drawings / documents and submission/distribution procedure for the same shall be intimated to the successful bidder after award of contract and the same shall be complied by the successful bidder without any commercial implication.

15.0.0 DRAWINGS ENCLOSED WITH THE SPECIFICATION

Following drawings enclosed will form part of the specification.

- a) Plot plan
- b) Process & Instrumentation Diagram of HFO, PE-DG-400-166-A101
- c) Process & Instrumentation Diagram of LDO, PE-DG-400-166-A102
- d) Process & Instrumentation Diagram of steam & condensate, PE-DG-400-166-A103

The flow diagrams are indicative and show the minimum requirement to be followed including minimum requirement of instruments. Any other item and instruments required (within the terminal points) to make the system complete in all respect and for satisfactory operation of the system shall also deemed to have been included by the bidder in their scope .The detailed P&I diagrams for HFO, LDO system as well as for Aux. Steam in line with specification requirement shall



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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.

17.0.0 OTHER REQUIREMENTS

i) Site Visit before submission of offer.

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

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

iii) The O&M Manual to be submitted by the successful bidder will necessarily address the following:

- a. Complete System Description along with PIDs, write up on electrical philosophy and safety/process interlocks etc.
- b. Instructions for plant operation
- c. Commissioning procedure of the system
- d. Chapter on precautions to be taken during:
 - Operation
 - Idle time
 - Long shutdown
- e. Chapter on trouble shooting during plant operation covering:
 - Safely aspects
 - Do's and do not's
 - Maintenance schedule
 - Schedule of lubricants & consumables
- f. O & M instruction for all individual equipment which shall invariably contain but not necessarily limited to the following:
 - Equipment description/interdiction
 - Data sheet, Equipment GA & Cross Section Drawing
 - Catalogue of each equipment
 - DO's & DON'T's
 - Duty Conditions
 - Installation & Safety Recommendation
 - Start-up & shut down procedure
 - Instructions for testing and adjustment of system parameters
 - Disassembly & Assembly Instructions giving sequence no. of each component
 - List of Replacement/ Spare parts along with their drawing and catalogues and procedure for ordering spares.
 - Reason & Remedy Chart for any problem



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- Maintenance Schedules- Daily, Weekly, Monthly, Half Yearly and Annual indicating clearly the spares part and man-hour requirement for each stage.
- Detailed specification/ Schedule of all the consumables including lubricant oils, greases, chemicals etc. required for the complete system
- Commission procedure for equipment.

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 being carried out in 3D environment at BHEL end. Name of engineering platform on which BHEL is doing the project is Smart Plant Suite. This is being done to have automated interface checking and thereby minimising rework at site. Hence bidder, in their own interest, is requested to prepare all layout drawings using 3D Modelling software. These drawings will also be made available to BHEL in soft for checking interface with other agencies in consolidated layout drawings. Bidder's inability to prepare drawing using 3D Modelling software will not be criterion for evaluation of their bid.

viii) Final Electrical Load list will be submitted by the successful bidder as per agreed drawing/ doc submission schedule. Thereafter any change in the electrical load list shall be entertained only subject to its feasibility, and BHEL reserves the right to debit the vendor cost of any changes necessitated in the switch gear /MCC on account of changed loads.



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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".

xi) In case of any contradiction of above specification with that of specification given under section-VIII, the spec. given under section-VIII shall prevail.

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**ANNEXURE-I
(SYSTEM WRTIE-UP)**



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



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1.0 SYSTEM DESCRIPTION

Light Diesel Oil (LDO) shall be used as initial start-up/ warm up fuel while heavy Fuel Oil (HFO Gr HV) shall be used for flame stabilization during low load operation. The Fuel Oil Handling System to be considered comprises unloading & storage of LDO and Heavy Fuel oil (HFO Gr HV). The basic operation & control philosophy of fuel oil unloading & storage system is described in succeeding sections. The bidder shall provide all the features as specified herein including other features as required for safe, efficient and trouble free operation of the system. The successful bidder shall furnish the detailed operation & control philosophy during contract stage for customer's approval.

Fuel Oil Characteristics are provided at Clause No.3.0 of this document.

1.1 HEAVY FUEL OIL SYSTEM

- 1.1.1 Heavy Fuel Oil (HFO Gr HV) shall be delivered to power station by six (6) nos road tankers. The road tankers shall be unloaded through flexible metallic / neoprene unloading hoses of 8.0m length with fire safe type ball valve for isolation and a hose stand for each unloading hose. The Fuel Oil unloading header will have 6 Nos. unloading points. The HFO unloading header shall be steam heat traced and insulated.
- 1.1.2 The road tankers shall have steam heating coil arrangement dully installed for heating HFO up to min. 50°C. Steam supply to the road tankers from Aux steam header (laid by the side of Fuel Oil unloading header) shall be through metallic flexible hoses and the condensate shall be collected in a condensate header laid by the side of Fuel Oil unloading header.
- 1.1.3 Heavy Fuel Oil from unloading header shall be pumped to Heavy Fuel Oil storage tank with the help of Three(3) Nos (2W+1S) unloading pumps as indicated in the HFO Unloading and Storage system flow diagram. The Heavy Fuel Oil unloading pumps are of rotary positive displacement, twin screw type and provided with matching capacity simplex strainers (steam heated) at their suction with interconnecting piping and valves as shown in the P&I diagrams for HFO System, Drwg No.- PE-DG-400-166-A101.
- 1.1.4 Two (2) nos. HFO storage tanks, each of net capacity 2000 m3 are envisaged. The HFO tank shall be provided with steam floor coil heaters at the bottom of the tank to raise the temperature of oil to handling / tank maintenance temp. of 60°C in 72 hrs. time and maintaining the temperature inside the tank at 60° C. The floor coil heater for the Fuel oil storage tanks shall have adequate nos. of sections and shall be regulated through one pneumatically operated modulating type control valve on the steam supply line. This shall be actuated from tank temperature.
- 1.1.5 Each HFO Storage Tank shall be insulated and cladded on the shell.
- 1.1.6 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for HFO system (Drwg.no. PE-DG-400-166-A101) shall be provided. Piping, valves and other equipment shall be steam traced and insulated.
- 1.1.7 Each HFO storage tank shall also be provided with a suction heater at tank outlet to heat the outgoing HFO by 10 degC over maintenance temp of 60°C inside the tanks.

1.2 LIGHT DIESEL SYSTEM

- 1.2.1 LDO shall be delivered to power station by three (3) nos road tankers. The road tankers shall be unloaded through flexible metallic / neoprene unloading hoses of min. 8.0m length with fire safe type ball valve for isolation and a hose stand for each unloading hose. The LDO unloading header will have 3 Nos. unloading points.
- 1.2.2 LDO from unloading header shall be pumped to LDO storage tank with the help of Two(2) Nos (1W+1S) unloading pumps as indicated in the LDO Unloading and Storage system flow diagram. The LDO unloading pumps are of rotary positive displacement, twin screw type and provided with matching capacity simplex strainers at their suction with interconnecting piping and valves as shown in the P&I diagrams for LDO System, Drwg No.- PE-DG-400-166-A102.



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- 1.2.3 Two (2) nos. LDO storage tanks, each of net capacity 200 m³ are envisaged.
- 1.2.4 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for LDO system (Drwg.no. PE-DG-400-166-A102) shall be provided.

1.3 STEAM & CONDENSATE SYSTEM

- 1.3.1 One no. pressure reducing station consisting of self-regulating type control valves with safety relief valve and bypass arrangement shall be provided for reducing auxiliary steam available at 16 kg/cm² (a) to 4.0 kg/ cm² (a). Reduced steam shall be used for heating of HFO road tankers, unloading header, HFO tanks, strainers, pumps etc. and tracing of HFO lines.
- 1.3.2 A condensate flash tank of capacity 6.0 m³ will also be provided in the unloading area for collecting condensate from road tankers heating before discharging the same to guard pond in ETP area.
- 1.3.3 Condensate formed in HFO unloading pump house i.e. pumps, strainers, drain oil tank shall be fed to sump.
- 1.3.4 Condensate generated from floor coil heater of HFO Storage tanks shall be fed to flash tank placed near tank farm area.
- 1.3.5 Interconnecting piping, valves and instruments as indicated in the Process & Instrumentation diagram for STEAM & CONDENSATE system (Drwg.no. PE-DG-400-166-A103) shall be provided.

1.4 DRAIN OIL SYSTEM, SUMP WATER & OIL WATER SEPARATION

- 1.4.1 The fuel oil drains from different equipment's (LDO & HFO U/L pumps, strainers) and piping etc. in FO unloading pump house shall be collected by gravity in a Drain Oil tank of capacity 10m³. Two (2) nos, 1W+1S, rotary positive displacement type drain oil pump of capacity 10 m³/hr shall be provided to transfer the drained oil to HFO tanks.
- 1.4.2 The above drain oil tank in the unloading pump house shall be provided with a steam coil with isolation valve. Steam will be supplied to the drain tank manually on need basis. The condensate formed shall be discharged through a trap in to the sump.
- 1.4.3 All oil drain headers will have a size not less than 25 NB and adequately sloped.
- 1.4.4 Two (2) nos. vertical centrifugal type sump pumps of cap. 10m³/hr, are also envisaged inside FO Unloading pump house to pump the oil water mixture to oil water separator located near tanks farm area.
- 1.4.5 One no. (1) Oil Water Separator is envisaged near tank farm area. Separated water from Oil Water Separator shall be discharged to guard pond in ETP area through one (1) no. vertical sump pump of cap. 10m³/hr. Recovered oil shall be pumped to HFO Storage Tank/ Drain Oil Tank through two (2) nos. vertical screw pump of cap. 5 cum/hr as per Process & Instrumentation Diagram for HFO unloading system (Drwg.no. PE-DG-400-166-A101).

1.5 LDO DAY TANK SYSTEM

- 1.5.1 One (1) no. LDO day tank having cap. as 50m³ has been envisaged to cater to the Auxiliary boiler.
- 1.5.2 The day tank shall be filled with the help of two (2) no LDO transfer pump of cap. 25 m³/hr. These LDO transfer pumps shall take suction from main LDO tanks located in tank farm area.
- 1.5.3 Location of LDO transfer pumps shall be inside FO unloading pump house & that of day tank shall be nearby to Auxiliary boiler.
- 1.5.4 Necessary piping, valves & fitting between Main LDO tanks, LDO transfer pumps & LDO day tank shall be provided as per PID no. PE-DG-400-166A102.

2.0 INSTRUMENTATION & CONTROL

- 2.1 Operation and Control of Fuel Oil unloading and storage system will be from main plant DCS (under customer scope).



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- 2.2 Instrumentation shall be as shown in Process & Instrumentation Diagram for HFO, LDO, and Steam & Condensate system given at last of this document.
- 2.3 Following functions shall be done through main plant DCS:
- 2.3.1 Filling any of the HFO/LDO storage tanks by ensuring proper and safe selection of these tanks. Simultaneous filling and emptying of same HFO storage tanks will be avoided. Signals from Limit switches at the inlet and outlet valves of storage tanks shall be used for this purpose.
- 2.3.2 Start the HFO/LDO unloading /decanting pumps **through main plant DCS** for filling the tanks after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
 - Selected storage tank level not HI (high).
 - Pump suction header inlet pressure not LO (low).
 - DP across pump suction strainer not HI (high).
- 2.4 Stop the running unloading/decanting pump(s) **through main plant DCS** in case of annunciation for Level HI in corresponding tanks.
- 2.5 Stop/Trip the running unloading /decanting pump(s) automatically in case of Level HI-HI in corresponding tanks.
- 2.6 Stop/Trip the running unloading pump(s) automatically in case of Pressure HI in pump discharge header.
- 2.7 Stop/Trip the running unloading pump(s) automatically in case of DP across corresponding suction strainer is HI.
- 2.8 Start standby unloading pump **through main plant DCS** only in case running pumps trips due either to any mechanical or electrical failure
- 2.9 Start the drain pump through main plant DCS on receipt of level alarm-HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
 - Levels in DOT not low.
 - Selected storage tank level for dumping of drained oil is not HI.
- 2.10 Stop the running drain oil pump automatically in case of annunciation for Level LO in drain oil tank.
- 2.11 Start standby drain oil pump **through main plant DCS** only in case running pumps trips due either to any mechanical or electrical failure
- 2.12 Start the sump pump in respective areas **through main plant DCS** on receipt of level alarm HI or if physically the level is found to be high after ensuring safe start permissive. The safe start permissive shall comprise of:
- MCC healthy
- 2.13 Stop the running sump pump automatically in case of annunciation for Level LO in sump
- 2.14 Start standby sump pump **through DCS** only in case running pump trips due either to any mechanical or electrical failure.
- 2.15 Signals (annunciation & indication) from various switches / transmitters.
- 2.16 Running status (on/off) of all pumps.
- 2.17 Control of steam flow to floor coil heater and suction heater of HFO storage tanks through pneumatically operated control valve as indicated in respective flow diagram.



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- 2.18 Control of LDO day tank system on similar line given above for main storage tanks. Refer PID no. PE-DG-400-166-A102.
- 2.19 All signals from the field instruments will be first terminated on a field mounted Junction box (JB) before transmitting the signals to main plant DCS.

3.0 FUE OIL CHARACTERISTICS

3.1 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.	4.5% Max
1.2	Gross calorific value (Kcal/kg)	Of the order of 10,000
1.3	Flash point (Min.)	66°C
1.4	Water content by volume (Max.)	1.0%
1.5	Sediment by weight (Max.)	0.25%
1.6	Density at 15 ^o 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.)	0.1%
1.9	Pour Point (Max.)	57°C

3.2 LIGHT DIESEL OIL (LDO) ANALYSIS AS PER IS 1460, 1995

Sl no.	Characteristics	Light Diesel Oil (LDO)
1.1	Kinematic Viscosity in centistokes at 40° C	2.5 to 15.7
1.2	Waste content percent by volume (Max.)	0.25
1.3	Sediment percent by mass (Max.)	0.10
1.4	Total Sulphur percent by mass, Max.	1.8
1.5	Ash percentage by mass (Max.)	0.02
1.6	Water Content Max, % Volume	0.25
1.7	Density at 15°C(approximate), Kg/m ³	850-870
1.8	a) Flash point, Min- Pensky Martens Abel b) Pour point:	66°C - 21°C in Summer and 12°C in Winter



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1.9	Copper Strip corrosion for 3hrs.at 100°C	Not worse than no.2
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ANNEXURE-II

(EQUIPMENT DESIGN CRITERIA)



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

1. EQUIPMENT SELECTION & DESIGN CRITERIA/ DATA SHEET

1.1 FO STORAGE AND DRAIN OILTANKS

S.No.		HFO STORAGE TANKS	LDO STORAGE TANKS	DRAIN OIL TANK
1	Storage Medium	HFO	LDO	HFO /LDO
2	No. of Tanks	As per scope of supply		
3	Type of Construction	Vertical Cylindrical, non-pressure type with atmospheric vents fitted with flame arrestor fixed cone roof type.		Rectangular
4	Tank Capacity (m ³)	2000	200	10
5	Dimensions	16.5 m dia x 10.5 m ht	7.5 m dia x 5.7 m ht	2 m x 2 m x 2.7 m ht
6	Design & Construction Code	IS 803 / API650		IS-800/ standard hand book
7	Design Pressure	Atmospheric		Atmospheric
8	Corrosion allowance	2 mm on the bottom plate and bottom shell course, 1.5mm on rest of the shell course and roof.		
9	Material of construction	IS 2062 Gr A/B with minimum plate thickness as 6.0 mm including corrosion allowance		
10	Venting Capacity	As per API 2000/ IS 803		
13	Joint efficiency	85 % on all butt welded joints		
14	Insulation	YES, (on tank shell)	NA	YES

1.2 CONDENSATE FLASH TANK

1	Storage Medium	Condensate
2	Number Of Tank	One(1) No.
3	Type of Construction	Vertical /Cylindrical with dished ends.
4	Tank Capacity(m3)	Six(6)
5	Dimensions	Dia. 2.0M x Ht. 2.5M
6	Design Code	IS 2825
7	Material Of Construction	PLATES : IS 2002 GR.2A
8	Thermal Insulation	Applicable
9	Worst Operating Pressure	Four(4.0) Kg/cm2
10	Design Pressure	10% Margin On Worst Operating Condition

1.3 FLOOR COIL HEATER OF HFO STORAGE TANKS

S.No	Characteristics	Value
1	Heating medium at the inlet of control valve	Aux. Steam at 4.0kg/cm ² (a) or higher as decided by FO System vendor.

2	Capacity of the floor coil heater shall be determined for following conditions:	
a	Design capacity	To raise the temperature of full tank capacity of Heavy Fuel oil from min. temp. of 12°C to storage temperature of 60°C in 72hours.
b	Normal capacity	To compensate heat loss from the uninsulated tank completely filled with oil at storage temperature
c	Wind Speed	2 m/second for heat loss calculation
d	Margin to be provided on calculated surface area of floor coil	10%
3	Tube side design pressure & temperature	1.5 times the heating steam pressure, 250 Deg. C
4	Temperature of steam to be considered for thermal design	Tsat @ 4 kg/cm ² (a) or higher pressure as decided by FO system vendor.
5	Material of Heating element	Seamless steel tubes to ASTM A 106 Gr.B
6	Number of heating coil	To be decided by the vendor to ensure uniform heating,
7	Type of Control	Through pneumatically operated modulating type control valve
8	Specific Heat of Oil to be considered for design (Kcal /kg/°C)	0.5

1.4 SUCTION HEATER FOR HFO STORAGE TANKS

S.No	Characteristics	Value
1	Type of heater	U-tube, shell & tube type (Oil in shell, steam in tube.
2	Design ambient temperature	As per project information
3	Heater capacity	100 m ³ /hr
4	Differential temperature	10 degC
5	Initial temperature of oil	60 degC
6	Final temperature of oil	70 degC
7	Heating medium	Aux. steam @ 4 kg/cm ² (a) or higher as decided by FO system vendor.

8	Specific heat of oil(Kcal/kg/degC)	0.5
9	Design temperature & pressure	Seamless steel tubes to ASTM A 106 Gr.B
a	Shell side	2.5 kg/cm2 (g) , 120 degC
b	Tube side	1.5 times the heating medium pressure in kg/cm2 (g), 230 degC.
10	Corrosion allowance	1.8mm
11	Oil properties	As per specification
12	Temperature of steam to be considered for thermal design	Tsat @ heating medium pressure
13	Heater Tube material	Seamless tube as per ASME SA 179 Gr.C / Equivalent
14	Design/construction	TEMA Class-C/ IS 2825 Class-2/ASME Sec-VIII, Div-I

1.5 UNLOADING PUMPS, DRAIN OIL PUMPS & SUMP PUMPS

	Characteristics	HFO Unloading / Decanting Pumps	LDO Unloading Pumps	Drain oil Pumps	Sump Pump in Oil Water Separator pit	Sump Pumps in pump house
1	Type of Pumps	Twin Screw Positive Displacement, with Steam Jacketing	Twin Screw Positive Displacement	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	Intermittent	Intermittent
4	Type of Drive	Direct driven by Electric Motor				
5	Location	Indoor	Indoor	Indoor	Outdoor	Indoor
6	Nature of Fluid to be pumped	HFO	LDO	HFO/LDO	Water with traces of oil	Water with traces of oil
7	Design Viscosity range	50-500 cST	2-20 cST	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	CI to IS 210 Gr FG 260	NA
vii)	Relief valve spring	Spring steel	NA
viii)	Base Plate	Fabricated from MS to IS 2062	
ix)	Coupling	Manufacturer specific	

1.6 STRAINERS FOR HFO/LDO UNLOADING PUMPS & DRAIN OIL PUMPS

S.No.	Characteristics	Value
01	Type	Simplex Type for unloading pumps & Not applicable for Drain oil pumps
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	0.1 kg/cm ²
09 b)	Maximum permissible pressure drop under 50 % clogged condition	0.3 kg/cm ²
10	Screen basket data	
a)	Dia of perforations	40 mesh
b)	Minimum thickness	Bidder specific
11	Steam Jacket	Applicable for HFO unloading pump suction strainer.
12	Steam pressure for steam heating	4 kg/cm ² (a) or higher 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

1.7 STEAM TRAPS

S.No.	Characteristics	Value
	Design Features	

1	Type	TD type or any other type as per trap vendor recommendation for steam heat tracing
2	Strainer	Integral with trap
3	End connection	Welded /Manufacturer Standard.
3	Material of construction	
a	Body	SA105 /Equivalent
b	Trims	SS conforming to AISI-316 /304/ Manufacture Standard Practice
c	Strainer	SS conforming to AISI-316 /304/ Manufacture Standard Practice

- Trap to trap distance shall be 40M.
- Traps shall be suitable for a pressure of 16bar.

1.8 STEAM TRACING

Number and Pipe Size of Steam Tracers shall be as per following,

Sl. No.	Pipe Size	No. & Size of Tracer
1	350NB and Above	3X20NB
2	150NB to 300NB	2X20NB
3	100NB and Below	1X20NB

1.9 DATA SHEET FOR OIL HOSES

S.No	Characteristics	Value
1	Type	Flexible metallic / rubber hose confirming to BS 1435/ IS 10733
2	Size	75 NB X 6 m long for LDO/HFO
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 road tanker unloading nozzle (details to be provided by customer)

1.10 DATA SHEET FOR STEAM/CONDENSATE HOSES

S. No.	Characteristics	Value
1.	Type	Metallic Flexible Hose, Electro zinc plated, Carbon /Stainless Steel double interlocked, non- asbestos/ galvanised wire inserted hose
2	Size	50 NBx6 m long for steam service 50 NB x6 m long for condensate service.

3.	Quantity	As per scope of supply
4.	Temperature of fluid handled, °C	Capable of Handling Oil Upto 210°C Temperature
5.	Type of end connection	To Match Road Tanker Steam & Condensate Nozzle(Details to be provided by customer)

1.11 DATASHEET FOR PRESSURE REDUCING STATION

S.No.	Characteristics	Value
1	Type	Self-actuated pilot operated
2	Steam pressure at inlet	16 kg/ cm2 (a)
3	Steam Pressure at outlet	4 kg/ cm2 (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

1.12 VAVES

S.No.	Characteristics	Value
	Design Features	
1	General Requirement for all valves	i) All valves shall be provided with hand wheels, extension spindles and floor stands or any other arrangement wherever required so that they can be operated manually with ease by a single operator from the nearest operating floors either at a lower or higher elevation as the case may be. Wherever necessary for safety purpose, locking devices shall be furnished with valves. Gear Operated valve shall be provided for valves where force applied is more than 25Kgf. In the case of those valves with extended spindles, indicators will be fitted both to the extended spindles and to the valve spindles.
2	Gate Valves	<p>i) Gate Valves shall be used for isolation purpose for all sizes in steam and condensate lines. The gate valves shall be provided with handle wheel, position indicator and draining arrangement.</p> <p>ii) Gate Valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800, forged carbon steel valves with solid wedge, OS and Y rising stem and bolted bonnet, Trim shall be of 13% chrome steel. Body material shall be to ASTM A105 and ends shall be socket welded. STEM and Disc material shall be to ASTM A182 F6a.</p> <p>iii) For sizes above 40 NB/ 50 NB (As per manufacturer's standard), valves shall be of class 150/300 (depending on service), Cast Carbon Steel gate valves. Face to face dimensions shall be as per ANSI B 16.10. Body material shall be ASTM A216 Gr. WCB and ends shall be flanged to ANSI 150/300 lbs rating with raised face.</p>

		<ul style="list-style-type: none"> iv) Gate valve shall be used in the oil lines for sizes 400NB and above. v) The valves shall conform to API-600/ API-602 and shall be tested to API 598/IS: 6157 requirements.
3	Globe Valves	<ul style="list-style-type: none"> i) Globe valves shall be used for regulation purpose for all sizes in steam, condensate and oil lines, they shall be provided with hand wheel, position indicator and draining arrangement, if required. ii) Globe valves for sizes up to 40 NB/50 NB (As per manufacturer's standard) shall be of class 800 forged carbon steel valves with plug disc. Other particulars shall be same as 2 (ii) above. iii) For sizes above 40 NB/50 NB (As per manufacturer's standard), valves shall be class 150/300 (depending on service) Cast Carbon steel globe valves with plug or ball type disc, other particulars shall be same as 2 (iii) above. iv) The valve shall conform to BS, 1873/BS: 2995 and shall be tested to BS: 5146 requirements.
4	Check Valves.	<ul style="list-style-type: none"> i) Check Valves shall be used for non-return services for all sizes in steam, condensate and oil lines. ii) For sizes up to 40 NB/ 50 NB (As per manufacturer's standard), check valves shall be of class 800 forged Carbon Steel horizontal lift type, with bolted cover, Valves shall have 13% Chrome Steel trim and body material to ASTM A 105, Ends-shall be socket welded. iii) For sizes above 50 NB, check valves shall be of class 150/300 (depending on service) Cast Carbon Steel valves of swing check type having bolted cover. Trim shall be of 13% Chromium Steel and body material to ASTM A 216 Gr. WCB. Ends shall be flanged to ANSI Class 150/300 lb rating with raised face. iv) The valves shall conform to BS: 1868 and shall be tested to BS: 5146/IS: 5312 requirements.
5	Oil Line Ball / Plug Valves	<ul style="list-style-type: none"> i) Ball valves shall be used for isolation purpose in oil lines. These shall have 'port' position indicators with CLOSE/OPEN indications marked on valve body. ii) Ball valves shall be of class 150 full-bore type with face to face dimension as per ANSI B 16.10. Body material for plug/Ball Valves shall be ASTM A216 Gr. WCB. The ball shall be of SS AISI 316 quality.

		<p>iii) Ball valves shall be of safe patter for internal (line) & external leakage. Ball valves in general shall confirm to BS: 5351/ and to BS6755 Part-2/API 607/ Equivalent for fire safe test.</p> <p>iv) Plug valves shall be of fire safe pattern for external leakage only. Plug valves in general shall confirm to API 6D/ Equivalent for design & manufacturing standard and to BS6755 Part-2/ API607/ Equivalent for fire safe test.</p>
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1.13 PIPES, FITTINGS & FLANGES

Sr. No	Size	Material Standard/ Other details	Dimension Standard
A	PIPE		
a.	FUEL OIL		
1	Fuel Oil Unloading Pipes Fuel Oil Pump Discharge Piping/Other Fuel Oil / Piping	IS 1239/IS1978/API 5L Gr. B(ERW) / IS 3589 Fabricated from IS 2062 Plates API 5L GR.B (ERW)	ASME B36.10/ IS 1978/ API 5L /Equivalent
2	Type of end connection (Pipe to pipe & Pipe to equipment)	Butt welded for pipe size 65 NB & above; however, near equipment, this shall be of flanged type. Socket welded for 50 NB & below; near equipment this may be either socket welded or flanged.	Socket welding – ANSI B 16.11 Butt welding – ANSI B 16.25 Flanged- ANSI B 16.5/BS 4504 / IS 6392; Class- As per relevant standard & suitable for intended service
b.	STEAM AND CONDENSATE SERVICE		
	All Sizes	SA 106 GR.B	IS 1239/ ASME B36.10/ Equivalent
	Type of end connection (Pipe to pipe & Pipe to equipment)	Butt welded for pipe size 65 NB & above; however, near equipment, this shall be of flanged type. Socket welded for 50 NB & below; near equipment this may be either socket welded or flanged.	Socket welding – ANSI B 16.11 Butt welding – ANSI B 16.25 Flanged- ANSI B 16.5/ BS 4504/ IS 6392; Class- As per relevant standard & suitable for intended service
c.	AIR LINE		

	25 NB & below	MS ERW PIPES TO IS1239(1) Heavy Grade (GI) , Screwed Ends, galvanized	IS 1239
	Type of end connection (Pipe to pipe & Pipe to equipment)	SOCKET WELDED	ANSI B 2.1/ IS 1239
d.	BURIED PIPE, IF ANY / PIPE CARRYING BILGE WATER (WATER WITH TRACES OF OIL)		
	Up to 150 NB	M.S ERW to IS 1239 (1) Heavy Grade	AS PER IS 1239
	Type of end connection (Pipe to pipe & Pipe to equipment)	As per standard engineering practice.	
B.	FITTINGS & FLANGES		
a.	FUEL OIL		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Fabricated from parent pipe / Carbon Steel to ASTM A 234,Gr.WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	ASTM A 105/ Fabricated from IS2062 plate	As per ANSI B16.5, Class 150,/BS 4504/ IS 6392 ; class 150 lb/ equivalent to relevant standard.
b.	STEAM AND CONDENSATE SERVICE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	50 NB and below	Forged carbon steel to ASTM A 105	SW ends to ANSI B 16.11 (3000#)
	65 NB and above	Carbon Steel to ASTM A 234, Gr. WPB	BW ends to ANSI B 16.9, Sch.40
2.	Slip on Flanges/Blind Flanges	Material Standard	Dimension Standard
	All sizes	Forged carbon steel to ASTM A 105	ANSI B16.5/ BS 4504/ IS 6392, class suitable for intended service.
c.	AIR LINE		
1.	Fittings (Elbow, Tees and Reducers)	Material Standard	Dimension Standard
	25 NB and below	IS 1239 (II) (Galvanized)	IS 1239 (II)
d.	Buried pipe/ Pipe carrying bilge water		

1.	Fitting - 150 NB and below	IS 1239 (II)	IS 1239 (II)
2.	Slip on Flanges / Blind Flanges	Material Standard	Dimension Standard
	All sizes	Fabricated from IS2062 plate	ANSI B16.5/ BS 4504/ IS 6392; Class- 150 lb /Equivalent to relevant standard

1.14 VELOCITIES FOR SELECTING PIPING

Sizes of pipelines shall be selected so that velocity in pipes may not exceed the following maximum velocities		
Sr. No	Description	Maximum Velocity
A	STEAM	
1	Saturated Steam	40m/s
2	Wet Steam/Exhaust Steam	30m/s
B	Water	
1	Pump Suction	1.5m/s
2	Pump Discharge	3.0m/s
C	Air LINE	
	Compressed air	15m/s
D	Oil	
1	LDO	2.0m/s
2	HFO	1.5m/s

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

ANNEXURE-III

(QUALITY PLANS-MECHANICAL)



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



QUALITY ASSURANCE

Quality System for Inspection & Testing of Plant & Equipment at Manufacturer's Premises

11.1 General

1. Inspection & testing of plant & equipment shall be carried out by NLC at the works of successful Contractor/Sub-contractor during manufacturing and on final product to ensure conformity of the same with acceptable criteria of technical specifications, approved drawings, authenticated manufacturing drawings and reference national / international standards.
- ~~2. This specification is in addition to provisions laid-down elsewhere in Purchaser's Draft Contract and special instructions to tenderers, if any.~~
3. Contractor must recognise the importance of quality and follow defined quality programme in all manufacturing and quality control activities of the product. Contractor must define and implement the tasks and controls that shall provide needed assurance in case manufacturing of product is sub contracted either partly or fully and/or for the procured components of the product.
4. Purchaser/ Consultant reserve the right to verify the quality programme and entire product characteristics to assure the intended and specified quality of the product.
5. The inspection, examination or testing carried out by the purchaser shall not relieve the contractor from any of his obligation under this contract. The inspection procedure shall be discussed and finalised.

11.2 Quality Assurance Plan (QAP)

1. Inspection and test requirements shall be decided with due consideration of factors like safety, duty cycle, operating conditions, equipment life, environmental conditions, place of installation and statutory regulations, as applicable, for a particular equipment.
2. Detailed QAP shall be prepared by Contractor in consultation with Sub-contractors / Manufacturers to avoid any complication later.
3. QAP shall clearly indicate the followings:
 - (a) Range of inspection & tests to be done by Manufacturers and cross checked by Contractor during manufacture of equipment from raw materials to finishing stage.
 - (b) Suggestive check/ hold points for Purchaser's Inspection and witnessing of tests during the manufacturing and final product inspection.
 - (c) Inspection documents to be furnished by Contractor/ Manufacturers to Purchaser for reference during inspection.





11.3 Internal Inspection by Contractor / Manufacturer

1. Inspection and tests shall be carried out by Contractor/ Manufacturer in accordance with approved drawings, Contract Specification, Purchase Order, and approved QAP. Contractor/ Manufacturer shall maintain record of each inspection and test carried out and signed documents shall be submitted to purchaser for verification.
2. Contractor shall carry out their internal inspection & obtain clearance from statutory bodies e.g. IBR, CCE, TAC, Weights & Measures, safety, IE rules etc. However, Purchaser shall carry out inspection as agreed in approved QAP prior to Contractor offering the equipment for statutory clearance.
3. All the measuring & test instruments shall be calibrated by manufacturers and record of the same shall be maintained for purchaser's scrutiny. Contractor shall ensure use of appropriate calibrated measuring & test instruments during their internal inspection, as well as, make available the same for purchaser's inspection and tests. Calibration standard shall be national standard, if existing. Otherwise, manufacturers' own standard & calibration procedure shall be accepted. Valid calibration certificates traceable to national/ international standards shall be submitted to purchaser during / prior to inspection.
4. Contractor / Manufacturers shall identify all the inspected equipment / component/raw materials & shall maintain the record of status of inspection viz. inspected & found acceptable, require rectification/rework, rejected etc.
5. The Contractor shall establish and maintain procedures to ensure that product that does not conform to specified requirements, is prevented from inadvertent use or installation. The description of non-conformity that has been accepted subsequently by Designer / Purchaser by concession and/or of repairs, shall be recorded and forms part of the subsequent drawings / schedules relevant to the products.
6. Repaired and reworked product shall be offered for re- inspection to purchaser along with records of corrective action taken.
7. Contractor / Manufacturer shall not despatch any equipment till receipt of despatch clearance from purchaser.

11.4 Method of Undertaking Inspection & Testing By Purchaser

11.4.1 Agency Responsible

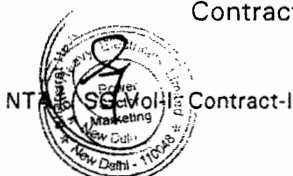
Inspection/Waiver of equipment shall be undertaken by purchaser.

11.4.2 Method of Issuing Inspection Call to Purchaser

Inspection call shall be given only on readiness of the equipment/ assembly/ sub-assembly and approval of all relevant drawings and QAP. In case, equipment/ assembly/ sub-assembly offered for inspection are found not ready, all the cost of visit of purchaser's engineer shall have to be borne by the Contractor.

11.4.3 Obligations of Contractor

1. Contractor shall provide all facilities and ensure full and free access of the Inspection Engineer of purchaser to the Contractor's or their Sub-Contractor's premises at any time during contract period, to facilitate him to





carry out inspection & testing of the product during or after manufacture of the same.

2. The Contractor shall delegate a Representative / Co-ordinator to deal with purchaser on all inspection matters. Also, Contractor's Representative shall be present during all inspection at Sub-Contractor's works.
3. The Contractor shall comply with instructions of the Inspection Engineer fully and promptly.
4. The Contractor / Sub-Contractor shall provide all instruments, tools, necessary testing & other inspection facilities to Inspection Engineer free of cost for carrying out inspection.
5. The cost of testing welds by ultrasonic, radiographic and dye penetration tests etc. in the fabrication workshop shall be borne by the Contractor.
6. The Contractor shall ensure that the equipment / assembly /component of the plant and equipment required to be inspected, are not dismantled or despatched before inspection.
7. The Contractor shall not offer equipment for inspection in painted condition unless otherwise agreed in writing by purchaser.
8. The Contractor shall ensure that the equipment and materials once rejected by the Inspection Engineer, are not re-used in the manufacture of the plant and equipment. Where parts rejected by the Inspection Engineer have been rectified as per agreed procedures laid down in advance, such parts shall be segregated for separate inspection and approval, before being used in the work.

11.4.4 Stamping and issue of inspection documents

1. Inspection Memo

For stage inspection and for rejected items/items which do not conform to Technical specification in one or more quality characteristics requiring rectification/rework, Inspection memo shall be issued in standard form indicating therein the details of observation and remarks. All the non-conformities with respect to specification of the product shall be indicated in the inspection memo for further control by manufacturer.

2. Inspection Certificate

On satisfactory completion of final inspection and testing, an inspection Certificate in standard form shall be issued by the Inspection engineer for the accepted items.

3. Inspection Waiver Certificate

For the inspection waiver category of items identified in the approved QAP, Purchaser shall issue Inspection Waiver Certificate.

11.5 General Clauses

1. Inspection & tests carried out by purchaser shall not absolve the responsibility of the Contractor/ Manufacturer to provide acceptable product nor shall it preclude subsequent rejection.



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2. Purchaser reserve the right to inspect any product at any stage of manufacturing without prior notice to Contractor/Manufacturer beyond pre-identified stages & hold points of approved QAP. The inspection mentioned in this clause is meant for Purchaser getting apprised of status of manufacturing and not to obstruct the manufacturing program of the Contractor.
- ~~3. Contractor shall refer to Volume IIA & II B of Contract Specification for further detailed information.~~

* * * * *





9.1 Quality Assurance

9.1.1 Introduction

All materials, components and equipments covered under the scope of supply will be procured, manufactured, erected and tested at all stages as per the comprehensive Quality Assurance (QA) programme. The QA document indicating the specific inspection and testing requirements to be followed will be subject to the approval of the Owner/Consultant. The Contractor will submit his quality assurance programme for review by Owner/Consultant and will generally cover the following:

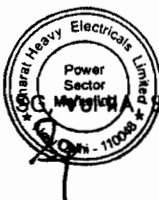
1. Organizational structure for management and implementation of the proposed quality assurance programme.
2. Quality system manual.
3. Documentation control system.
4. Qualification and experience data of Contractor's key personnel.
5. The procedure for procurement of materials, parts, components and equipment.
6. Procedure for inspection at source, inspection of incoming raw-materials/ parts/ components & verification of materials purchased.
7. System for shop manufacturing including process controls, fabrication and assembly controls, and procedure for product identification & traceability.
8. System for inspection and testing during manufacture, processing, fabrication, welding, assembly and other activities.
9. The reference documents, plant standards, acceptance norms, test and inspection procedure etc.
10. Control of calibration and testing of measuring and testing equipments.
11. System for quality audits, documentation to indicate conformance or nonconformance of the product to the specification and testing and inspection requirements; review and control of non-conforming items and system for corrective actions.
12. System for indication and appraisal of inspection status.
13. System for authorizing release of manufactured product to the Owner.
14. System for packaging, handling, transportation, storage and delivery.
15. System for generation and maintenance of inspection and test records.

9.1.2 ~~Steam Generator and Auxiliaries~~

~~Testing and inspection requirements of major equipment over and above the respective codes / standards requirement are given hereunder:~~

9.1.2.1 ~~Pressure Parts~~

~~Only those materials will be used in the manufacture of pressure parts which can be identified against mill sheet or manufacturer test certificates. Material will meet~~





- a) Chemical and tensile tests.
 - b) Metallographic examination-longitudinal and transverse (250X)
 - c) Surface finish and surface purity from chloride ions.
 - d) Spring back and surface finish after coiling (applicable to helical discharge electrodes
- ii) Work tests for collecting electrodes and rigid discharges electrode will include the following:
- a) Chemical and mechanical properties.
 - b) Check for profile and straightness.
 - c) Check for surface finish and dimensional accuracy.
 - d) Cupping test for deep drawn sheets.

B. ESP structure

- i) Visual inspection of all welds will be performed in accordance with AWS D1.1.
- ii) Also the butt and fillet welds for built up plates and columns will be inspected by 100% MPI.
- iii) Radiographic examination will be performed on butt welds as per AWS D1.1. 100% radiography on tension flange (bottom flange) welds and spot radiography on all joints in compression flange (top flange) of all beams and columns will be carried out. The minimum length of welds for spot radiography and acceptance criterion will be as per AWS D 1.1.
- iv) Edge preparation for field welding will be examined by MPI.

9.2 Inspection and Testing

- a. The word 'Inspector' will mean the Owner's Inspection engineer and/or an outside inspection agency acting on behalf of the Owner to inspect and examine the materials and workmanship of the works during its manufacture or erection.
- b. The Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner will have access at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection and if part of the works is being manufactured or assembled on other premises or works, the Contractor will obtain for the Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner, permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works.
- c. The Contractor will give the Owner fifteen (15) days written notice of any material being ready for testing. Such tests will be to the Contractor's account except for the expenses of the Inspector's. The Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner, unless the witnessing of the tests is virtually waived and confirmed in writing, will attend such tests within fifteen (15) days of the date on which the



- equipment is noticed as being ready for test/inspection failing which the Contractor may proceed with test which will be deemed to have been made in the inspector's presence and he will forthwith forward to the inspector duly certified copies of test reports in two (2) copies for his review and approval.
- d. The Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner will within fifteen (15) days from the date of inspection as defined herein give notice in writing to the Contractor, on any objection to any drawings and all or any equipment and workmanship which is in his opinion is not in accordance with the contract. The Contractor will give due consideration to such objections and will either make modifications that may be necessary to meet the said objections or will inform in writing to the Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner, giving reasons therein, that no modifications are necessary to comply with the contract. After due consideration, the Owner may accept or reject the same.
 - e. When the factory tests have been completed satisfactorily at the Contractor's or sub-Contractor's works, the Project Manager / Inspector will issue a certificate to this effect within fifteen (15) days of completion of tests. The completion of these tests or the issue of the certificates will not bind the Owner to accept the equipment should it, on further tests after erection be found not to comply with the contract.
 - f. In all cases where the contract provides for tests whether at the premises or works of the Contractor or any sub-Contractor, the Contractor, except where otherwise specified, will provide free of charge such items as labour, material, electricity, fuel, water, stores, apparatus and instruments as may be reasonably demanded by the Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner, to carry out effectively such tests on the equipment in accordance with the Contract and will provide the facilities to accomplish testing.
 - g. The inspection by the Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner and issue of Inspection Certificate thereon will in no way limit the liabilities and responsibilities of the Contractor in respect of the contract.
 - h. To facilitate advance planning of inspection in addition to giving inspection notice, the Contractor will furnish quarterly inspection programme indicating schedule dates of inspection at Customer Hold Point and final inspection stages. Updated quarterly inspection plans will be made for each three consecutive months and will be furnished before beginning of each calendar month.
 - i. All inspection, measuring and test equipment used by Contractor will be calibrated periodically depending on its use and criticality of the test/measurement to be done. The Contractor will maintain all the relevant records of periodic calibration and instrument identification, and will produce the same for inspection by Owner. Wherever asked specifically, the Contractor





will re-calibrate the measuring/test equipment in the presence of Owner's Inspection Engineer and/or an outside inspection agency acting on behalf of the Owner.

Name of the Manufacturer and address		SIMHADRI TPS-2X500 MW Contract No. 3520 -001		Sheet 01 of 01 REV - 1			
A.S. PER APPROVED LIST.		CHECK LIST FOR CS-FITTINGS (FORGED/SEAMLESS) CHECK LIST No. 3520-001-00-PE-QVM-Q-013-01					
SL.No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	N	
1	Visual and Dimensional Checks for each size and type	100% by manufacturer, 10% by BHEL	Approved Data Sheet/ Relevant Standards	P	V	V	
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

[Handwritten Signature]
05/01/99

Legend
Records Identified with ✓ shall be essentially included by Contractor in QA Documentation
M= Manufacturer / Sub Contractor
C= Contractor/ Nominated Inspection Agency
N= NTPC
P= Perform; W= Witness ; V= Verification

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(V. P. Sharma)
Dy Gen Manager (Mech. Aux.)
Project Engg. Mgmt Division
Bharat Heavy Electricals Ltd.

Name of the Manufacturer and address		SIMHADRI TPS-2X500 MW Contract No. 3520 -001		Sheet 01 of 01 REV - 1			
As Per Approved List		CHECK LIST FOR CS-SEAMLESS PIPES					
		CHECK LIST No. 3520-001-00-PE-QVM-Q-015-01					
SL.No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	N	
1	Visual and Dimensional Checks for each size and type of Pipe	100% by manufacturer, 10% by BHEL	Approved Data Sheet/ Relevant Standards	P	W	V	
2	Check for Logo mark & Specification	Do	Do	P	V	V	
3	Check for Chemical composition of material	One sample / Heat	Do	P	V	V	Manufacturer's TCs shall be furnished
4	Check for physical properties of material; Tensile strength, Yield strength, % Elongation of Pipes	Do	Do	P	V	V	Do
5	Hydrotest of Pipes	100% by M and 10% by BHEL	Do	P	W	V	Do

(Signature)
05/01/99

Controlled Copy

Legend
Records Identified with ✓ shall be essentially included by Contractor in QA Documentation
M= Manufacturer / Sub Contractor
C= Contractor/ Nominated Inspection Agency
N= NTPC
P= Perform; W= Witness; V= Verification

(Signature)
By Gen. Manager (Mech. Aux.)
Project Eng. Mgmt. Division
Electricity & Electronics Ltd.

Name of the Manufacturer and address
 AS PER APPROVAL LIST.
 SIMHADRI TPS-2X500 MW
 Contract No. 3520 -001
 CHECK LIST FOR CS- ERW PIPES
 CHECK LIST No. 3520-001-00-PE-QVM-Q-014 -01

Sheet 01 of 01
 REV - 1

SL.No.	TESTS/CHECKS	QUANTUM OF CHECKS	REFERENCE DOC./ ACCEPTANCE NORMS	AGENCY				REMARKS
				M	C	N	D	
1	Visual and Dimensional Checks for each size and type of pipe	100% by manufacturer, 10% by BHEL	Approved Data Sheet/ Relevant Standards	P	W	V		
2	Check for Logo mark & Specification	Do	Do	P	V	V		
3	Check for Chemical composition of material	One sample / Heat	Do	P	V	V	✓	Manufacturer's TCs shall be furnished
4	Check for physical properties of material; Tensile strength, Yield strength, % Elongation of Pipes	Do	Do	P	V	V	✓	Do
5	Hydrotest of Pipes	100% by M and 10% by BHEL	Do	P	W	V	✓	Do

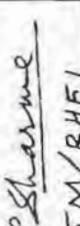
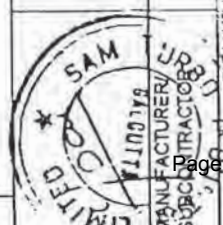

Legend
 Records Identified with ✓ shall be essentially included by Contarctor in QA Documentation
 M= Manufacturer / Sub Contractor
 C= Contractor/ Nominated Inspection Agency

(Handwritten signature)

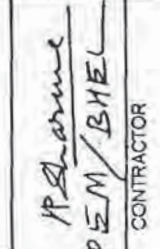
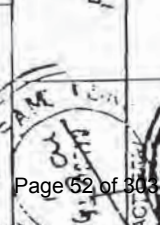
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Sent to Vendor with left 4 nos.
PE.S/D-186-450-0263 of H. 2.2.07.22.

MANUFACTURING QUALITY PLAN

MANUFACTURER'S NAME & ADDRESS		ITEM: SUMP PUMP (VERTICAL)		CP NO. 3520-001-00-PE-QVM-Q-016		PROJECT: 2x500 MVA SIMHADRI TPS								
SUB-SYSTEM:		SUB-SYSTEM:		REV: DATE: 25/03/2000		PACKAGE: FUEL OIL SYSTEM								
CONTRACTOR: BHEL, PEM - NEW DELHI		CONTRACT NO: 3520 001		PAGE 1 OF 2		CONTRACTOR: BHEL, PEM - NEW DELHI								
SL NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD				REMARKS		
								D	M	C	N			
1.0	RAW MATERIAL		4		6	7	8	9	10	11				
1.1	CASING ROTOR (IMPELLER) HOUSING (NI-CAST IRON), MECHANICAL & CHEMICAL TEST	SURFACE DEFECTS DIMENSIONAL CONFORMITY MECHANICAL & CHEMICAL TEST	MAJOR MAJOR MAJOR MAJOR	VISUAL MEASUREMENT MECHANICAL TEST	100% 100% 1/HEAT 1/HEAT	APPD. DRAWING/ ALLOY CI 350 BHN	APPD. DRAWING/ ALLOY CI 350 BHN	IR & TC IR & TC IR & TC IR & TC	V V V V	V V V V	V V V V	HARDNESS TO BE CHECKED ON 100% BASIS		
1.2	IMPELLER (ROTOR) (NI-CAST IRON)	SURFACE DEFECTS DIMENSIONAL CONFORMITY CHEMICAL & MECH. HARDNESS DYPENETRATION TEST (AFTER MACHINING)	MAJOR MAJOR MAJOR MAJOR	VISUAL MEASUREMENT CHEMICAL & MECH. HARDNESS DYPENETRATION TEST	100% 100% 100% 100%	APPD. DRAWING/ ALLOY CI 350 BHN ASTM E165	APPD. DRAWING/ ALLOY CI 350 BHN NO LINEAR DEFECT	IR & TC IR & TC IR & TC IR & TC	V V V V	V V V V	V V V V	*** WHEN BACKWALL ECHO IS SET TO 100% OF FSH IN SOUND AREA 1) DEFECT ECHO NOT TO EXCEED 20% OF FSH 2) BACK WALL ECHO HEIGHT TO BE 80% MIN. OF FSH FREQ. 2 MHZ. MINIMUM		
1.3	SHAFT	DIMENSIONAL CONFORMITY CHEMICAL ANALYSIS MECHANICAL TESTING UT DIA > 50MM	MAJOR MAJOR MAJOR MAJOR	MEASUREMENT CHEMICAL MECHANICAL UT	100% 1/HEAT 1/HEAT 100%	APPD. DRAWING BS 970/EN 8 ASTM A388	APPD. DRAWING BS 970/EN 8	IR & TC IR & TC IR & TC IR & TC	V V V V	V V V W	V V V V			
1.4	SHAFT SLEEVE	CHEMICAL ANALYSIS HARDNESS	MAJOR MAJOR	CHEMICAL HARDNESS	1/HEAT 100%	APPD. DRAWING	APPD. DRAWING	IR & TC	V	V	V			
1.5	WEARING RINGS	CHEMICAL & MECH. PROP. HARDNESS	MAJOR MAJOR	CHEMICAL & MECH. PROP. HARDNESS	1/HEAT 100%	APPD. DRAWING SS	APPD. DRAWING SS	IR & TC IR & TC	V V	V V	V V			
LEGEND:								FOR NTPC USE					DOC. NO. 3520-001-00-PE-QVM-Q-008/0	
RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.														
'M' MANUFACTURER/SUB-CONTRACTOR														
'C' CONTRACTOR/NOMINATED INSPECTION AGENCY														
'N' NTPC. INDICATE 'P' PERFORM 'W' WITNESS AND														
'V' VERIFICATION AS APPROPRIATE CHP NTPC SHALL IDENTIFIED IN COLUMN 'N'														
 P. SHARMA CONTRACTOR														NAME & SIGN. OF APPROVING AUTHORITY & SEAL

MANUFACTURING QUALITY PLAN

MANUFACTURER'S NAME & ADDRESS SAM TURBO INDUSTRY LTD. COIMBATORE		ITEM: 3 BUMP PUMP (VERTICAL)		PROJECT: 2X500 MW SIMHADRI TPS					
SUB-SYSTEM:		PACKAGE: FUEL OIL SYSTEM		CONTRACT NO. 3520 001					
CONTRACTOR: BHEL, PEM - NEW DELHI		CONTRACTOR: BHEL, PEM - NEW DELHI		CONTRACTOR: BHEL, PEM - NEW DELHI					
COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS
2	3	4	5	6	7	8	9	D M C N	11
RAW MATERIAL									
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 W W CHP	
SHAFT	DP ON SHAFT	MAJOR	DPT	100%	ASTM E-165	NO LINEAR DEFECT	IR & TC	P V V	
IMPELLER	RESIDUAL UNBALANCE	MAJOR	DYNAMIC/STAT BALANCING	100%	ISO 1940 GR. 6.3	ISO 1940 GR. 6/3	IR & TC	P W W CHP	
FINAL INSPECTION									
OVERALL DIMENSION	DIMENSIONAL	MAJOR	MEASUREMENT	100%	APPD. DRAWING	APPD. DRAWING	IR & TC	P W W CHP	
PERFORMANCE TEST WITH CALIBRATED LAB MOTOR	Q VRS HEAD Q VRS POWER Q VRS EFFICIENCY NOISE LEVEL & VIBRATION	CRITICAL	MEASUREMENT	100%	HIS / APPROVED DATASHEET	HIS / APPROVED DATASHEET	IR & TC	P W W CHP	
STRIP TEST	STRIP TEST	CRITICAL	VISUAL (WEAR & TEAR)			NO UNDUWEAR	IR & TC	P W W CHP	
REVIEW OF DOCUMENTATIONS									
PAINTING	VISUAL	MINOR	VISUAL	100%	APPD. QAP	APPD. QAP	IR	P V V	STRIP DOWN TEST ON 100% BASIS SHALL BE DONE IN CASE ABNORMAL PERFORMANCE/ NOISE/VIBRATION. OTHERWISE SAME SHALL BE RESTRICTED TO BEARING INSPECTION ONLY
NOTE: ALL MATERIAL OF CONSTRUCTION SHALL BE AS PER APPROVED DRAWING/DATA SHEET									
LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY. "N" NTPC. INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP NTPC SHALL IDENTIFIED IN COLUMN "N".									
FOR NTPC USE DOC. NO. 3520-001-16 PE-QVM-Q-038 / D									
 P. Sharma CONTRACTOR BHEL									
 P. Sharma CONTRACTOR BHEL									

MANUFACTURING QUALITY PLAN

SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE CRITERIA	AGENCY				REMARKS	
								D	M	C	N		
MANUFACTURER'S NAME & ADDRESS: N.T.P.C. ROTOPUMPS LTD. PANKJ INDUSTRIAL AREA, KANPUR-206022		ITEM: POSITIVE DISPLACEMENT PUMP (SINGLE/TWIN SCREW PUMP).		Q.P. NO.: 3520-001-15-PE QVM-Q-009 REV. 03 DATE: 15/03/2000 PAGE 1 OF 2		PROJECT: 2X500 MW SIMHADRI TPP CUSTOMER: NTPC PACKAGE: MAIN PLANT: FUEL OIL HANDLING SYSTEM							
SUB-SYSTEM: F.O.I.D.O UNLOADING/DRAIN OIL/OIL RECOVERY PUMP FOR F.O.H SYSTEM		CONTRACT NO: 3520 CONTRACTOR: PE MIB/DEL-II		FORMA OF RECORD		RECORD							
1	Raw Material & Bought Out Items		MA	Chemical Analysis	Sample/heat	Appo. Data Sheet/ Appo. Drg/VS 210 FG 200	Same as Cl.7	✓	P	V	V	V	
1.1	Casing, stuffing box & end cover	i) Chemical test ii) Physical test iii) Hardness	MA	Physical Properties Meas.	Sample/heat	.00	Same as C.7	✓	P <td>V <td>V <td>V <td></td> </td></td></td>	V <td>V <td>V <td></td> </td></td>	V <td>V <td></td> </td>	V <td></td>	
1.2	Shaft, Rotor, Suck-up gear, Timing gear	i) Chemical test ii) Physical test iii) Heat treatment iv) Hardness	MA	Chemical Analysis Physical Properties Heat treatment Meas.	Sample/heat	AISI-431/ASS 304/EN 39 .00 .00 .00 .00	Same as Cl.7	✓	P <td>V <td>V <td>V <td></td> </td></td></td>	V <td>V <td>V <td></td> </td></td>	V <td>V <td></td> </td>	V <td></td>	
1.3	Bearing	Make, size & bearing No.	MA	Visual	100%	Mfg. Drawing/ Mfg. Catalogue	.00	✓	P <td>V <td>V <td>V <td></td> </td></td></td>	V <td>V <td>V <td></td> </td></td>	V <td>V <td></td> </td>	V <td></td>	
2	In Process Control												
2.1	Machining of all Components	i) Dimension ii) Surface finish	MA	Meas. Visual	100% 100%	.00 .00	.00 .00		P <td>V <td>V <td>V <td></td> </td></td></td>	V <td>V <td>V <td></td> </td></td>	V <td>V <td></td> </td>	V <td></td>	
2.2	Casing	Pressure test	MA	Hyd. Test w/CR UT/Leak test	100%	1.5 x max. discharge br. for 30 min. ASTM A338 ASTM E 195	No leakage / Seepage	✓	P <td>V <td>V <td>V <td>CHF</td> </td></td></td>	V <td>V <td>V <td>CHF</td> </td></td>	V <td>V <td>CHF</td> </td>	V <td>CHF</td>	CHF
2.3	Shaft, Rotor, Screw, Suck-up gear, timing gear	1. Internal Defects 2. Surface Defects 3. Case Hardness of timing gear	CR	DPT (After final machining) Hardness	100% 100%	EN-36/EN-370	After case carburising it is hardened & tempered to have tooth hardness of 56 to 57 HRC	✓	P <td>V <td>V <td>V <td>CHF</td> </td></td></td>	V <td>V <td>V <td>CHF</td> </td></td>	V <td>V <td>CHF</td> </td>	V <td>CHF</td>	CHF

MANUFACTURING QUALITY PLAN

MANUFACTURER'S NAME & ADDRESS: M/S ROTO PUMPS LTD. DANKI INDUSTRIAL AREA, KANPUR-208022		ITEM: POSITIVE DISPLACEMENT PUMP (SINGLE SCREW/TWIN SCREW PUMP)		D.P.NO.: 3620-001-15-PE QVM-Q-008		PROJECT: 20590 MW SIMHADRI TPP CUSTOMER: NTPC		
SUB-SYSTEM: F.O.L.D.O UNLOADING/DRAIN OIL/OIL RECOVERY PUMP FOR F.O.H SYSTEM		REV: 03		ACCEPTANCE NORMS		PACKAGE: MAIN PLANT FUEL OIL HANDLING SYSTEM		
CONTRACT NO: 3520		DATE: 15/03/2000		FORM OF		CONTRACT NO: 3520		
CONTRACT NO: 3520		PAGE 2 OF 2		RECORD		CONTRACT NO: 3520		
CONTRACT NO: 3520		PAGE 2 OF 2		RECORD		CONTRACT NO: 3520		
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	AGENCY	REMARKS
							M C N	
3	Assembly Control Final Inspection & Testing		4		0		0	
3.1	Pump Assembly	1) Completeness, correctness, oval dimension	MA	Visual & Meas.	100%	Appd. Dig	✓	W W
3.2	Performance Test - with test bed motor (daily calibrated)	1. Performance for capacity, head, power cons; 2. NPSHR for twin screw 3. Vibration/Noise	CR	Performance Test	100%	Appd. Procedure/Spec	✓	W W
3.3	Review of QA Documentation as per approved QP	Relief Valve set Pt.	CR	- do -	100%	Appd. Data sheet	✓	W W
3.4	Painting	Surface Preparation Shade of Paint	MA	Visual	100%	As per Mfg. Std	✓	W W

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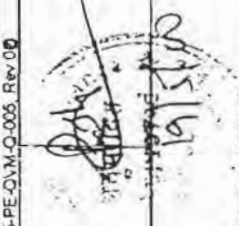
CHP
Noise & Vibration value measured at site to be for reference only.
dme

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 mismatch in material in QP with Data Sheet. The material indicated in approved data sheet will be final.




FOR NTPC USE
DOC NO: 352

FOR NTPC USE
DOC NO: 352

REVISION BY

MANUFACTURING QUALITY PLAN																
MANUFACTURER'S NAME & ADDRESS (AS PER APPROVED MAKE APPROVED MAKE) / BHEL Lot A		ITEM: STEAM TRAP WITH IN-BUILT STRAINER			CP No. 3520-001-15-PE-Q/M-Q-005			PROJECT : 2X500 MW SIMHADRI TPP			SPEC. NO.					
SUB-SYSTEM:		DATE: 03/01/2000			REV: 02			CUSTOMER : NTPC			PACKAGE : MAIN PLANT			SPEC. TITLE		
CONTRACT No. : 3520		BIDDERS/VENDOR : TECHNIO ELECTRIC & ENGG. CO. LTD.			PAGE 1 OF 1			CONTRACT No. : 3520			REMARKS					
SL NO	COMPONENT & OPERATING CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	D	V	C	N	REMARKS				
1	Raw Material Body, Filter cap, Disc, Cover & Filter screen	Major	Chemical Analysis	Sample Check	As per Appd. Drg / Data Sheet	As per Appd. Drg / Data Sheet	MTC	✓	P	V	V					
2	Final Inspection	Major	Physical properties	- do -	- do -	- do -	- do -	✓	P	V	V					
	i) Visual	Major	Visual Inspn	100%	As per Appd. Drg / Data sheet	As per Appd. Drg / Data sheet	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		IBR Certificate to be produced whenever applicable			
	iv) Functional Test	Critical	Function (Flow Capacities)	Random	As per Mfg. Std / Procedure / Catalogue	As per Mfg. Std / Procedure / Catalogue	- do -	✓	P	W	V		CHP			
3. Review of QA Documents as per appd. & P.																
 MANUFACTURER / SUBCONTRACTOR		LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY "W" NTPC INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP NTPC SHALL IDENTIFIED IN COLUMN "N" CONTRACTOR SIGNATURE			FOR NTPC USE			DOC. NO. 3520-001-15-PE-Q/M-Q-005, Rev.00			 REVIEWED BY NAME & SIGN OF APPROVING AUTHORITY & SEAL					

MANUFACTURING QUALITY PLAN

		MANUFACTURER'S NAME & ADDRESS (AS PER NTPC APPROVED MAKE) (A2 404.)		ITEM: OIL STRAINER		Q.P. NO. 3520-001-15 PE-TPP GVM-0-008		PROJECT: 2X500 MW SIMHADRI TPP CUSTOMER NTPC		SPEC. NO SPEC. TITLE	
SUB-SYSTEM:		REFERENCE DOCUMENT		ACCEPTANCE NORMS		CONTRACT NO. 3520 BIDDER/VENDOR:		PACKAGE MAIN PLANT		TECHNO ELECTRIC & ENGG. CO. LTD.	
SL. NO.	COMPONENT & OPERATIONS	CHARACTERISTICS	CLASS	TYPE OF CHECK	QUANTUM OF CHECK	REFERENCE DOCUMENT	AGENCY	FORMAT OF RECORD	REMARKS		
1	2	3	4	5	6	7	M C N	9	10	11	
1	Raw Material		MA	Physical & Chemical Test	1/Sample	Appd. Drg./Mfg Std.	V	Mtrl. TC	V	V	
1.1	Body, flange, dished end	Physical & Chemical Properties	MA	Chem. Test	1/Sheet	- do -	V	- do -	V	V	
1.2	Screen	1. Chem. composition 2. Dimension, Mesh Size	MA	Meas.		- do -	V	log book	V	V	
2	In Process		MA	WPS Scrutiny	100%	ASME-IX	F	QW-482	V	V	Joint WPS to be affd by BHE
2.1	Welding Procedure Specification	Correctness	MA	Phy Test/ RT	100%	ASME-IX	P	QW-493/ 484	V	V	Only Lloyds/NTPC signed welders to be employed
2.2	Procedure Qualification Record & welder qualification	Weld Soundness	MA	Meas/ Visual	100%	ASME-IX	P	log book	V	V	
3	Weld fit up	1. Dimension, alignment, orientation	MA	Penetration Test	10%	ASTM E-165	P	- do -	W	V	
4	Weldments - Final Run	1. Surface Defect	MA								
SIGNATURE 		CONTRACTOR PEM/BHEL		LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT. "M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY, "N" NTPC, INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP NTPC SHALL IDENTIFIED IN COLUMN "N"		FOR NTPC USE		DOC. NO. 3520-001-15-PE-GVM-0-008 Rev 0		REVIEWED BY 	

MANUFACTURING QUALITY PLAN

<p>BHEL</p>		<p>MANUFACTURER'S NAME & ADDRESS (AS PER NTPC APPROVED MAKEUP FOR IQA)</p>		<p>ITEM: OIL STRAINER</p>		<p>Q.P. NO. 3520-00-105-PE- QVM 13-008</p>		<p>PROJECT: 2X500 MW SIMHAD CUSTOMER: NTPC</p>		<p>SPEC. N°</p>	
<p>SUB-SYSTEM</p>		<p>REFERENCE DOCUMENT</p>		<p>ACCEPTANCE NORMS</p>		<p>CONTRACT NO: 3520 BIDDER/VENDOR</p>		<p>PACKAGE: MAIN PLANT</p>		<p>SPEC. TITLE</p>	
<p>COMPONENT & OPERATIONS</p>		<p>CHARACTERISTICS</p>		<p>CLASS</p>		<p>QUANTUM OF CHECK</p>		<p>TYPE OF CHECK</p>		<p>REMARKS</p>	
<p>5 Assembly of Internal Fittings Basket placement</p>		<p>3 Orientation Location of Tapping Points & fitting of Internals</p>		<p>4</p>		<p>6</p>		<p>5 Visual & Meas.</p>		<p>7 Appd. Dwg /Mfg Std</p>	
<p>6 Final Assembly</p>		<p>Completeness cleanliness Dimension</p>		<p>MA</p>		<p>100%</p>		<p>Visual & Meas</p>		<p>8</p>	
<p>6.1 Final Inspection</p>		<p>Leak tightness</p>		<p>CR</p>		<p>100%</p>		<p>Hyd Test at 1.5 times design pr. for 30 min</p>		<p>9</p>	
<p>Review of Q.M. Documentation</p>		<p>Performance Test - Flow vs Pr. Drop</p>		<p>MA</p>		<p>One/Type</p>		<p>Testing</p>		<p>10</p>	
<p>Signature: <i>MS. Laxman</i></p>		<p>Signature: <i>MS. Laxman</i></p>		<p>CONTRACTOR</p>		<p>FOR NTPC USE</p>		<p>DOC NO: 3520-001-15-PE-QVM-Q-MR-RWD</p>		<p>REVIEWED BY</p>	
<p>Signature: <i>IRECH</i></p>		<p>Signature: <i>MS. Laxman</i></p>		<p>CONTRACTOR</p>		<p>LEGEND: RECORDS IDENTIFIED WITH "TICK" SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENT.</p>		<p>NAME & SIGN OF APPROVING AUTHORITY</p>		<p>6/7/99</p>	
<p>Signature: <i>IRECH</i></p>		<p>Signature: <i>MS. Laxman</i></p>		<p>CONTRACTOR</p>		<p>"M" MANUFACTURER/SUB-CONTRACTOR "C" CONTRACTOR/NOMINATED INSPECTION AGENCY, "N" NTPC INDICATE "P" PERFORM "W" WITNESS AND "V" VERIFICATION AS APPROPRIATE CHP NTPC SHALL IDENTIFIED IN COLUMN "N"</p>		<p>REMARKS</p>		<p>11</p>	

CHIP

Test will be carried out at shops in case earlier test report of Elm V. Prod. for strainer of same type. Size is not available. If available test report available, same shall be reviewed and the final inspection done.

NTPC		MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN			PROJECT		
ORNATE VALVES, NASIK (upto 400 NB# 150 only)		FISHER XOMOX, VIRALIMALAI (upto 250 NB# 300 only)		ITEM: CS BALL VALVES	REV.0	Q.P. NO. 3520-001-15-PE-QVM-Q-007	2x500 M.W. SIMHADRI - TPP		
				SUB-SYSTEM: F.O./DO U/L FOR F.O. SYSTEM	DATE: 14.03.00	CONTRACT NO. 3520	PACKAGE : F.O.H SYSTEM		
					PAGE 1 OF 3	CONTRACTOR	: BHEL, PEN, NEV/DELHI		
S.NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	REFERENCE DOCUMENT	QUANTUM OF CHECK	AGENCY	FORMAT OF RECORD	FL MARKS
1	2	3	4	5	6	7	D M C N	9	10
1.0	MATERIALS								
1.1	BODY & END PIECE	CHEMICAL COMPOSITION	CRITICAL	CHEM. TEST	ONE/HEAT	APPD.DRG./DATA SHEET		TEST CERT.	P V
		MECHANICAL PROPERTIES	-DO-	MECH. TEST	ONE/HEAT/HEAT TREATMENT BATCH	-DO-		-DO-	P V
		HEAT TREATMENT	-DO-	REVIEW OF HT CHART	100%	-DO-		-DO- / H.T. CHART	P V
		IDENTIFICATION & CORRELATION	MAJOR	VISUAL	100%	-DO-		INTERNAL RECORD	P V
		SURFACE DEFECTS	-DO-	-DO-	100%	MSS-SP-55		-DO-	P V
		DIMENSIONAL	-DO-	MEASUREMENT	100%	APPD. DRG.		LOG BOOK	P V
								FOR NTPC USE	

CONTROLLED COPY

LEGEND:
 * RECORDS, IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.
 ** M: MANUFACTURER OF ITEM/EQUIP.
 C: CONTRACTOR/BHEL NOMINATED INSP. AGENCY N: NTPC
 W: INDICATE 'P' PERFORM, 'W' WITNESS AND 'V' VERIFICATION AS APPROPRIATE. 'CHP' NTPC SHALL BE IN CHARGE.

TECC - Calcutta
 Signature: *[Handwritten Signature]*
 (V.P. PH/MA)
 MANUFACTURER Gen. In-charge
 SUBCONTRACTOR Division
 SIGNATURE
 Date: 14.03.00
 Sui Fed. No. 303/11/1998

MANUFACTURER'S NAME & ADDRESS		MANUFACTURING QUALITY PLAN			PROJECT						
NTPC CORNATE VALVES, NASIK (UPTO 400MS #150 only) FISHER XOMOX, VIRALIMALAI (UPTO 250MS #300 only)		ITEM: CS BALL VALVES SUB-SYSTEM: F.O./DO U/L FOR F.O. SYSTEM			Q.P. NO. 3520-001-15-PE-QVM-Q-007						
MANUFACTURER'S NAME & ADDRESS		ACCEPTANCE NORM			PACKAGE						
FISHER XOMOX, VIRALIMALAI (UPTO 250MS #300 only)		DATE: 14.03.00 PAGE 2 OF 3			F.O.H. SYSTEM						
CHARACTERISTICS		REFERENCE DOCUMENT			CONTRACT NO. 3520						
CLASS		QUANTUM OF CHECK			CONTRACTOR						
3		6			BHEL, PEM, NEW DELHI						
4		7			REMARKS						
5		8			FORMAT OF RECORD						
6		9			RECORD						
7		10			AGENCY						
8		11			M C N						
9		12			D						
1	2	3	4	5	6	7	8	9	10	11	12
1.2	BALL, SPINDLE, GLAND, LEVER FASTENERS	CHEMICAL COMPOSITION	CRITICAL	CHEM. TEST	ONE/HEAT	APPD.DRG./DATA SHEET	SAME AS COL.7	TEST CERT	P	V	V
	MECHANICAL PROPERTIES	-DO-	-DO-	MECH. TEST	ONE/HEAT TREATMENT	-DO-	-DO-	-DO-	P	V	V
	HEAT TREATMENT SURFACE DEFECTS	-DO- MAJOR	-DO- MAJOR	REVIEW OF BATCH M.T.C. VISUAL	BATCH 100% 100%	-DO- FREE FROM DEFECTS	-DO- -DO-	-DO- INTERNAL RECORD	P	V	V
	DIMENSIONS	-DO-	-DO-	MEASUREMENT	100%	APPD.DRG.	-DO-	LOG BOOK	P	V	V
1.3	BODY SEAL, STEM SEAL, GLAND PACKING	DIMENSIONS	-DO-	-DO-	100%	APPD.DRG.	-DO-	INTERNAL RECORD	P	V	V
	TEMPERATURE RESISTANCE	-DO-	-DO-	TEMP. CHECK	100%	PTFE REL. VANT STD.	-DO-	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.	-DO-	LOG BOOK	P	V	V
	SURFACE FINISH	-DO-	-DO-	VISUAL	100%	-DO-	-DO-	-DO-	P	V	V
2.2	BALL, SPINDLE	HARDNESS	-DO-	HARDNESS TEST	100%	APPD.DRG./DATA SHEET/TECH.SPEC.	-DO-	TEST CERT.	P	V	V
	SURFACE DEFECTS	CRITICAL	CRITICAL	DPT	100%	ASTM-E-165	No Linear Indication	INTERNAL RECORD	P	V	V
		LEGEND:									
		* RECORDS IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.									
		** M: MANUFACTURER OF ITEM/EQUIP.									
		C: CONTRACTOR/BHEL NOMINATED INSP. AGENCY N: NTPC									
		INDICATE 'P' PERFORM, 'W' WITNESS, 'V' VERIFICATION AS APPROPRIATE. 'CHP' NTPC SIGNATURE									
		SIGNATURE									
		CONTRACTOR									
		Munit Division									
		Page 69 of 211									

NTPC		ORNATE VALVES, NASIK (UP TO VCO N/B # 150 only)		ITEM: CS BALL VALVES		GVM-Q-007		F.O.H. SYSTEM		
FISHER XOMOX, VIRALIMALAI (UP TO 250 N/B # 300 only)		SUB-SYSTEM: F.O./DO U/L FOR F.O. SYSTEM		TYPE OF CHECK		REV. 0		PACKAGE		
CHARACTERISTICS		CLASS		QUANTUM OF CHECK		DATE: 14.03.00		CONTRACT NO.		
COMPONENT & OPERATION				REFERENCE DOCUMENT		PAGE 3 OF 3		CONTRACTOR		
S.NO.	COMPONENT & OPERATION	CHARACTERISTICS	CLASS	TYPE OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	AGENCY	RECORD	REMARKS	
1	2	3	4	5	6	7	8	9	10	
11	12	13	14	15	16	17	18	19	20	
2.3	BALL & SEAT		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	ASSEMBLY	DIMENSIONS	MAJOR	MEASUREMENT	100%	APPD. DRG.	- DO -	INTERNAL RECORD	P W W	
4.0	TESTING SHELL	LEAKAGE	CRITICAL	HYDRAULIC	100%	APPD. DRG/ DATA SHEET	NO LEAKAGE	TEST CERTIFICATE	P W W	
4.1										
4.2	SEAT	- DO -	- DO -	- DO -	100%	- DO -	- DO -	- DO -	P W W	
4.3	SEAT	- DO -	- DO -	AIR	100%	- DO -	- DO -	- DO -	P W W	
5.0	REVIEW OF QA DOCUMENTATION AS PER APPD. QUALITY & THICKNESS OF PAINT		MAJOR	VISUAL & MEASUREMENT	100%	TECH. SPEC.	SAME AS COL.7	INTERNAL RECORD	P V V	
6.0	PACKING		MAJOR	VISUAL	100%			INTERNAL RECORD	P	
<p>FIRE SAFE PATTERN TEST</p> <p>A. FOR ORNATE VALVES, NASIK</p> <p>TEST REPORTS OF FIRE SAFE TEST ALREADY CONDUCTED IN PRESENCE OF BHEL/INSP FOR OFFERED VALVES SHALL BE VERIFIED. IN ABSENCE OF SUCH SATISFACTORY TEST REPORT, FIRE SAFE TEST SHALL BE CONDUCTED IN PRESENCE OF NTPC REPRESENTATIVE.</p> <p>B. FOR FISHER - XOMOX, VIRALIMALAI</p> <p>FIRE SAFE TEST SHALL BE CONDUCTED IN PRESENCE OF NTPC REPRESENTATIVE AS CONFIRMED BY EXSL LTR. No. X-VR/024/0 DT. 3.11.99</p> <p>* FOR GENR OPERATED/ELECTRICALLY ACTUATED VALVES, TEST AT SR. No. 3.0 TO 4.3 SHALL BE DONE ALONG WITH RETURNE ACTUATOR.</p>										
<p>LEGEND:</p> <p>* RECORDS, IDENTIFIED WITH 'TICK' SHALL BE ESSENTIALLY INCLUDED BY CONTRACTOR IN QA DOCUMENTATION.</p> <p>M: MANUFACTURER OF ITEM/EQUIP</p> <p>C: CONTRACTOR/BHEL NOMINATED INSP. AGENCY N: NTPC</p> <p>INDICATE 'P' PERFORM, 'W' WITNESS AND 'V' VERIFICATION AS APPROPRIATE. 'CHP' NTPC SHALL IDENTIFY IN COL. 'N'</p>										
<p>MANUFACTURER: (Signature) (Date)</p> <p>CONTRACTOR: (Signature) (Date)</p> <p>SUBCONTRACTOR: (Signature) (Date)</p> <p>SIGNATURE: (Signature)</p>										
<p>FOR NTPC USE</p> <p>DOCS3520-001-15 PF QVM-Q-007</p>										



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 CAPTIONED DO. COPY

CHP * *

CHP

**QUALITY ASSURANCE REQUIREMENTS
MINIMUM INSPECTION
REQUIREMENTS FOR SAFETY AND SAFETY RELIEF VALVES**

SHEET 1 OF 2

SR. NO.	COMPONENT / OPERATION	CHARACTERISTICS CHECKED	TYPE / METHOD OF CHECK	EXTENT	REF. DOCUMENT / ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
							S	M	P	
1	2	3	4	5	6	7	8	9		
1.0 MATERIALS:										
1.1	Body and Bonnet of Cast Carbon and Stainless Steel valves (60C rating and above), Ferritic Alloy Steel valves (All ratings)	Chem., Mech. properties, Dimns.	Review of docs.	100%	Material specification, IBR*	TC		V	*If appl. cable	
		Soundness	RT	100%	ASME B 16.34	TC		V	RT film review	
1.2	Body and Bonnet of forged Steel valves (1500 rating and above)	Chem., Mech. properties, Dimns.	Review of docs.	100%	Material specification, IBR*	TC		V	*If applicable	
		Soundness	UT	100%	ASME B 16.34	TC		V		
1.3	Body & Bonnet of all valves	Surface defects	MPI (LPI for non-magnetic materials)	100%	ASME B 16.34	TC		V		
1.4	Inlet neck and seat bushing	Chem., Mech. properties, Dimns.	Review of docs.	100%	Material specification, IBR*	TC		V	*If applicable	
		Soundness	RT/UT	100%	ASME B 16.34	TC		V	RT film review	
1.5	Nozzle	Chem., Mech. properties, Dimns.	Review of docs.	100%	Material specification, IBR*	TC		V	*If applicable	
		Soundness	RT/UT	100%	ASME B 16.34	TC		V	RT film review	
1.6	Valve stem	Chem., Mech. properties, Dimns.	Review of docs.	100%	Material specification, IBR*	TC		V	*If applicable	
		Soundness (for diameter > 50mm)	UT	100%	AM 203.2 of Sec. VIII Div. 2	TC		V		

A. STATUTORY REQUIREMENTS SHALL BE COMPLIED WITH BY THE VENDOR.
 B. MATERIAL TESTS OF SAMPLES DRAWN BY PURCHASER SHALL BE WITNESSED BY PURCHASER.
 C. FOR STAGES WITNESSED / DOCUMENTS REVIEWED BY PURCHASER, COPIES OF RELEVANT DOCUMENTS SHALL BE FURNISHED TO PURCHASER.
 D. PURCHASER'S IDENTIFICATION STAMP ON MATERIALS SHALL BE PRESERVED / GOT TRANSFERRED BY PURCHASER AT APPROPRIATE STAGES.
 E. THE EXTENT INDICATED IN COLUMN 5 IS IN VENDOR'S SCOPE. PURCHASER MAY INSPECT AS PER THIS COLUMN OR RANDOM SAMPLES.
 F. COLUMN 6 SHALL BE AS PER PURCHASER APPROVED DRAWINGS / DATA SHEETS / SPECIFICATIONS WHEREVER APPLICABLE.
 G. INSTRUMENTS FOR LEAK TESTS AND PERFORMANCE TESTS SHALL HAVE VALID CALIBRATION CERTIFICATE WITH TRACEABILITY TO NATIONAL LEVEL.
 H. LEGEND : S - SUB - VENDOR, M - MAIN VENDOR, P - PURCHASER/CONSULTANT W - WITNESS, V - DOCUMENTS REVIEW, H - HOLD POINT.

SR.	COMPONENT / OPERATION	CHARACTERISTICS	TYPE / METHOD	EXTENT	REF. DOCUMENT	FORMAT OF	AGENCY	REMARKS
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TITLE

QUALITY ASSURANCE REQUIREMENTS

MINIMUM INSPECTION REQUIREMENTS FOR SAFETY AND SAFETY RELIEF VALVES

SHEET 2 OF 2

NO.	CHECKED	OF CHECK	ACCEPTANCE NORM	RECORD	S	M	P	
1	2	3	4	5	6	7	8	9
1.7	Springs	Chem., Mech. properties, Dimms. Surface defects	Review of docs. MPI	100% 100%	Material specification, IBR*	TC	V	*If applicable
		Hardness test	Measurement	10%	ASME B 16.34	MPI report	V	
		Performance test	Performance check	10%	Material specification	Hardness report	V	
					Drawing	Inspection report	V	
IN-PROCESS INSPECTION :								
2.1	Welding	Procedure, Personnel qualification	Review of docs.	100%	ASME Sec. IX	WPS, PQR, WPQ	V	
2.2	Weld inspection	Surface defects	Visual	100%	ASME B 16.34	Inspection report	V	
2.3	NDE of stellite seats	Surface defects	LPI	100%	ASME B 16.34	LPI report	V	
2.4	Hardness test on stellite seat	Hardness	Measurement	10%	Drawing	Hardness report	V	
2.5	NDE of full penetration welds	Soundness	RT/UT	100%	ASME B 16.34	RT/UT report	V	RT film review
2.6	NDE of fillet welds	Surface defects	MPI/LPI	100%	ASME B 16.34	MPI/LPI report	V	
2.7	Machined Surface of all components	Surface defects	MPI/LPI	100%	ASME B 16.34	MPI/LPI report	V	
2.8	PWHT	Temp. and time control	HT chart review	100%	ASME Sec. I, IBR	HT chart	V	
2.9	Hydrotest of the base assembly/ nozzle	Strength	Hydrotest	100%	Drawing, IBR, ASME Sec. I	Hydrotest report	V	
3.0	FINAL :							
3.1	Visual and dimensional inspection	Overall dimms., Surface cond., etc.	Visual, Measurement	100 %	Drawing	Inspection report	V	
3.2	Testing*	Set Pressure test, Seat test Back Pr. test (For S. R. valves) Paint thk., Identification, etc.	Refer Note-1 Air test Visual, Measurement, Document review	100 % 100 % 100 %	Drawing, ASME Sec. I, IBR Drawing, ASME Sec. I, IBR Drawing, IBR	Inspection report Inspection report Inspection report	W W V	*Flow measurement check, lift and blow down % check to be carried out.
3.3	Completeness, IBR certification*					Inspection report		

Notes - 1 : Seat and Set Pressure test to be conducted with steam/air for Safety Valves 2. Seat and Set Pressure test to be conducted with air/water for Safety Relief Valves



QUALITY PLAN

SHEET 1 OF 2

CUSTOMER:

BIDDER/VENDOR: SEE NOTE 'E'

PROJECT:

Q.P. NO: PE-QP-999-169-M031 REV. 01 DT: 21.07.2007
 ITEM: THERMAL INSULATION - BONDED MINERAL (ROCK) WOOL MATTRESSES

SPEC. NO: PE-SS-999-169-M032

SPEC. TITLE: THERMAL INSULATION

VOLUME: -

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE GORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	P	AGENCY W	V	REMARKS
1.	Bonded Mineral (Rock) wool mattresses	Chemical composition	MA	Chemical	1 / Lot	Vendor std.	Vendor std.	Test Certificate	3	-	-	-
		Bulk density ✓	MA	Lab. Test	Sampling as per IS: 8183	IS: 3144 & spec	IS: 8183 & spec	-do-	3	2	-	-
		Dimensions ✓	MA	Physical	-do-	-do-	-do-	-do-	3	2	-	-
		Shot content ✓	MA	Lab. Test	-do-	-do-	-do-	-do-	3	2	-	-
		Chloride content ✓	MA	Chemical	-do-	-do-	-do-	-do-	3	2	-	-
		Thermal Conductivity ✓	MA	Lab. Test	-do-	IS: 3346 & spec	-do-	-do-	3	-	2	Ref. Note "A"
		Heat Resistance ✓	MA	Physical	-do-	IS: 3144 & spec	-do-	-do-	3	2	-	Ref. Note "C"
		Moisture Content ✓	MA	-do-	-do-	-do-	-do-	-do-	3	2	-	Ref. Note "C"
		Moisture Absorption ✓	MA	-do-	-do-	-do-	-do-	-do-	3	2	-	Ref. Note "B"
		Recovery after compression ✓	MA	-do-	-do-	IS: 8183 & spec	-do-	-do-	3	2	-	Ref. Note "C"
		Resistance to vibration ✓	MA	-do-	-do-	IS: 3144 & spec	-do-	-do-	3	2	-	Ref. Note "B"
		Resistance to jolting ✓	MA	-do-	-do-	-do-	-do-	-do-	3	2	-	Ref. Note "B"
		Fibre diameter ✓	MA	-do-	-do-	-do-	-do-	-do-	3	2	-	Ref. Note "B"
		Incombustibility ✓	MA	-do-	Sampling as per IS: 3144	-do-	Tech. spec	-do-	3	2	-	Ref. Note "B"
		Sulphur Content ✓	MA	Chemical	Sampling as per IS: 8183	-do-	IS: 8183 & Tech. spec	-do-	3	2	-	Ref. Note "B"
		Alkalinity ✓	MA	Chemical	-do-	-do-	-do-	-do-	3	2	-	Ref. Note "C"
		Appearance	MA	Visual	-do-	IS: 8183 & spec	-do-	-do-	3	2	-	Ref. Note "C"
						-----	To be free from Voids, Cracks	Inspection Report	3	2	-	-

BHEL		BIDDER/VENDOR	
PARTICULARS		NAME	
SIGNATURE		DATE	
		BIDDERS/VENDORS COMPANY SEAL	



QUALITY PLAN

CUSTOMER:

PROJECT:

SPEC. NO : PE-SS-999-169-M032

BIDDER/VENDOR : SEE NOTE 'E'

QP NO. PE-QP-999-169-M031 REV. 01 DT: 21.07.2007

SPEC. TITLE: THERMAL INSULATION

SHEET 2 OF 2

SYSTEM

ITEM: THERMAL INSULATION - BONDED MINERAL (ROCK) WOOL MATTRESSES

VOLUME -

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	CATE GORY	TYPE OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	P	AGENCY W	V	REMARKS
2.	Hexagonal wire netting & stitching wire											
i)	GS Wire	Dimensional, Gauge dia, Coating test, Tensile test, Wrapping test, Bend test Appearance	MA	Physical	1 sample per lot	IS:4826, IS:3150, IS:280 & Tech. spec.	IS:4826, IS:3150, IS:280 & Tech. spec. Shall be bright & free from defects	Test report	3	-	2	Ref. note "D"
ii)	SS Wire	Dimensional, Gauge dia, Chemical analysis, Tensile test, Wrapping test, Reverse Bend test Appearance	MA	Visual	Random	Tech. Spec.	IS:6528 & Tech. spec.	Inspection Report	3	2	-	
				Physical	1 sample per lot	IS:6528 & Tech. spec.	IS:6528 & Tech. spec.	Test report	3	-	2	Ref. note "D"
				Visual	Random	Tech. Spec.	Shall be bright & free from defects	Inspection Report	3	2	-	
3.	Packing and marking	Packing type and identification marking	MA	Visual	Random	Tech. Spec.	Tech. Spec.	-do-	3	2	-	

NOTES:

- A) 'K' value tests will be carried out on samples sealed by BHEL inspector. These tests will be carried out at approved labs once in 6 months.
- B) These type tests to be carried out once in 6 months.
- C) These type tests to be carried out once in 3 months.
- D) Manufacturer's / supplier's compliance certificate will be furnished.
- E) Manufacturer's Name :
 - i) M/s Minwool Rock Fibres Ltd.
 - ii) M/s Lapinus Rockwool Pvt. Ltd.
 - iii) M/s Rockwool India Ltd.
 - iv) M/s Rockwool Industries [Lloyds Insulation (I) Ltd.]
 - v) M/S Goenka Rockwool (India) Pvt. Ltd.

LEGEND

- MA MAJOR CHARACTERISTIC
- P PERFORM
- W WITNESS
- V VERIFICATION
- 1 CUSTOMER
- 2 BHEL
- 3 VENDOR OR SUBVENDOR

BHEL

PARTICULARS

BIDDER/VENDOR

NAME

SIGNATURE

DATE

BIDDERS/VENDOR'S COMPANY SEAL



QUALITY PLAN			CUSTOMER: LATER			PROJECT: LATER			SPEC. NO. PE-SS-999-100-M001			
SHEET 1 OF 3			BIDDERS/VENDOR:			REV. 03 DT. 26-04-77			SPEC. TITLE			
S.N.O.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	SYSTEM	POWER CYCLE	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	SECTION	VOLUME	REMARKS
			CATE-GORY	TYPE/METHOD OF CHECK	OF CHECK	DOCUMENT	NORMS	RECORD	P	W	V	
1.0	MATERIALS		MA	PHYS. CHEM. TESTS	ONE/HEAT	APPD DRG./TECH. SPEC.	APPD DRG./TECH. SPEC.	TEST CERT	3/2	2	1	CORRELATION REQD FOR BODY BONNET.
1.1	BODY, BONNET, YOKE, WEDGE/DISC, SEAT, SPINDLE, BODY SEAT, BACK SEAT, THRUST PLATE	1. PHYS. CHEM. PROPS 2. HEAT TREATMENT 3. SURFACE DEFECTS	MA	REVIEW OF H.T RECORDS VISUAL	100%	-DO-	-DO-	H.T. INTERNAL INSPN RECORDS INSPN REPORT	3/2	2	2	
1.2	BODY, BONNET & DISC/WEDGE	a) CASTINGS 1. SURFACE DEFECTS 2. SUB-SURFACE DEFECTS	CR	PT/MP RT/UT	100%	ANSI B16.34 AND TECH. SPEC.	ANSI B16.34 AND TECH. SPEC.	INSPN REPORT	3/2	2	1	1. MPI FOR ALL SIZES & RATING FOR CS/CS VALVES 2. PT FOR SS VALVES RT ON B/W END & CHANGE OF SECTION FOR ALL VALVES OF CRH & EX TAGS 2. ALL SS VALVES 3. SIZE UP TO 300 NB & ABOVE. RATING 800 & 900. 4. SIZE 100NB & ABOVE. RATING UP TO 300 5. ALL SIZES & RATING 1500 & ABOVE 6. SIZE UP TO 250 NB & RATING 2500 & ABOVE RT B/W END ONLY FOR 1. SIZE UP TO 250 NB & ABOVE AND RATING UP TO 100 RT ON ALL AREAS 1. 200NB & ABOVE AND RATING 2500 & ABOVE 2. RT FILM REVIEW BY BH' (1) 1. ALL SS VALVES 2. ALL AREAS RATING 800 & ABOVE FOR CS HAS VALVES 3. ALL VALVES OF CRH & EX TAGS CS & AS VALVES 4. ALL AREAS RATING 1100 & ABOVE 5. ALL VALVES OF CRH & EX TAGS
1.3	ACTUATORS 1. ELECTRIC ACTUATORS	1. TORQUE TESTING & SETTING OF TORQUE SWITCH 2. TRAVEL/STROKE 3. TRAVEL TIME	MA	MECH., ELEC. TESTS	100%	TECH. SPEC./APPD. DRG./DATA SHEET/IS:9334	APPD. DRG./DATA SHEET/IS:9334	INSPN REPORT	3	3/2	1, 2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									
												BIDDER'S/VENDOR'S COMPANY SEAL

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QUALITY PLAN		CUSTOMER: LATER		PROJECT: LATER		SPEC. NO. PE-SS-999-100-MC01	
SHEET 2 OF 3		SYSTEM POWER CYCLE		REV. 03 DT. 26-04-07		SPEC. TITLE	
COMPONENT/ OPERATION		CATE- GORY		ITEM: CS/AS/SS GATE/GLOBE VALVE		SECTION	
CHARACTERISTICS CHECKED		TYPE/METHOD OF CHECK		ACCEPTANCE NORMS		AGENCY	
S.NO		EXTENT OF CHECK		FORMAT OF RECORD		REMARKS	
		CHECK		P W V			

S.NO	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	SYSTEM	CATE- GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	SECTION	VOLUME	REMARKS
2.0	SS/ STELLITE DEPOSIT ON DISC & BODY SEAT, BACK SEAT	4. OPERATION OF LIMIT SWITCH 5. MANUAL OPERATION THROUGH HAND WHEEL 6. OPERATION TEST WITH POWER SUPPLY VARIATION ENERGISES TO OPEN/CLOSE 7. IR, HV, IR 8. DEGREE OF PROTECTION 9. DESIGN VERIFICATION	MA	MA	WATER, DUST TEST	1/ TYPE	TECH. SPEC./ APPD. DRG./ DATA SHEET/ IS:9334	-DO-	3RD PARTY TEST CERT.	-	2.1		
3.0	IN-PROCESS INSPECTION	1. SURFACE DEFECTS 2. HARDNESS	CR	MA	PT TESTING	100%	ASTME-165 & TECH.SPEC. APP.DRG.	-DO-	TEST INSPN REPORT	3/2	2	1	
3.1	MACHINING OF ALL COMPONENTS INCLUDING BW ENDS	1. DIMENSIONS, WORKMANSHIP AND FINISH 2. SURFACE & SUB- SURFACE DEFECTS 3. SUB SURFACE DEFECTS (SPINDLE, BODY / DISCS SEAT RING)	CR	MA	MEAS., VISUAL 1. PT 2. MPI (ACCESSIBLE AREA OF BODY & BONNET)	100%	ANSI B16.34 AND TECH. SPEC./ MFG.DRG.	-DO-	LOG BOOK	3/2	2	1	
3.2	WEDGE/DISC & SEAT RING, SPINDLE AND BACK SEAT	1. LAPPING	CR	MA	BLUE MATCHING	100%	ANSI B16.34 AND TECH. SPEC./ UNIFORM METAL TO METAL CONTACT	-DO-	INSPN REPORT	3/2	2	1	1. IF DIATHK IS EQUAL OR GREATER THAN 1.40 mm 2. IF BOO // DISC SEAT'S THICK// E IS EQUAL OR GREATER THAN 25 MP FOR CRH & EX TAGS IRRESPECTIVE OF DIATHK
4.0	ASSEMBLY	1. DIMENSIONS 2. WEAR TRAVEL 3. VALVE LIFT	MA	MA	MEAS.	100%	APPD DRG.	-DO-	-DO-	3/2	2.1	-	FOR GATE VALVES ONLY
5.0	TESTING		MA	MA	MEAS.	100%	-DO-	-DO-	-DO-	3/2	2.1	-	

BHEL		BIDDER/VENDOR	
PARTICULARS		BIDDER/VENDOR	
NAME			
SIGNATURE			
DATE			
BIDDER'S / VENDOR'S COMPANY SEAL			

QUALITY PLAN		PROJECT: LATER		SPEC. NO. PE-SS-999-100-M0J1	
SHEET 3 OF 3		CUSTOMER: LATER		REV. 03 DT. 26-04-07	
COMPONENT/ OPERATION		SYSTEM POWER CYCLE		SPEC. TITLE	
CHARACTERISTICS CHECKED		CATEGORY		SECTION	
EXTENT OF CHECK		TYPE/METHOD OF CHECK		AGENCY	
FORM		ACCEPTANCE NORMS		VOLUME	
FORM		FORMAT		REMARKS	
CHECK		RECORD		P W V	

S.NO.	COMPONENT/ OPERATION	CHARACTERISTICS CHECKED	SYSTEM	CATEGORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	APPD. DRG./ TECH. SPEC.	NO LEAKAGE	INSPN REPORT	AGENCY	REFER NOTE*
5.1	BODY, SEAT, BACK SEAT	1. LEAK TIGHTNESS OF BODY 2. LEAK TIGHTNESS OF BACK SEAT AND SEAT 3. LEAK TIGHTNESS OF SEAT	CR	CR	HYDRAULIC TEST	100%	APPD. DRG./ TECH. SPEC.	NO LEAKAGE	INSPN REPORT	2,1	-
5.2	SEAT & BACK SEAT FOR MOTORIZED/ PNEU. VALVES WITH ACTUATOR OPERATIONAL TESTING	1. LEAK TIGHTNESS OF SEAT 1. LEAK TIGHTNESS OF SEAT	CR	CR	PNEUMATIC TEST HYDRAULIC TEST	100%	APPD. DRG./ TECH. SPEC.	LEAKAGE PERMISSIBLE AS PER API 598	INSPN REPORT	2,1	-
5.3	1. MANUALLY OPERATED VALVES	1. SMOOTH & FULL OPENING AND CLOSING	CR	CR	MANUAL	100%	TECH. SPEC.	SMOOTH OPERATION OF VALVES & CLEAR FLOE	INSPN. REPORT	2,1	-
6.0	2 MOTOR OPERATED VALVES	1. ASCENDING & DESCENDING LIFT CHARACTERISTIC	CR	CR	ELEC.	100%	APP. DRG./ TECH. SPEC./ IS:9334	APP. DRG./ TECH. SPEC./ IS:9334	INSPN. REPORT	2,1	-
7.0	COMPLETE VALVES END CONNECTION DETAILS	2. LIMIT/TORQUE SWITCH SETTING FOR OPENING AND CLOSING TIME	CR	CR	ELEC.	100%	APP. DRG./ TECH. SPEC./ IS:9334	TECH. SPEC./ APPD. DRG	INSP. REPORT	2,1	-
8.0	FINAL INSPECTION	1. OVERALL DIMENSION	MA	MA	MEAS	SAMP-LE 100%	APPD. DRG	APP. DRG. / RELV. STD	INSPN. REPORT	2,1	-
9.0	PAINTING	1. CLEANLINESS & COMPLETENESS. NAME WITH VALVE TAG NOS.	MA	MA	VISUAL	100%	APPD. DRG. / RELV. STD	APP. DRG. / RELV. STD	INSPN. REPORT	2	2,1
10.0	PACKING	1. SURFACE PREPARATION 2. UNIFORMITY & THICKNESS AS PER BHEL TECH. SPEC	MI	MI	VISUAL	100%	TECH. SPEC.	TECH. SPEC.	INSPN. REPORT	2	2,1

ABBREVIATIONS
 CR = CRITICAL CHARACTERISTIC P = PERFORMED BY W = WITNESSED BY V = VERIFIED BY
 MA = MAJOR CHARACTERISTIC 1 = PURCHASER (BHEL) 2 = VENDOR 3 = SUB VENDOR OF THE VENDOR
 MI = MINOR CHARACTERISTIC

NOTE :- A) MATERIAL TEST CERTIFICATES (IBR CERTIFICATES IN FORM III-C) WITH PROPER IDENTIFICATION AND CO-RELATION SHALL BE FURNISHED FOR BODY & BONNET FOR VALVES UNDER PERVIEW OF IBR.
 B) FOR OTHERS PARTS MATERIAL TEST CERTIFICATES SHALL BE FURNISHED.
 C) HYDRAULIC AND AIR TEST CERTIFICATES SHALL BE FURNISHED. FOR VALVES COMING UNDER IBR, TEST CERTIFICATES IN IBR FORM III-C SHALL BE FURNISHED.

BHEL		BIDDER/VENDOR	
PARTICULARS		BIDDER/VENDOR	
NAME			
SIGNATURE			
DATE			
		BIDDER'S/VENDOR'S COMPANY SEAL	

10/9/11

QUALITY PLAN		CUSTOMER: LATER		PROJECT: LATER		SPEC. NO. PE-SS-999-100-M001	
SHEET 1 OF 2		BIDDER/VENDOR		REV. 02 DT. 26-04-2007		SPEC. TITLE	
COMPONENT/OPERATION		SYSTEM: POWER CYCLE		ITEM: CS/AS/SS NON RETURN VALVES		SECTION	
S.N.O.		CHARACTERISTICS CHECKED		REFERENCE DOCUMENT		AGENCY	
		CATE-GORY		ACCEPTANCE NORMS		REMARKS	
		TYPE/METHOD OF CHECK		FORMAT OF RECORD		VOLUME	
		EXTENT OF CHECK		P		W	
				V			

S.N.O.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATE-GORY	TYPE/METHOD OF CHECK	EXTENT OF CHECK	APPD. DRG./TECH. SPEC.	APPD. DRG./TECH. SPEC.	T.C.	AGENCY	SECTION	VOLUME	REMARKS
1.0	MATERIALS											
1.1	BODY COVER, BODY, SEAT RING, DISC, HINGE, HINGE PIN	1. PHYSICAL, CHEMICAL PROPS. 2. HEAT TREATMENT 3. SURFACE DEFECTS	MA	REVIEW OF HT CHART RECORDS	100%	-DO-	-DO-	HT INTERNAL RECORDS INSPN REPORT T.C.	2	2	1	CORRELATION RECD. FOR BODY & COVER SOLUTION ANNEALING FOR STAINLESS STEEL.
1.2	BODY COVER, HINGE & DISC	a) <u>CASTINGS</u> 1. SUB-SURFACE DEFECTS	CR	VISUAL RT / UT	100%	MSS-SP-55 ANSI B-16.34/ TECH. SPEC.	MSS-SP-55 ANSI B-16.34/ TECH. SPEC.		2	2	1	RT ON BW END & CHANGE OF SECTION FOR 1. ALL VALVES CR & LX TIGS 2. ALL VALVES 3. SIZE UPTO 300 NB & ABOVE. RATING 800 & 900 4. SIZE 300NB & ABOVE. RATING UPTO 300 5. ALL SIZES & RATING 1500 6. SIZE UPTO 250 N3 & RATING 2500 & ABOVE RT & MEND ONLY FOR 1. SIZE UPTO 250 NB & ABOVE AND RATING UPTO 300 2. ON ALL AREAS 3. 300NB & ABOVE AND RATING 2500 & ABOVE RT FILM REVIEW BY BHEL
2.0	IN PROCESS											
2.1	SS/STELLITE DEPOSIT ON BODY SEAT RING, DISC/SEAT	1. SURFACE DEFECTS 2. HARDNESS	CR	1. PT/MPI 2. UT	100%	ASTME-165/ ASTME 709 ANSI B16.34/ TECH. SPEC. -DO-	ASTME 165/ ASTME 709 ANSI B16.34/ TECH. SPEC. -DO--	TC INSPN REPORT -DO-	2	2	1	1. MPI FOR ALL SIZES & RATING FOR CCS/CAS VALVES 2. PT FOR SS VALVES 3. ALL SS VALVES 4. ALL AREAS RATING 800 & ABOVE FOR CS & AS VALVES 5. ALL VALVES OF CRH & EX TAGS CS & AS VALVES 6. ALL AREAS RATING 1500 & ABOVE 7. ALL VALVES OF CRH & EX TAGS

BIDDER/VENDOR		BIDDER/VENDOR	
PARTICULARS		BIDDER/VENDOR	
NAME		NAME	
SIGNATURE		SIGNATURE	
DATE		DATE	
BHEL		BHEL	
BIDDER'S/ VENDOR'S COMPANY SEAL		BIDDER'S/ VENDOR'S COMPANY SEAL	

QUALITY PLAN		CUSTOMER: LATER		PROJECT: LATER		SPEC. NO. P-35-2-30-01	
SHEET 2 OF 2		BIDDER/VENDOR: SIDERVENDOR		REV 02 DT. 26.04.2007		SPEC. TITLE	
CHARACTERISTICS CHECKED		SYSTEM: POWER CYCLE		ITEM: CS/AS/SS NON RETURN VALVES		SECTION	
S.N.O. COMPONENT/OPERATION		CATE. GORY		REFERENCE DOCUMENT		AGENCY	
		TYPE/METHOD OF CHECK		ACCEPTANCE NORMS		P W Y	
		EXTENT OF CHECK		FORMAT OF RECORD		VC	
						REMARKS	

S.N.O.	COMPONENT/OPERATION	CHARACTERISTICS CHECKED	CATE. GORY	MEASUREMENT	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORMS	FORMAT OF RECORD	AGENCY	REMARKS	
2.2	MACHINING OF ALL COMPONENTS INCLUDING 8W ENDS	1. DIMENSIONS 2. SURFACE & SUB-SURFACE DEFECTS 3. SUB SURFACE DEFECTS (HINGE PIN, BODY & DISC SEAT RINGS)	MA CR CR	1. PT 2. MPI (ACCESSIBLE AREA OF BODY & BONNET) UT	100% 100% 100%	ASTME-165 ANSI B16.34 AND TECH. SPEC./	MFG. DRG. NO DEFECTS ANSI B16.34 AND TECH. SPEC./	LOG BOOK INSPN. REPORT TEST CERT	3/2 3/2 3/2	1 1 1	1. F/ATHK IS EQUAL OR GREATER THAN 1.0 MM 2. IF BODY/SSC SEATS ARE TO BE EQUAL OR GREATER THAN 25 MM 3. FOR CRH & TAGS IRRESPECTIVE OF DIA/TKY
2.3	DISC AND BODY SEAT RING ASSEMBLY	1. LAPPING	CR	BLUE MATCHING	100%	UNIFORM METAL TO METAL CONTACT		TEST CERT	3/2	2.1	
3.0	TESTING	1. DIMENSIONS	MA	1. MEASUREMENT	100%	APPD. DRG. / TECH. SPEC.	APPD. DRG. / TECH. SPEC.	INSPN. REPORT	3/2	2	
4.0	TESTING	1. LEAK TIGHTNESS	CR	HYDRAULIC TEST	100%	APPD. DRG. / TECH. SPEC.	NO LEAKAGE	TEST CERT	3/2	2.1	REFER NOTE*
4.1	TESTING	1. LEAK TIGHTNESS	CR	HYDRAULIC TEST	100%	APPD. DRG. / TECH. SPEC.	-DO-	-DO-	3/2	2.1	REFER NOTE*
4.2	TESTING	1. LEAK TIGHTNESS	CR	HYDRAULIC TEST 1. AT SPECIFIED PRESSURE 2. AT 25% OF SEAT TEST PRESSURE	100%	TECH. SPEC.	TECH. SPEC.	INSPN. REPORT	3/2	2.1	
4.3	COMPLETE VALVE	PERFORMANCE	CR	OPERATION OF FLAP MEASUREMENT/ VISUAL	100%	TECH. SPEC.	TECH. SPEC.	INSPN. REPORT	3/2	2.1	
5.0	END CONNECTION DETAILS	1. DIMENSIONS, VALVE TAG NOS	MA	MEASUREMENT/ VISUAL	100%	APPD. DRG. / RELEVANT STANDARD TECH. SPEC.	APPD. DRG. / RELEVANT STANDARD TECH. SPEC.	INSPN. REPORT	3/2	2.1	
6.0	PAINTING	1. QUALITY AND THICKNESS OF PAINT	MA	VISUAL AND MEASUREMENT	100%	TECH. SPEC.	TECH. SPEC.	T.C	3/2	2	For CS/MS bod) valve only.
7.0	PACKING	1. AS PER BHEL TECH. SPEC.	MA	VISUAL	100%	-DO-	-DO-	T.C.	3/2	2.1	

ABBREVIATIONS
 CR = CRITICAL CHARACTERISTIC P = PERFORMED BY
 MA = MAJOR CHARACTERISTIC W = WITNESSED BY
 PT = PENETRANT TEST, UT = ULTRASONIC TEST, RT = RADIOGRAPHIC TEST MPI = MAGNETIC PARTICAL INSPECTION.
 NOTE: A) MATERIAL TEST CERTIFICATES (IBR CERTIFICATES IN FORM III-C) WITH PROPER IDENTIFICATION AND CO-RELATION SHALL BE FURNISHED FOR BODY & BONNET FOR VALVES UNDER PERVIEW OF IBR.
 B) FOR OTHERS PARTS MATERIAL TEST CERTIFICATES SHALL BE FURNISHED.
 C) HYDRAULIC AND AIR TEST CERTIFICATES SHALL BE FURNISHED. FOR VALVES COMING UNDER IBR, TEST CERTIFICATES IN IBR FORM III-C SHALL BE FURNISHED.

BHEL		PARTICULARS		BIDDER/VENDOR	
		NAME			
		SIGNATURE			
		DATE		Page 79 of 211	
				BIDDER'S/ VENDOR'S COMPANY SEAL	

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

**ANNEXURE-IV
(SUB-VENDORS LIST)**



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



10.1 General

1. The Package Contractor is responsible for performance/guarantee of the complete package including bought out items and out sourced processes.
2. The proposed list of sub vendors furnished by the bidders have been reviewed during Techno commercial / pre-award discussions by NLC/Consultant and categorized as below
 - a) **Category – I: Sub vendors accepted.** Based on past experience of NLC/Consultant.
 - b) **Category – II: Sub vendors enlisted for future acceptance.** Such acceptance shall be based on the various details regarding capacity, capability, experience etc of the sub-vendor proposed by the Contractor. It is the responsibility of Contractor to get the details of the sub vendors under category II, compiled and submitted to NLC/consultant for scrutiny and acceptance. The acceptance criteria are mentioned below. However, NLC reserves its right to accept or reject any of the proposed vendors based on information available with them
3. Intentionally Deleted
4. NLC may consider the Contractor's proposal for inclusion of new sub vendors, if any, during post award stage for approval, based on the merits, in the overall interest of the Package, after establishing that the sub vendors proposed meets the acceptance criteria specified.
5. Subsequent to approval of main sub vendor for main system, after verifying the acceptance criteria, the main sub vendor shall be allowed to choose his sub vendor for the sub system provided they meet the technical stipulations as per the contract requirements.
6. For all other components/equipments/systems which are not figuring in the following list or in the additional list furnished by the Contractor, Contractor's standard practice of selection of vendors may be carried out.
7. Acceptance criteria for sub vendors:
 - a) For all Mechanical , Electrical, and Control & Instrumentation (Except for items mentioned under b), c) and f) below)

For Class I Items:

Contractor to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor or their associate/collaborator and the same has been operating satisfactorily for two years. The documentary evidence shall be in the form of Performance certificates furnished by the end user.

For Class II Items:

Contractor to furnish documentary evidence to show that similar or higher capacity component/equipment / system has been supplied by the vendor or their associate/collaborator. The documentary evidence shall be in the form of Material Receipt Certificate, Site Inspection





Report, etc from the end user for having received the material by the end user.

The component/equipment / system covered under Class I and Class II are furnished below for Mechanical, Electrical, Control and Instrumentation

- b) For SG Integral control System
 - i. In case the Contractor is the Manufacturer of control system
 - a. The offered control system must have been successfully supplied, erected, tested and commissioned for at least one unit of capacity 210 MW or above. Further, these units should have been in successful operation for a minimum period of two (2) years. The system offered should be same as has been rendered to the unit running successfully as mentioned above with proven performance and/ or improved version of the same.
 - b. Contractor shall furnish all required information to fully satisfy Purchaser / Consultant regarding successful operation and high reliability of products / systems furnished.
 - ii. In case the Contractor is not a Manufacturer of control system, he shall associate with a Vendor who shall satisfy the Clause (i) above.
- c) For Programmable Logic Controller (PLC) / Control System
 - i. In case the Contractor is the Manufacturer of PLC:
 - a. The offered PLC must have been successfully supplied, erected, tested and commissioned for one such system in power plants and which should have been in satisfactory operation for not less than two years.
 - b. Contractor shall furnish all required information to fully satisfy Purchaser / Consultant regarding successful operation and high reliability of products / systems furnished.
 - ii. In case the Contractor is not a Manufacturer of PLC, he shall associate with a Vendor who shall satisfy the above Clause (i)
- d) For all civil items except structural steel
 - i. It should confirm to relevant Indian/international Standards.
 - ii. It should be of reputed makes supplied to similar construction/infrastructure projects.
 - iii. The Contractor should furnish documentary evidence to prove (i) and (ii) above.
- e) For reinforcement steel:
 - i. The quality shall confirm to Indian Standard/International Standards.





- ii. The Firm should have been in the market for a minimum period of 3 years as on the original date of Tender opening.
 - iii. The Contractor should furnish documentary evidence to prove (i) and (ii) above
- f) For Welding Electrodes:
- i. The welding electrodes should be confirming to AWS and related BIS.
 - ii. The Firm should have executed orders for the supply of electrodes for an order value not less than Rs. 3 lakhs in a calendar year for any or all sizes of the subject electrode within last three(3) years as on the original scheduled date of tender opening.
 - iii. The Contractor should furnish documentary evidence to prove ii above.
8. Acceptance Criteria For Sub Contractors
- a) For Mechanical and Electrical works:
- Contractor to furnish documentary evidence to prove that similar mechanical / electrical erection and installation work had been carried out by the Sub Contractor
- b) For Control and Instrumentation items:
- In case the C&I vendor is engaging a sub contractor for C&I works Documentation proof shall be furnished in the form of contract award copy and performance certificate (End user's certificate) to show that similar C&I erection & installation activities were carried out and the job completed satisfactorily by the C&I sub contractor.
- c) For Civil items:
- The main Contractor may engage one or more sub Contractors for carrying out civil works. However, the civil sub-contractor shall have the following qualifying requirements.
- 1. He shall have experience in carrying out civil engineering works for Industrial buildings/ equipment foundations/ high-rise buildings (3 storied and more) etc.,
 - 2. He should have executed not less than 5000 Cu.M of R.C.C work in a single agreement.
 - 3. The work in S.No 1 & 2 should have been completed within the past 7 years, as on the original scheduled date of tender opening.
 - 4. Contractor to furnish necessary documentary evidence to prove the above requirements and get approval from the Purchaser, prior to engaging them for civil works.
9. List of items/ components for which Contractors shall submit the sub vendor list are indicated below. Purchaser/Consultant shall categorise those vendors in Category-I & II and shall inform to all the Contractors before price cover opening



SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		13. THYSSENKRUPP ELEVATORS, INDIA	
17	Fuel oil pumps (LDO & HFO)	1. ALEKTON ENGINEERING INDUSTRIES PVT. LIMITED 2. M/S. TUSHACO PUMPS PVT LIMITED, MUMBAI 3. UT PUMPS AND SYSTEMS PVT LTD, 4. DEL, INDIA 5. ROTO PUMPS, INDIA	1. AIR AUTO, INDIA 2. LOTUS POWER GEAR
18	Centrifugal pumps	1. KIRLOSKAR BROTHERS LTD,INDIA 2. FLOWMORE LTD.,INDIA 3. SULZER PUMPS INDIA LTD,INDIA 4. KSB PUMPS LTD.,INDIA 5. BEACONWEIR, INDIA 6. MATHER & PLATT PUMPS, INDIA 7. VOLTAS LTD 8. WPIL 9. JYOTI LTD 10. AQUA	1. TAP ENGINEERING,INDIA 2. KIRLOSKAR EBARA PUMPS LTD,INDIA 3. FLOWSERVE INDIA CONTROLS PVT.LTD.,INDIA 4. ITT PUMPS
19	Oil burners	1. ALSTOM 2. ANSALDO CALDAIE, ITALY. 3. ANSALDO CALADAIE BOILERS INDIA PVT LTD.	1. SOFINTER MACCHI, ITALY 2. OHNUT 3. ET BRNO 4. PBS
20	Auxiliary boiler	1. ISGEC JOHN THOMPSON LTD. NOIDA 2. THERMAX BABCOX WILCOX LTD., PUNE 3. THYSSEN KRUPP	1. CETHAR VESSELS INDIA (CVI) 2. BRESSON 3. PBS 4. THERMODYNE TECHNOLOGIES PVT LTD.,
21	Plate type heat exchanger	1. ALFA LAVAL (INDIA) LTD. 2. GEA ECOFLEX INDIA PVT LTD 3. IDMC LIMITED 4. TRANTER INDIA PRIVATE LIMITED 5. LARSEN & TOUBRO, INDIA 6. GEA ENERGY SYSTEM (INDIA) LTD., CHENNAI 7. MATHER & PLATT INDIA LTD., CHENNAI	1. MARUN TECH, INDIA 2. DOVER INDIA
22	Positive displacement pumps	1. TUSHACO PUMPS, INDIA 2. ROTO, INDIA 3. FLOWMORE	1. AIR AUTO, INDIA 2. DEL, INDIA 3. WPIL 4. SUZLER 5. KBL 6. MATHER & PLATT
23	Regenerative Air Pre heaters	1. BHEL	1. ALSTOM AIR PREHEATER 2. L&T HOWDEN PRIVATE LIMITED 3. SHANGHAI HEAVY MACHINERY PLANT CO.LTD

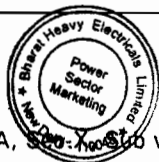


SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
			4. DONGFANG BOILER GROUP CO., LTD 5. SHANGHAI ELECTRIC POWER GENERATION GROUP 6. THERMAX 7. SHANGHAI BOILER WORKS LTD 8. BALKE-DURR 9. AC (MANUFACTURED IN INDIA)
24	DMCW pumps	1. KSB, INDIA 2. BEACON WEIR, INDIA 3. KIRLOSKAR, INDIA 4. SULZER, INDIA 5. FLOWMORE PVT. LTD. 6. VOLTAS LTD 7. WPIL 8. JYOTI LTD. 9. MATHER & PLATT PUMPS, INDIA	
25	Scanner air fans	1. C-DOCTOR, INDIA 2. PATELS AIR FLOW LTD	1. INDUSTRIAL FANS, INDIA 2. AIR CONTROL & CHEMICAL ENGG. CO. LTD. 3. ANDREW YULE 4. FLAKTWOODS 5. BLUE STAR 6. AIR CONTROL & CHEMICAL ENGG CO LTD 7. AERO CHEMICAL ENGG CO LTD 8. TCF NORDI INDUSTRIAL FANS PVT LTD
26	Vibration isolation system for ID fans, FD fans, mills	1. GERB VIBRATION CONTROL SYSTEM, INDIA 2. GERB, GERMANY	1. FPM SA (GROUP RAFAKO)

Class II Items

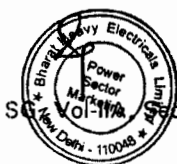
SI.No	Equipment/ Instrument	Category 1 Vendor	Category 2 Vendor
1.	L.P valves	1. KSB PUMPS LTD. 2. BHEL 3. B.D.K.ENGINEERING INDUSTRIES LTD. 4. FOURESS ENGG. (I) LTD. 5. LEADER VALVES 6. FLUIDLINE VALVES CO. PVT. LIMITED, MUMBAI 7. L&T AUDCO 8. CRESCENT VALVES MFG. CO. (P) LTD.	1. WEIR VALVES AND CONTROLS M.E. 2. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE 3. VALTECH INDUSTRIES. NSSL LTD. 4. OSWAL INDUSTRIES LTD. 5. ADVANCE VALVES PVT. LTD. 6. STAFFORD CONTROLS LTD.

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SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		9. A.V. VALVES LTD. 10. VENUS PUMPS & ENGG. WORKS 11. MICON VALVES INDIA PVT. LTD. 12. NITON IND. LTD. 13. PETROL VALVES S.R.L., ITALY 14. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI 15. BABCOCK BORSIG ESPANA, SA 16. SURYA VALVES AND INST. MFG. CO., CHENNAI 17. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL 18. INTERVALVE INDIA LTD. 19. KIRLOSKAR BROTHERS LTD., 20. G.M.DALUI & SONS 21. H.SARKER & CO 22. SANT VALVES PVT. LTD. 23. INSTRUMENTATION LTD.	PUNE 7. BONAFI – GERMANY 8. BOSCH REXROTH 9. CCI-SWITZERLAND 10.XOMOX SANMAR LTD., (PACIFIC VALVES) 11.R&D MULTIPLES (METAL CAST) PVT LTD., 12. BONETTI WAAREE INDIA (P) LTD, 13.NSSL LTD
2.	Welding electrodes	1. ESAB INDIA 2. ADVANI OERLIKON, INDIA 3. D&H (INDIA) PVT. LTD. 4. D&H (S) PVT. LTD	1. HYUNDAI ELECTRODES, INDIA 2. PADMA BALAJI, INDIA 3. L&T
3.	EOT (Single girder Cranes)	1. AVON CRANES PVT. LTD. 2. ANUPAM INDUSTRIES LTD. 3. ARMSEL MHE PVT. LTD 4. REVA INDUSTRIES LTD. 5. TUOBRO FURGUSON (INDIA) PVT LTD 6. WMI KONECRANES INDIA LTD. 7. UNIQUE INDUSTRIAL HANDLERS PVT LTD 8. CONSOLIDATED HOIST PVT LTD 9. FURNACE & FOUNDRY EQUIPMENTS CO. 10. EDDY CRANES 11. MUKUND LTD. 12. WMI CRANE LTD., 13. BUC MECHANICAL EQUIPMENTS PVT. LTD. 14. LIFTING EQUIPMENTS AND ACCESSORIES 15. W.H.BRADY & CO. LTD.	1. HEAVY ENGG. CORPORATION LTD. 2. ALPHA SERVICES 3. CENTURY CRANE ENGINEERS PVT. LTD. 4. ALEKTON ENGG.INDUSTRIES P.LTD. 5. TUSHACO PUMPS PVT.LTD. 6. LEAP LIFTING MACHINES PVT.LTD 7. U.T.PUMPS & SYSTEMS PVT. LTD. 8. TECHNO INDUSTRIES 9. UNIVERSAL HOIST-O-FABRIK 10. MEEKA MACHINERY, INDIA 11. SOUTHERN STRUCTURAL 12. TUNGABHADRA STEEL PRODUCTS 13. ELITE STEELS PVT. LTD., FARIDABAD 14. LIFTING MACHINERIES INDIA PVT. LTD KANPUR 15. SUPREME INDUSTRIES LTD.,



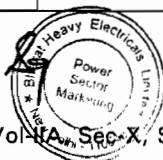


SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
			16. S CRANE ENGG WORKS 17. CENTURY HOISTS
4.	Fuel oil heaters Pressurised oil system	1. BHEL TRICHY/ GOINDWAL 2. KE BURGMANN FLEXIBLES INDIA (P) LTD,, INDIA 3. KELD ELLETOFT, INDIA 4. EAGLE BERGMANN	1. URJA PRODUCTS, INDIA 2. MACHMANN 3. IGP 4. LBH EXPANSION JOINTS INDIA (P) LTD., INDIA 5. INSAPLEX, INDIA 6. MIRANDA 7. MIRANDA EQUIPMENTS PVT. LTD
5.	HP valves	1. KSB, INDIA 2. L&T AUDCO, INDIA 3. BDK ENGG., INDIA 4. BHEL/TRICHY/GOINDWAL 5. SEMPELL VALVES, PUNE	1.XOMOX SANMAR 2.SAMSHIN, KOREA 3.WEIR VALVES 4.OKANO 5.ARMATURKA KRAVAFE 6.LDM 7.MODFANSKA PORTRUBNI 8.BOPP & REUTHER 9.SICHERHEITS-UND REGELARMATUREN GMBH 10.XOMOX SANMAR LTD (PACIFIC VALVES) 11.VELAN VALVES, CANADA 12.B.F.E. SPA, ITALY
6.	Metallic expansion. joint	1. FLEXATHERM EXPANLLOW PVT LTD BARODA 2. FLEXICAN BELLOWS & HOSES (P) LTD BARODA 3. FLUIDYNE ENGINEERS INDIA PVT. LTD. CHENNAI 4. LONE STAR INDUSTRIES CHENNAI 5. MB METALLIC BELLOWS PVT. LTD CHENNAI 6. EXPANSION JOINTS – USA 7. METALLIC BELLOWS, INDIA 8. EAGLE BERGMANN	1. SENIOR FLEXONICS 2. INSAPLEX, INDIA 3. LBH EXPANSION JOINTS INDIA (P). LTD., INDIA 4. MB METALLIC BELLOWS PVT. LTD 5. RRD DECORS PVT. LTD 6. SUR INDUSTRIES PVT. LTD
7.	Non-metallic expansion joint	1. KE BURGMANN FLEXIBLES INDIA (P) LTD,, INDIA 2. KELD ELLETOFT, INDIA 3. EAGLE BERGMANN	1. BACHMANN INDUSTRIES INDIA LTD, NEW DELHI. 2. ELASTOMERIC ENGINEERS, SALEM. 3. URJA PRODUCTS, INDIA 4. MACHMANN 5. IGP 6. LBH EXPANSION JOINTS INDIA (P) LTD., INDIA 7. INSAPLEX, INDIA 8. MIRANDA 9. MIRANDA EQUIPMENTS PVT.





SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
			LTD
8.	Refractory	1. BHASKAR REFRACTORIES&SW PIPES P LTD FARIDABAD 2. CALDERYS INDIA REFRACTORIES LTD. CHENNAI 3. DALMIA REFRACTORIES DALMIAPURAM 4. SOUVENIOR CERAMICS FARIDABAD 5. TATA REFRACTORIES 6. OCL INDIA	1. ABS REFRACTORIES PVT.LTD. KATNI 2. CASTWEL INDUSTRIES NAGPUR. 3. INDUSTRIAL ASSOCIATES KOLKATA 4. MAHAKOSHAL REFRACTORIES PVT. LTD KATNI 5. SHARADAA CERAMICS PVT.LTD CHENNAI 6. VISHVA VISHAL ENGINEERING LTD. CHATTISHGARH 7. VISHWAKARMA REFRACTORIS PRIVATE BANGALORE 8. KESORAM REFRACTORIES, INDIA 9. ORISSA INDUSTRIES 10. NATIONAL REFRACTORIES, INDIA 11. SHRI NATARAJ CERAMICS AND CHEM., INDIA 12. THE ACE REFRACTORIES LTD., 13. TIRUPATI REFRATORIES
9.	Rubber expansion joints	1. CORI ENGINEERING, CHENNAI 2. D WREN LTD., KOLKATA 3. KELD ELLENTOFT INDIA PVT LTD, CHENNAI. 4. EAGLE BURGMAN KE PVT LTD, CHENNAI.	1. SRM EXOFLEX PVT LTD., INDIA 2. ELASTOMERIC ENGINEERS, SALEM 3. URJA PRODUCTS PVT LTD, AHMADABAD 4. BACHMANN INDUSTRIES INDIA LTD, NEW DELHI.
10.	Steam coil air preheater	1. C-DOCTOR, INDIA 2. PATEL AIR TEMP, INDIA 3. GB ENGINEERING, INDIA	1. BARODA EQUIPMENT, VADODARA. 2. PAR ENERGY, HYDRABAD. 3. GEA-INDIA 4. THERMOTECH INDUSTRIES 5. ENMAX ENGINEERING 6. L. V. HEAT EXCHANGERS 7. SIMON COIL & HEAT EXCHANGER
11.	Thermal insulation	1. ROCKWOOL INDUSTRIES,INDIA 2. PUNJSTAR INSULATION FIBRE,INDIA 3. LAPINUS ROCKWOOL P. LTD,INDIA	1. POLYBOND INSULATION PVT.LTD.,INDIA 2. LLOYDS ROCKFIBRES LTD., 3. THE ACE REFRACTORIES LTD.,



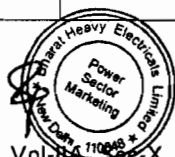


SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		4. MINWOOL ROCK FIBRES LTD,INDIA 5. GOENKA ROCKWOOL (INDIA) PVT.LTD. INDIA 6. THERMOCARE ROCKWOOL (I) PVT.LTD INDIA 7. LLOYDS INSULATION (INDIA) LTD., 8. BASKAR REFRACTORIES & S W PIPES (P) LTD., 9. DALMIA REFRACTORIES	4. JAMSHEDPUR MINERAL WOOL MFG.CO., JAMSHEDPUR 5. HYDERABAD INDUSTRIES LTD., INDIA
12.	Butterfly valves	1. INTER VALVE (INDIA) LTD. INDIA. 2. TYCO VALVES & CONTROLS INDIA P.LTD, INDIA 3. LARSEN & TOUBRO LTD (CTRL & AUTOMN), INDIA 4. INSTRUMENTATION LTD, INDIA. 5. FOURSSES ENGINEERING (I) LTD. INDIA. 6. KSB PUMPS LTD. 7. BHEL 8. B.D.K.ENGINEERING INDUSTRIES LTD. 9. LEADER VALVES 10. KIRLOSKAR BROTHERS LTD., 11. ADVANCE VALVES PVT LTD., 12. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI 13. L&T AUDCO 14. CRESCENT VALVES MFG. CO. (P) LTD. 15. A.V. VALVES LTD. 16. VENUS PUMPS & ENGG. WORKS 17. MICON VALVES INDIA PVT. LTD. 18. NITON IND. LTD. 19. PETROL VALVES S.R.L., ITALY 20. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI 21. BABCOCK BORSIG ESPANA, SA 22. SURYA VALVES AND INST. MFG. CO., CHENNAI 23. INTERVALVE INDIA LTD. 24. SANT VALVES PVT LTD., 25. H SARKER & CO., 26. G.M.DALUI & SONS 27. INSTRUMENTATION LTD	1. WEIR BDK VALVES-A UNIT OF WEIR. INDIA 2. WEIR VALVES AND CONTROLS M.E. 3. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE 4. VALTECH INDUSTRIES., MUMBAI 5. NSSL LTD 6. OSWAL INDUSTRIES LTD. 7. STAFFORD CONTROLS LTD. PUNE 8. R & D MULTIPLES (METAL CAST) PVT. LTD. 9. CRANE PROCESS, INDIA 10. ALFA LAVAL, INDIA 11. MICROFINISH VALVES, INDIA 12. DEMBLA VALVES, INDIA 13. EAGLE PONNAWALLIA, INDIA 14. GLOBE 15. VAAS INDUSTRIES 16. TULIP VALVES 17. V TORK CONTROLS 18. HAWA ENGINEERS LTD 19. AQUA VALVES 20. BDK PROCESS CONTROLS PVT.LTD.



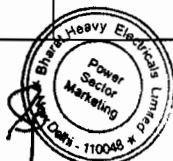


SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
13.	Air release valves	<ol style="list-style-type: none"> 1. KSB PUMPS LTD. 2. BHEL 3. B.D.K.ENGINEERING INDUSTRIES LTD. 4. FOURESS ENGG. (I) LTD. 5. LEADER VALVES 6. KIRLOSKAR BROTHERS LTD., 7. ADVANCE VALVES PVT LTD., 8. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI 9. L&T AUDCO 10. CRESCENT VALVES MFG. CO. (P) LTD. 11. A.V. VALVES LTD. 12. VENUS PUMPS & ENGG. WORKS 13. MICON VALVES INDIA PVT. LTD. 14. NITON IND. LTD. 15. PETROL VALVES S.R.L., ITALY 16. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI 17. BABCOCK BORSIG ESPANA, SA 18. SURYA VALVES AND INST. MFG. CO., CHENNAI 19. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL 20. INTERVALVE INDIA LTD. 21. SANT VALVES PVT LTD., 22. H SARKER & CO., 23. G.M.DALUI & SONS 24. INSTRUMENTATION LTD. 	<ol style="list-style-type: none"> 1. WEIR VALVES AND CONTROLS M.E. 2. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE 3. VALTECH INDUSTRIES., MUMBAI 4. NSSL LTD 5. OSWAL INDUSTRIES LTD. 6. STAFFORD CONTROLS LTD. PUNE 7. R & D MULTIPLES (METAL CAST) PVT. LTD. 8. CRANE PROCESS, INDIA 9. ALFA LAVAL, INDIA 10. MICROFINISH VALVES, INDIA 11. DEMBLA VALVES, INDIA 12. EAGLE PONNAWALLIA, INDIA 13. GLOBE 14. VAAS INDUSTRIES 15. TULIP VALVES 16. V TORK CONTROLS 17. HAWA ENGINEERS LTD 18. AQUA VALVES
14.	Ball valves	<ol style="list-style-type: none"> 1. AKAY INDUSTRIES PVT.LTD 2. KSB PUMPS LTD. 3. LEADER VALVES LTD. 4. MICROFINISH VALVES PVT LTD. 5. DEMBLA VALVES LTD. 6. BHEL 7. B.D.K.ENGINEERING INDUSTRIES LTD. 8. FOURESS ENGG. (I) LTD. 9. KIRLOSKAR BROTHERS LTD., 10. ADVANCE VALVES PVT LTD., 11. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI 12. L&T AUDCO 13. CRESCENT VALVES MFG. CO. (P) LTD. 14. A.V. VALVES LTD. 15. VENUS PUMPS & ENGG. 	<ol style="list-style-type: none"> 1. A.V. VALVES LTD 2. BELGAUM AQUA VALVES PVT. LTD. 3. ASIAN INDUSTRIAL VALVES & INSTRUMENTS. 4. ATAM VALVES PVT. LTD. 5. BOTELI VALVE GROUP CO. LTD. 6. FLUIDLINE VALVES COMPANY PVT.LTD. 7. M/S GM ENGINEERING 8. SAKHI ENGINEERS PVT.LTD 9. VALTECH INDUSTRIES 10. VAAS AUTOMATION PVT. LTD. 11. WEIR BDK VALVES- A UNIT OF WEIR 12. MICON ENGINEERS (HUBLI)





SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		<p>WORKS</p> <p>16. MICON VALVES INDIA PVT. LTD.</p> <p>17. NITON IND. LTD.</p> <p>18. PETROL VALVES S.R.L., ITALY</p> <p>19. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI</p> <p>20. BABCOCK BORSIG ESPANA, SA</p> <p>21. SURYA VALVES AND INST. MFG. CO., CHENNAI</p> <p>22. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL</p> <p>23. INTERVALVE INDIA LTD.</p> <p>24. SANT VALVES PVT LTD.,</p> <p>25. H SARKER & CO.,</p> <p>26. G.M.DALUI & SONS</p> <p>27. INSTRUMENTATION LTD.</p>	<p>PVT.LTD.,,India</p> <p>13. UNIFLOW,,India</p> <p>14. VOLTECH MANUFACTURING COMPANY LTD.,,India</p> <p>15. ZED VALVES CO.PVT.LTD.,,India</p>
15.	Flash tanks	<p>1. ANSALDO CALDAIE</p> <p>2. TECHNO FAB, INDIA</p> <p>3. UNITECH MACHINES, INDIA</p> <p>4. THERMO PAD, INDIA</p>	<p>1. BEND JOINTS PVT LIMITED,India</p> <p>2. MAS STEEL FABRICATORS,India</p> <p>3. S&G ENGINEERS PRIVATE LIMITED,India</p> <p>4. SAKTHI HI-TECH CONTSTRN. (P) LTD,India</p> <p>5. SEAM INDUSTRIES LIMITED,India</p> <p>6. SOUTHERN HEAVY ENGINEERING PVT. LTD,India</p> <p>7. TRIOMECH ENGINEERING PVT. LTD, India</p> <p>8. UNITECH MACHINES LIMITED,India</p> <p>9. Vijay Tanks and Vessels, India</p>
16.	G.M. gate/globe/ NRV	<p>1. KSB PUMPS LTD.</p> <p>2. BHEL</p> <p>3. B.D.K.ENGINEERING INDUSTRIES LTD.</p> <p>4. FOURESS ENGG. (I) LTD.</p> <p>5. LEADER VALVES</p> <p>6. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI</p> <p>7. L&T AUDCO</p> <p>8. CRESCENT VALVES MFG. CO. (P) LTD.</p> <p>9. A.V. VALVES LTD.</p> <p>10. VENUS PUMPS & ENGG. WORKS</p> <p>11. MICON VALVES INDIA PVT.</p>	<p>1. WEIR VALVES AND CONTROLS M.E.</p> <p>2. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE</p> <p>3. VALTECH INDUSTRIES., MUMBAI</p> <p>4. NSSL LTD.</p> <p>5. OSWAL INDUSTRIES LTD.</p> <p>6. ADVANCE VALVES PVT. LTD.</p> <p>7. STAFFORD CONTROLS LTD. PUNE</p> <p>8. R& D MULTIPLES (METAL CAST) PVT. LTD.</p> <p>9. GLOBE</p>



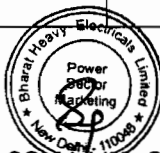


SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		LTD. 12. NITON IND. LTD. 13. PETROL VALVES S.R.L., ITALY 14. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI 15. BABCOCK BORSIG ESPANA, SA 16. SURYA VALVES AND INST. MFG. CO., CHENNAI 17. KIRLOSKAR BROTHERS LTD. 18. SANT VALVES PVT. LTD 19. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL 20. INTERVALVE INDIA LTD 21. G.M.DALUI & SONS 22. H.SARKER & CO. 23. INSTRUMENTATION LTD	10. HAWA ENGINEERS LTD
17.	Gate valve (steel)	1. FLUID CONTROLS PRIVATE LTD. MUMBAI 2. POWER PIPING CO. CHENNAI 3. KSB PUMPS LTD. 4. BHEL 5. B.D.K.ENGINEERING INDUSTRIES LTD. 6. FOURESS ENGG. (I) LTD. 7. LEADER VALVES 8. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI 9. L&T AUDCO 10. CRESCENT VALVES MFG. CO. (P) LTD. 11. A.V. VALVES LTD. 12. VENUS PUMPS & ENGG. WORKS 13. MICON VALVES INDIA PVT. LTD. 14. NITON IND. LTD. 15. PETROL VALVES S.R.L., ITALY 16. STEELSTRONG VALVES (INDIA) PVT. LTD., MUMBAI 17. BABCOCK BORSIG ESPANA, SA 18. SURYA VALVES AND INST. MFG. CO., CHENNAI 19. KIRLOSKAR BROTHERS LTD. 20. SANT VALVES PVT. LTD 21. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL 22. INTERVALVE INDIA LTD	1. ARYA CRAFTS & ENGINEERING PVT.LTD. VADODARA DT. 2. COMFIT & VALVES PVT LTD. DIST. MEHSANA 3. FLOWEZY HYDRAULICS PRIVATE LTD. MUMBAI FLOWTECH, KOLKATA 4. FLOWTECH KOLKATA 5. H.P.VALVES & FITTINGS CHENNAI 6. HONEST ENGINEERING WORKS MUMBAI 7. METPRESS ENGINEERING WORKS KOLKATTA 8. MULTIMETAL INDUSTRIES BARODA 9. PRECISION ENGINEERING INDUSTRIES MUMBAI 10. VALTEX INDIA MUMBAI 11. WEIR VALVES AND CONTROLS M.E. 12. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE 13. VALTECH INDUSTRIES., MUMBAI 14. NSSL LTD. 15. OSWAL INDUSTRIES LTD 16. ADVANCE VALVES PVT. LTD. 17. STAFFORD CONTROLS LTD. PUNE





SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		23. G.M.DALUI & SONS 24. H.SARKER & CO. 25. INSTRUMENTATION LTD	18. R & D MULTIPLES (METAL CAST) PVT. LTD. 19. GLOBE 20. HAWA ENGINEERS LTD
18.	Globe valve (steel)	1. FLUID CONTROLS PRIVATE LTD.MUMBAI 2. POWER PIPING CO. CHENNAI 3. KSB PUMPS LTD. 4. BHEL 5. B.D.K.ENGINEERING INDUSTRIES LTD. 6. FOURESS ENGG. (I) LTD. 7. LEADER VALVES 8. FLUIDLINE VALVES CO. PVT. LIMITED , MUMBAI 9. L&T AUDCO 10. CRESCENT VALVES MFG. CO. (P) LTD. 11. A.V. VALVES LTD. 12. VENUS PUMPS & ENGG. WORKS 13. MICON VALVES INDIA PVT. LTD. 14. NITON IND. LTD. 15. PETROL VALVES S.R.L., ITALY 16. STEELSTRONG VALVES (INDIA) PVT.LTD., MUMBAI 17. BABCOCK BORSIG ESPANA, SA 18. SURYA VALVES AND INST. MFG. CO., CHENNAI 19. KIRLOSKAR BROTHERS LTD. 20. SANT VALVES PVT. LTD 21. TYCO VALVES AND CONTROLS INDIA PVT. LTD., HALOL 22. INTERVALVE INDIA LTD 23. G.M.DALUI & SONS 24. H.SARKER & CO. 25. INSTRUMENTATION LTD	1. ARYA CRAFTS & ENGINEERING PVT.LTD. VADODARA DT. 2. COMFIT & VALVES PVT LTD. DIST. MEHSANA 3. FLOWEZY HYDRAULICS PRIVATE LTD. MUMBAI 4. FLOWTECH KOLKATA 5. H.P.VALVES & FITTINGS CHENNAI 6. HONEST ENGINEERING WORKS MUMBAI 7. METPRESS ENGINEERING WORKS KOLKATTA 8. MULTIMETAL INDUSTRIES BARODA 9. PRECISION ENGINEERING INDUSTRIES MUMBAI 10. VALTEX INDIA MUMBAI 11. WEIR VALVES AND CONTROLS M.E. 12. FEDERAL HARDWARE ENGG. CO PTE LTD., SINGAPORE 13. VALTECH INDUSTRIES., MUMBAI 14. NSSL LTD. 15. OSWAL INDUSTRIES LTD. 16. ADVANCE VALVES PVT. LTD. 17. STAFFORD CONTROLS LTD. PUNE 18. R & D MULTIPLES (METAL CAST) PVT. LTD. 19. GLOBE HAWA ENGINEERS LTD
19.	Low pressure piping	1. UNITECH MACHINES LIMITED,India	1. BEND JOINTS PVT LIMITED,India 2. DEE DEVELOPMENT ENGINEERS LTD.,,India 3. FLASH FORGE PVT LTD.,,India 4. IMECO LIMITED,,India 5. LARSEN & TOUBRO LTD, India 6. POWER PIPING CO.,,India 7. S&G ENGINEERS PRIVATE





SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
			LIMITED, India 8. SAKTHI HI-TECH CONTSTRN (P) LTD, India 9. SEAM INDUSTRIES LIMITED, India 10. TRIOMECH ENGINEERING PVT.LTD, India
20.	Misc. Tanks	1. TECHNO FAB, INDIA 2. THERMO PAD, INDIA 3. VIJAY TANKS AND VESSELS, INDIA 4. UNITECH MACHINES, INDIA	1. BEND JOINTS PVT LIMITED,INDIA 2. MAS STEEL FABRICATORS,INDIA 3. S&G ENGINEERS PRIVATE LIMITED,INDIA 4. SAKTHI HI-TECH CONTSTRN. (P) LTD,INDIA 5. SEAM INDUSTRIES LIMITED,INDIA 6. SOUTHERN HEAVY ENGINEERING PVT. LTD,INDIA
21.	Non return (steel) valves	1. LEADER 2. BDK 3. KSB 4. FOURESS	
22.	Submersible pumps	1. M/S. KILOSKAR BROTHERS LIMITED, MUMBAI (KBL) 2. WPIL 3. SULZER 4. FLOWMORE 5. M/S. MATHER & PLATT LIMITED, PUNE.	
23.	Sump pumps	1. KBL 2. KSB 3. SU MOTORS 4. KISHORE PUMPS	
24.	Dual plate check valves	1. AV VALVES 2. LEADER 3. BDK 4. KSB 5. FOURESS LTD BANGALORE	

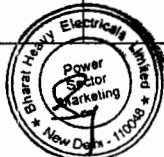




SL.NO	EQUIPMENT/ INSTRUMENT	CATEGORY-I	CATEGORY-II
		12. REVA ENGINEERING 13. ARMSEL PVT LTD 14. VIDYUT 15. FAFECO 16. TRANSPADE ENGG PVT LTD 17. ELMECH 18. HERCULES HOISTS LTD 19. WMI	
28.	Structural steel - raw material	1. JSPL 2. ESSAR STEEL 3. VIZAG STEEL	1. NIPPON STEEL 2. MAHAMAYA 3. HYUNDAI STEEL 4. ARCELOR MITTAL 5. DILLINGER 6. KORES, TAIWAN

10.3 List of Sub Vendors - Electrical

SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
CLASS I Items			
1.	415 V SWITCHGEAR (PCC/PMCC/ MCC)	1) ALSTOM LTD. 2) ASEA BROWN BOVERI LTD 3) C & S ELECTRIC LTD 4) CONTROLS & SCHEMATICS 5) L&T 6) SCHNEIDER ELECTRIC INDIA PVT. LTD. 7) SIEMENS LTD	1) ADVANCE / ADLEC 2) BHEL-EPD 3) GE INDIA INDUSTRIAL PVT. LTD. 4) INDUSTRIAL SWITCHGEAR & CONTROLS LTD. 5) POWER LOGIC 6) SPACEAGE SWITCH GEAR LTD., 7) UNILEC 8) VENUS
2.	415 V BUSDUCT	1) ABB 2) BHEL-EPD 3) BEST & CROMPTON 4) CONTROL & SWITCHGEAR 5) REEP 6) SIEMENS 7) SPACEAGE 8) STARDRIVE	1) ADVANCE / ADLEC 2) KLK 3) POWER GEAR 4) UNILEC
3.	CONTROL PANELS	1) ABB 2) BHEL 3) CHEMIN CONTROLS AND INSTRUMENTATION / PONDICHERY. 4) CONTROL & SCHEMATIC/HYDRABAD	1) AMBIT 2) COMPUTER CONTROL CORPORATION 3) INDUSTRIAL CONTROL AND APPLIANCE /MUMBAI 4) ICA MUMBAI 5) JACKSON ENGINEERS 6) KEAS CONTROL SYSTEM INDIA





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		5) REYROLLE 6) SIEMENS	(COIMBATORE). 7) LOTUS POWER GEAR 8) POPULAR SWITCH GEARS 9) POSITRONICS 10) PRAMMEN INDUSTRIES 11) SAJAS ELECTRICAL/TRICHY 12) SHIBSHA INSTRUMENT INDIA PVT LTD / CHENNAI 13) TRYSQURE SWITCHGEGEAR 14) TYCON AUTOMATION
4.	MLDB/ PDB/ ACDB/ DCDB	1) ABB 2) C & S ELECTRIC LTD, 3) CONTROL & SCHEMATICS 4) L&T 5) PYRO TECH 6) SIEMENS 7) SPACEAGE 8) UNILEC 9) VENUS	1) ADLEC 2) ADVANCE 3) BHEL-EPD 4) DB POWER ELECTRONICS 5) EMERSON NETWORK
5.	AC CONTROL CONTACTORS	1) ABB INDIA 2) BCH 3) C & S ELECTRIC 4) CGL 5) GE POWER CONTROLS 6) L&T 7) SCHNEIDER. 8) SIEMENS 9) TELEMECHANIQUE 10) JYOTHI LTD	1) GE-POWER 2) SPACEAGE
6.	AC POWER CONTACTORS	1) ABB 2) BCH 3) CGL 4) L&T 5) SCHNEIDER ELECTRIC INDIA PVT. LTD. 6) SIEMENS 7) TELEMECHANIQUE 8) C & S ELECTRIC	1) GE-POWER 2) JYOTHI LTD 3) SPACEAGE 4) GE POWER CONTROLS
7.	CT	1) ABB 2) AE 3) AREVA 4) C & S ELECTRIC	1) ECS BARODA 2) IMP 3) PACTIL 4) PARAS POWER ENGG.





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		5) CGL 6) INDCOIL 7) INSTARNS ENGINEERING CO 8) INTRA VIDYUT 9) KALPA ELECTRICAL 10) KAPPA ELECTRICALS 11) PRAGATI ELECTRICALS 12) PRAYOG 13) PRECISE 14) SIEMENS 15) SILKAANS	5) SOUTHERN ELECTRICS
8.	PT	1) AE 2) INDCOIL 3) INSTARNS ENGINEERING CO 4) INTRA VIDYUT 5) KALPA ELECTRICAL 6) KAPPA ELECTRICALS 7) PRAGATI ELECTRICALS 8) PRAYOG ELECTRICAL 9) PRECISE ELECTRICALS 10) SIEMENS 11) SILKAANS	1) IMP 2) PACTIL 3) PARAS POWER ENGG. 4) SOUTHERN ELECTRICS
9.	VCB	1) ABB 2) AREVA 3) BHEL, BHOPAL 4) CGL 5) SCHNEIDER 6) SIEMENS	1) GE POWER CONTROLS 2) L&T
10.	ACB	1) ABB 2) C & S ELECTRIC 3) L&T 4) SCHNEIDER. 5) SIEMENS	1) GE POWER CONTROLS 2) GE-POWER 3) SPACEAGE-HUNDAI
11.	LT TRANSFORMER (DRY TYPE)	1) ABB 2) BHEL, 3) CGL, 4) EMCO 5) INDOTECH 6) INTRA VIDHYUT 7) KEC 8) KRILOSKAR	1) MEGAWIN 2) RPG RAICHEM





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		9) VIJAY ELECTRICLS 10) VOLTAMP	
12.	LT TRANSFORMER (OIL FILLED)	1) ABB 2) ALSTOM 3) ANDREWYULE 4) AREVA 5) BHARATH BIJLEE 6) BHEL 7) CROMPTON GREAVES 8) EMCO 9) INDOTECH TRANSFORMERS 10) INTRAVIDYUT 11) KEC 12) KRILOSKAR 13) TRANSFORMER & RECTIFIERS 14) VIJAY ELECTRICAL 15) VOLTAMP	1) TR 2) UNIVERSAL TRANSFORMERS 3) EASUN
13.	CONTROL TRANSFORMER S	1) ABB 2) AUTOMATIC ELECTRIC 3) BCH 4) GYRO 5) INDCOIL 6) INTRAVIDYUT 7) KAPPA ELECTRICALS 8) PRECISE ELECTRICALS 9) KALPA 10) SIEMENS 11) SILKAANS	1) LOGICSTAT 2) TRANSPower INDUSTRIES 3) TRIO 4) SOUTHERN ELECTRICS
14.	H.T. MOTORS	1) ABB 2) BHEL 3) CGL 4) KIRLOSKAR 5) SIEMENS 6) MARATHON (Alstom)	1) HHI 2) MARSHALL 3) SHMP 4) WEG 5) XIANGIAN ELECTRIC MANUFACTURING CO. LTD. 6) HYOSUNG CORP (South korea)
15.	L.T. MOTORS (AC & DC)	1) ABB 2) BHARAT BIJLEE LIMITED 3) BHEL 4) CROMPTON GREAVES LIMITED 5) JYOTHI	1) BHEL Electrical machines Kasaragod Kerala 2) BPL 3) HEM INDUSTRIES MUMBAI 4) LAXMI HYDRAULICS PVT.LTD. SHOLAPUR



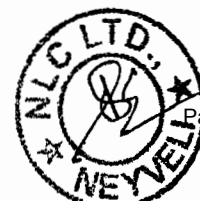


SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		6) KIRLOSKAR ELECTRIC CO.LTD 7) MARATHON ELECTRIC MOTORS 8) SIEMENS	5) PRECISION WORKS,MUMBAI ENGINEERING
16.	VARIABLE SPEED DRIVES	1) ABB 2) BHEL 3) EUROTHERM 4) HITACHI, JAPAN 5) SCHNEIDER 6) SIEMENS 7) HIREL HITACHI	1) DEL 2) DONFOSS 3) L&T 4) TOSHIBA MITSUBISHI-ELECTRINDUSTRIAL SYSTEM CORPORATION 5) AMTECH
17.	PROTECTION RELAYS	1) ABB 2) ALSTOM 3) AREVA 4) GE 5) L&T 6) REYROLE 7) SCHNEIDER 8) SIEMENS	1) C & S ELECTRIC 2) EASUN 3) GE-POWER 4) JYOTI 5) OEN
18.	AUX RELAYS	1) ABB 2) ALSTOM 3) BCH 4) JYOTHI LTD 5) L&T 6) SCHNEIDER 7) SIEMENS 8) GE	1) GE POWER CONTROLS 2) GEC
19.	BIMETAL RELAYS	1) ABB 2) ALSTOM 3) BCH 4) C & S ELECTRIC 5) GE-POWER CONTROLS 6) L&T 7) SCHNEIDER 8) SIEMENS 9) GE	1) GE POWER 2) SPACEAGE 3) SUNIL & CO 4) TELEMECHANIQUE
20.	MCCB	1) ABB 2) CROMPTON GREAVES 3) L&T 4) MDS LEGRAND 5) SCHNEIDER 6) SIEMENS	1) UNILEC 2) SPACEAGE 3) GE POWER 4) C & S ELECTRIC 5) GE POWER CONTROLS



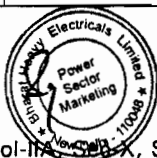


SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		7) GE	
21.	MCB	1) ABB 2) ALSTOM 3) CGL 4) GE 5) GEC 6) HAVELLS 7) L&T 8) MDS 9) SCHNEIDER 10) SIEMENS INDIA 11) SIEMENS, AG 12) STANDARD 13) TELEMCHANIQUE	1) CONTROL & SWITCHGEAER 2) GE POWER CONTROLS 3) MDS LOAD CONTACT 4) NGEF
22.	ELCBS	1) ABB 2) GE 3) L&T 4) MDS LEGRAND 5) SCHNEIDER 6) MERLIN GERIN 7) SIEMENS	1) CONTROL & SWITCHGEAR 2) CUTLER HAMMER 3) GE POWER CONTROLS 4) AVAIDS TECHNOVATORS PVT LTD 5) MLKA ENGINEERS 6) BAJAJ ELECTRICALS LTD 7) CROMPTON GREAVES LIMITED 8) PHILIPS ELECTRONICS INDIA LTD
23.	SWITCH FUSE UNITS	1) ABB 2) ALSTOM 3) CGL 4) GE 5) HAVELLS 6) INDO ASIAN 7) L&T 8) SCHNEIDER ELECIC INDIA PVT. LTD., 9) SIEMENS 10) STANDARD ELECTRICALS	1) BCH 2) GE-POWER 3) SPACEAGE 4) C & S ELECTRIC
24.	AC/DC POWER CONTACTORS	1) ABB INDIA 2) C & S ELECTRIC 3) L&T 4) SCHNEIDER. 5) SIEMENS 6) TELEMCHANIQUE	1) GE-POWER 2) JYOTHI LTD 3) SPACEAGE 4) BCH 5) GE POWER CONTROLS
25.	AC/DC CONTROL CONTACTORS	1) ABB 2) BCH 3) C & S ELECTRIC 4) CGL	1) GE POWER CONTROLS 2) GE-POWER 3) SPACEAGE





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		5) JYOTHI LTD 6) L&T 7) SCHNEIDER 8) SIEMENS 9) TELEMCHANIQUE	
26.	H.T. POWER CABLES (XLPE)	1) CABLE CORPORATION OF INDIA LTD. 2) CENTRAL CABLES LTD. 3) FORT GLOSTER INDUSTRIES LTD., 4) HINDUSTAN VIDYUT PRODUCT LTD. 5) INCAB 6) KRISHNA ELECTRICAL INDUSTRIES LTD. 7) NICCO 8) POLYCAB 9) RPG 10) TORRENT CABLES LTD., 11) UNIVERSAL CABLE LTD 12) KEI	1) CORDS 2) DIAMOND POWER INFRASTRUCTURE LTD 3) HAVELLS 4) KEC INTERNATIONAL LIMITED 5) PARAMOUNT COMMUNICATIONS LTD. 6) RADIANT 7) RAVIN CABLES LIMITED 8) SRIRAM CABLES PVT. LTD. 9) UNIFLEX CABLES LIMITED 10) KEI INDUSTRIES LTD.
27.	LT POWER CABLES (XLPE)	1) CABLE CORPORATION OF INDIA LTD., 2) CENTRAL CABLES LTD 3) CORDS CABLE 4) DELTON CABLES, 5) GEMSCAB INDUSTRIES LTD 6) HAVELLS 7) HINDUSTAN VIDHUT PRODUCTS LT., 8) INCAB 9) INDUSTRIAL CABLES (INDIA) LTD 10) KEI 11) KRISHNA ELECTRICAL INDUSTRIES LTD., 12) NICCO CORPORATIONS 13) PARAMOUNT CABLES 14) POLYCAB 15) SUYOG ELECTRICALS LTD 16) RADIANT CABLES PVT. LTD	1) ASSOCIATED CABLES PVT. LTD. 2) BICC CABLES LIMITED, UK 3) BRIMSON CABLES PVT.LTD.,DELHI 4) DIAMOND POWER INFRASTRUCTURE LTD 5) ECKO CABLES PVT. TD 6) ELKAY TELELINKS LIMITED,FARIDABAD 7) GOVIND CABLE INDUSTRIES,KOLKATA 8) KEC INTERNATIONAL LIMITED 9) LEONI KERPEN GMBH,GERMANY 10) MANSFIELD CABLE COMPANY LTD.,NOIDA 11) PARAGON CBALES INDIA 12) RPG RAYCHEM 13) SARK CABLES PVT.LTD.,PALAKKAD 14) SCOT INNOVATION WIRES AND CABLES PVT. LTD. 15) SERVEL UDYOG (P) LTD.,FARIDABAD 16) SPECIAL CABLES PVT. LTD. 17) SRIRAM CABLES PVT LTD 18) TECHNO CABLES





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		17) RAVIN CABLES LTD 18) RELIANCE ENGINEERS LTD., 19) RPG CABLES 20) TORRENT CABLES LTD. 21) UNIVERSAL CABLES LTD	19) THERMO ELECTRIC INTERNATIONAL 20) THERMOCABLES LIMITED, HYDERABAD 21) UNIFLEX CABLES LIMITED, VALSAD
28.	L.T. CONTROL CABLES	1) BRIMSON CABLES PVT.LTD., DELHI 2) CABLE CORPORATION OF INDIA LTD. 3) CMI LTD 4) CORDS CABLE INDUSTRIES LTD. 5) CRYSTAL CABLE 6) DELTON CABLES LIMITED, NEW DELHI 7) FORT GLOSTER INDUSTRIES LTD. 8) GEMSCAB INDUSTRIES LTD. 9) GOYOLENE FIBERS (INIDA) PVT. LTD. 10) HAVELLS INDIA LTD. 11) HINDUSTHAN VIDYUT PRODUCTS LTD. 12) INCAB 13) INDUSTRIAL CABLES(INDIA) LTD 14) KEI INDUSTRIES LTD. 15) KRISHNA ELECTRICAL INDUSTRIES LTD. 16) NICCO COPORATATION LTD 17) PARAMOUNT CABLES 18) POLYCAB 19) RADIANT CABLES PRIVATE LIMITED 20) RAVIN CABLES LIMITED 21) RELIANCE ENGINEERS LTD. 22) RPG CABLES LTD. 23) SUYOG CABLE 24) TORRENT CABLES LTD. 25) UNIVERSAL CABLE	1) ADVANCE CABLE TECHNOLOGIES (P) LTD. 2) ASSOCIATED CABLES PVT LTD, MUMBAI 3) BICC CABLES LIMITED, UK 4) DIAMOND POWER INFRASTRUCTURE LTD 5) ELKAY TELELINKS LIMITED, FARIDABAD 6) GOVIND CABLE INDUSTRIES, KOLKATA 7) KEC INTERNATIONAL LIMITED 8) LEONI KERPEN GMBH, GERMANY 9) MANSFIELD CABLE COMPANY LTD., NOIDA 10) RPG RAYCHEM 11) SARK CABLES PVT.LTD., PALAKKAD 12) SCOT INNOVATION WIRES AND CABLES PVT. LTD. 13) SERVEL UDYOG (P) LTD., FARIDABAD 14) SPECIAL CABLES PVT. LTD. 15) SUYOG ELECTRICALS LTD 16) THERMO CABLES LTD. 17) THERMO ELECTRIC INTERNATIONAL 18) THERMOCABLES LIMITED, HYDERABAD 19) UNIFLEX CABLES LIMITED, VALSAD





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
29.	CABLE TERMINATION & JOINTING KITS	1) CABLE CORPORATION OF INDIA 2) RPG 3) YAMUNA POWER & INFRA STRUCTURE LTD. 4) RAYCHEM RPG PRIVATE LTD 5) 3M ELECTRO AND COMMUNICATION INDIA P LTD	1) KEI 2) SUNIL & COMPANY PVT. LTD. 3) HARI CONSOLIDATED PVT LTD NEW DELHI
30.	CABLE LUGS	1) 3M ELETRO AND COMMUNICATION 2) COMET 3) DOWELLS 4) ELECTROMAG INDUSTRIES 5) JAINSON	1) CHETNA ENGINEERING CO. NASHIK 2) DIVYAJOTHY LUGS PVT LTD BANGALORE 3) ELECTROTECH 4) HEX 5) KRISHNA COMMERCIAL CORPORTION, CHENNAI 6) LOTUS 7) RAYCHEM 8) RPG 9) UNIVERSAL MACHINES
31.	ELECTRICAL ACTUATORS	1) ANTRIEB 2) AUMA (INDIA) 3) LIMITORQUE INDIA 4) ROTORK CONTROLS LIMITED UK. 5) ROTORK CONTROLS LTD. (INDIA)	1) ANTRIELS TECNICK 2) INSTRUMENTATION LTD. KERELA 3) KELTRON CONTROLS AROOR 4) R.G.S.ELECTRO-PNEUMATICS LTD.UK 5) ROTEX MANUFACTURERS & MUMBAI 6) WEIR BDK VALVES-A UNIT OF WEIR HUBLI
32.	KWHR METERS	1) AUTOMATIC ELECTRIC 2) ENERCON 3) L&T 4) RISHABH 5) SECURE	1) ANTRIELS TECNICK 2) BHEL (EDN) 3) CONZERV 4) IMP 5) M.B CONTROLS 6) MECO 7) METERS & INSTRUMENTS 8) SIMCO 9) TTL 10) UNIVERSAL
33.	TRANSDUCER	1) ABB 2) AE 3) ELSTER METERING 4) MECO 5) PYROTECH 6) RISHAB	1) ADEPT, PUNE



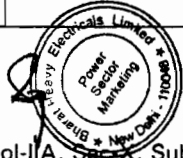


SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		7) SOUTHERN TRANSDUCER,	
34.	TERMINAL BLOCKS	1) CONNETWELL 2) ELMEX 3) PHOENIX 4) WAGO	1) ELEMEX 2) ESSEN DEINKI 3) TECHNIC 4) TECHNOPLAST 5) TELEMECHNIQUE
35.	CONTROL SWITCHES / SELECTOR SWITCHES	1) ALSTOM 2) KAYCEE 3) L&T 4) SALZER 5) SWITRON 6) VAISHNO	1) GE-POWER 2) KRAUS & NAIMER 3) RELIABLE ELECTRONIC
36.	LIGHTING FIXTURES	1) BAJAJ 2) CGL 3) CROMPTON 4) PHILIPS 5) WIPRO	1) SURYA 2) CONTROL & SWITCH GEAR 3) AVAIDS TECHNOVATORS PVT LTD 4) MLKA ENGINEERS
37.	LIGHTING FIXTURES (FLAME PROOF)	1) BAJAJ 2) CGL 3) PHILIPS 4) WIPRO 5) BALIGA	1) CONTROL & SWITCH GEAR 2) FEPL 3) SURYA 4) FEPL 5) AVAIDS TECHNOVATORS PVT LTD 6) MLKA ENGINEERS
38.	VVVF DRIVE	1) ABB 2) ABL 3) ALSTOM PROJECT PVT. LTD. 4) BHEL 5) HITACHI 6) KIRLOSKAR ELECTRIC CO LTD 7) L&T 8) NELCO 9) ROCKWELL AUTOMATION 10) SCHNEIDER 11) SIEMENS	1) TOSHIBA
CLASS II Items			
1.	CABLE TRAYS	1) APT ENGINEERING WORKS, NEW DELHI 2) INAR PROFILES PVT.LTD 3) INDIANA 4) INDUSTRIAL	1) AMTECH 2) AM-TECH ENGINEERING SERVICES,PUNE 3) ASSOCIATED POWER STRUCTURES PVT. LTD





SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		PERFORATIONS (INDIA) PVT. LTD 5) JAMNA METAL COMPANY 6) PATNY SYSTEMS (P) LTD 7) PRAMMEN INDUSTRIES 8) PREMIER POWER PRODUCTS (CALCUTTA) PVT LTD 9) RATAN ENGG CO. PVT. LTD 10) STEELMITE ENGINEERING, PONDICHERY	4) BALIGA LIGHTING EQUIPMENTS PVT. CHENNAI 5) CAUVERY ENGG/PUDUKOTTAI 6) GLOBE ELECTRIC INDUSTRIES 7) INDIA ELECTRICALS SYNDICATE, KOLKATA 8) INDUSTRIAL CORPORATION 9) KANADE ANAND UDYOG PVT. LTD.,MUMBAI 10) M META PRINTINDUSTRIES/CHENNAI 11) PARMER METALS/RAJKOT 12) POWER LOGIC 13) PREMIER POWER PRODUCTS 14) RABI ENGG WORKS 15) RABI ENGINEERING WORKS PVT. LTD. 16) RUKMANI ELECTRICAL & COMPONENTS PVT LTD 17) STEELITE ENGG. LTD. MUMBAI 18) UNITECH FABRICATORS and ENGINEERS PVT LTD 19) VATCO 20) VINFAB ENGINEERS,THANE
2.	CABLE GLANDS	1) BRACO 2) CABLE CORPORATION OF INDIA 3) CENTRAL HARDWARE 4) CHW 5) COMET 6) COSMOS 7) DOWELLS 8) ELECTROMAC INDUSTRIES 9) ELECTROMAT 10) FLAME PROOF CONTROL GEARS 11) GLAND-MECH INDUSTRIES KOLKATA. 12) HEX 13) JIMSON 14) MAHAVEER ENGG 15) SUNIL & CO.	1) ALLIED TRADERS 2) ARUP ENGG. & FOUNDRY WORKS 3) BALIGA LIGHTING EQPT. 4) ELEXPRO ELECTRICALS 5) INCAB 6) PROMPT ENGG WORKS MUMBAI 7) SARATHI TRADING CO. TRICHY 8) SCG EX D TECH PVT. LTD. CHENNAI 9) STANDARD METAL INDUSTRIES
3.	LOCAL PUSH BUTTON STATION	1) BCH 2) BHEL-EPD 3) L&T 4) RAM E&I	1) BRACO 2) GE POWER CONTROL 3) HAVELLS

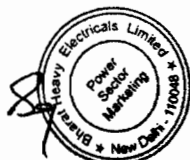




SL. NO	EQUIPMENT/ SYSTEM	CATEGORY-I	CATEGORY-II
		5) SIEMENS 6) TEKNIC 7) BALIGA	
4.	SWITCH SOCKET OUTLETS / POWER RECEPTACLES	1) ALSTOM 2) ANCHOR 3) B&C 4) BCH 5) CGL 6) CROMPTON 7) ESSEN 8) MDS LEGARD	1) CRAB TREE 2) MK 3) NORTH WEST 4) AVAIDS TECHNOVATORS PVT LTD 5) MLKA ENGINEERS 6) BAJAJ ELECTRICALS LTD 7) PHILIPS ELECTRONICS INDIA LTD 8) ELLORA
5.	CEILING FAN	1) BAJAJ 2) CROMPTON GREAVES 3) GEC 4) KHAITAN 5) ORIENT 6) POLAR 7) USHA	1) PHILIPS ELECTRONICS INDIA LTD 2) AVAIDS TECHNOVATORS PVT LTD 3) MLKA ENGINEERS
6.	EXHAUST FAN	1) BAJAJ 2) CROMPTON 3) FLAKT WOOD (I) LTD. 4) GE 5) KHAITAN 6) ORIENT 7) POLAR	1) ABB LTD 2) AIR LINK ENGINEERS PVT LTD 3) BLUE STAR LTD 4) C.DOCTOR AND CO PVT LTD 5) DRAFT AIR (INDIA) PVT LTD 6) ROOTS COOLING SYSTEMS PVT LTD S K SYSTEMS PRIVATE LTD 7) STERLING AND WILSON LIMITED 8) VOLTAS LTD

10.4 List of Sub-Vendors – Control & Instrumentation

SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
A	Class- I Equipments		
1.	SG INTEGRAL CONTROL SYSTEM	SIEMENS ABB EMERSON RTP CONTROLS HONEYWELL INVENSYS	ROCKWELL YOKOGAWA BHEL- EDN HIMA
2.	ENGINEERING WORK STATION	HP DELL	RETTAL ABB SIEMENS BHEL- EDN





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
3.	PRINTERS	EPSON CANNON HP XEROX TVS (for dot-matrix only)	WIPRO TVS ABB SIEMENS LEXMARK IBM
4.	NETWORK SWITCH	D-LINK	SIEMENS JUPITER EXTREME
5.	PRESSURE TRANSMITTER	ABB E + H EMERSON PROCESS MANAGEMENT HONEYWELL YOKOGAWA SIEMENS FUJI EMERSON PROCESS ENDRESS + HAUSER	SMAR CHEMTROLS INDUSTRIES LTD, MUMBAI
6.	DP TRANSMITTER	ABB E + H EMERSON PROCESS MANAGEMENT HONEYWELL YOKOGAWA SIEMENS FUJI EMERSON PROCESS ENDRESS + HAUSER	CHEMTROLS INDUSTRIES LTD,
7.	TEMPERATURE TRANSMITTER	ABB E + H EMERSON PROCESS MANAGEMENT HONEYWELL YOKOGAWA SIEMENS EMERSON PROCESS ENDRESS + HAUSER	MCIH MOORE,USA





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
8.	THERMOCOUPLES	DETRIEV INSTRUMENTATION GENERAL INSTRUMENTS CONSORTIUM INDUSTRIAL INSTRUMENTS, KOLKATA PYROELECTRIC INSTRUMENTS GOA PVT. LTD TEMP SEN INSTRUMENTS (I) PVT. LTD. ALTOP TEMPESENS INSTRUMENTS (II) PVT. LTD. DETRIVE, MUMBAI PYRO ELEC INSTRUMENTS GOA P LTD TEMPESENS INSTRUMENTS (II) PVT LTD, UDAIPUR ALTOP INDUSTRIES LTD. INDIA	PYROELECTRONICS ABB SIEMENS TECHNO INSTRUMENTS KALOL EXOTHERM INSTRUMENTS MUMBAI
9.	RTD	DETRIEV INSTRUMENTATION GENERAL INSTRUMENTS CONSORTIUM INDUSTRIAL INSTRUMENTS, KOLKATA PYROELECTRIC INSTRUMENTS GOA PVT. LTD TEMP SEN INSTRUMENTS (I) PVT. LTD ALTOP DETRIV, MUMBAI PYRO ELEC INSTRUMENTS GOA P LTD TEMPESENS INSTRUMENTS (II) PVT LTD, UDAIPUR ALTOP INDUSTRIES LTD. INDIA	PYROELECTRONICS ABB SIEMENS INDUSTRIAL INSTRUMENTS, KOLKATA TECHNO INSTRUMENTS KALOL JINDAL ELECTRONICS PRIVATE LIMITED, - PROCESS CONTROLS (INDIA R.J.INDUSTRIAL CORPORATION GHANACON PRODUCTS, EXOTHERM INSTRUMENTS MUMBAI GOA INSTRUMENT INDUSTRIES PVT LTD., India
10.	METAL TEMPERATURE THERMOCOUPLES	DETRIEV INSTRUMENTATION GENERAL INSTRUMENTS CONSORTIUM INDUSTRIAL INSTRUMENTS, KOLKATA PYROELECTRIC INSTRUMENTS GOA PVT. LTD TEMP SEN INSTRUMENTS (I) PVT. LTD SIEMENS ALTOP ALTOP INDUSTRIES LTD. INDIA PYRO ELECTRIC CABLES AND GOA	PYROELECTRONICS ABB EXOTHERM INSTRUMENTS MUMBAI TECHNO INSTRUMENTS AHMEDABAD ROSSEL





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
11.	DISPLACER TYPE LEVEL TRANSMITTER	CHEMTROLS ENGG PVT LTD V-AUTOMATION DRESSER VALVES ECKARDT GERMANY DRESSER MASONIELAN, FRANCE. / DRESSER VALVES INDIA LTD, COIMBATORE CHEMTROLS, MUMBAI (ECKARDT, GERMANY) ECKARDT, GERMANY	LEVCON INSTRUMENTS PVT LTD PUNE TECHTROL PVT LTD SBEM ABB SIEMENS DK INSTRUMENTS MIL CONTROLS LIMITED, KERALA
12.	ULTRASONIC LEVEL TRANSMITTER	E&H EMERSON VEGA, GERMANY SIEMENS, CANADA ABB KROHNE EMERSON PROCESS ENDRESS + HAUSER, GERMANY/INDIA SIEMENS MILTRONICS, CANADA	TOSHBRO, INDIA
13.	RADAR TYPE LEVEL TRANSMITTER	EMERSON E&H SIEMENS, CANADA EMERSON PROCESS ENDRESS + HAUSER, GERMANY / INDIA HONEYWELL, USA / PUNE KROHNE, FRANCE K-TEK, USA MAGNETROL, BELGIUM VEGA, GERMANY	TOSHBRO, INDIA MAGNETROL LEVCON ABB
14.	RF TYPE LEVEL SWITCH	E&H LEVCON LEVCON INSTRUMENTS P LTD, KOLKATA	EMERSON, INDIA SIEMENS, CANADA TOSHBRO, INDIA MAGNETROL EPT CHEMTROL CHEMTROLS SAMIL, MUMBAI DK INSTRUMENTS, KOLKATA S.B.ELECTRO-MECHANICALS PVT LTD, PUNE SIGMA INSTRUMENTS COMPANY, MUMBAI
15.	CORIOLIS FLOW METER	ENDRESS + HAUSER, INDIA EMERSON PROCESS MANAGEMENT, INDIA YOKOGAWA	HEINRICHS MESSTECHNIK GMBH, GERMANY FORBES MARSHAL SIEMENS ABB





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
16.	ORIFICE PLATE	BALIGA LIGHTING EQUIPMENTS LTD, INDIA MICRO PRECISION PRODUCT PVT. LTD., INDIA STARMECH CONTROLS(II) PVT. LTD., INDIA INSTRUMENTATION LIMITED ENGINEERING SPECIALITIES PRIVATE LTD MICRO PRECISION PRODUCTS (P) LTD, FARIDABAD	ASIAN INDUSTRIAL VALVES AND INSTRUMENTS, CHENNAI GENERAL INSTRUMENTS CONSORTIUM, CHENNAI IA FLOW ELEMENTS PVT.LTD. CHENNAI JRU CONTTROL PVT. LTD. CHENNAI BOPP & REUTHER HEINRICHS MESSTECHNI, Germany MINCO (INDIA) PVT. LTD. India TECHNOMATIC, Italy
17.	FLOW NOZZLE	BALIGA LIGHTING EQUIPMENTS LTD, INDIA MICRO PRECISION PRODUCT PVT. LTD., INDIA STARMECH CONTROLS(II) PVT. LTD., INDIA INSTRUMENTATION LIMITED ENGINEERING SPECIALITIES PRIVATE LTD MICRO PRECISION PRODUCTS (P) LTD, INDIA	ASIAN INDUSTRIAL VALVES AND INSTRUM, INDIA.- BOPP & REUTHER HEINRICHS MESSTEHCNI GERMANY. MINCO (INDIA) PVT LTD, INDIA. TECHNOMATIC, INDIA. GENERAL INSTRUMENTS CONSORTIUM CHENNAI
18.	OXYGEN ANALYZER	ABB EMERSON PROCESS MANAGEMENT (I) PVT LTD. INDIA YOKOGAWA INDIA LTD, INDIA EMERSON ABB, UK (with M/s ABB, INDIA) EMERSON PROCESS MANAGEMENT YOKOGAWA	AMETEK, USA AIC ANALYSER INSTRUMENTS CO. PVT LTD (FUJI) SICK MAIHAK AMETEK P AND AI DIVISION, SINGAPORE /USA ICE, MUMBAI ENOTEC GMBH, GERMANY (with FORBES MARSHALL,PUNE supplying indogenous components) TELEDYNE, USA (with STEAM EQUIPMENTs supplying Indegenous components) MARATHON MONITORS,USA ANALYSER INSTRUMENT CO.PVT.LTD., KOTA FORBES MARSHALL PVT LTD , PUNE SECO, CHENNAI
19.	CARBON MONOXIDE ANALYZER	ABB-INDIA AMETEK, USA EMERSON PROCESS MANAGEMENT (I) PVT LTD. INDIA YOKOGAWA INDIA LTD, INDIA SICK MAIHAK FORBES MARSHALL CODEL INTERNATIONAL LTD,UK	AIC ANALYSER INSTRUMENTS CO. PVT LTD (FUJI) SIEMENS ANALYSER INSTRUMENT CO.PVT.LTD., KOTA CHEMTROLS INDUSTRIES LTD, MUMBAI ENVIRONNEMENT S.A.INDIA PVT.





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
		LAND INSTRUMENTS INTERNATIONAL, UK ABB LTD., BANGALORE EMERSON PROCESS MANAGEMENT (INDIA) HORIBA LTD. SICK GMBH, GERMANY	LTD, NAVI MUMBAI THERMO FISHER SCIENTIFIC INDIA, NAVI MUMBAI YOKOGAWA INDIA LIMITED, CHENNAI
20.	PNEUMATIC ACTUATOR	INSTRUMENTATION LIMITED, PALAKKAD INSTRUMENTATION LTD. KERELA	ASCO PNEUMATICS FESTO PNEUCON BELLS CONTROLS ROTEX KELTRON CONTROLS AROOR - ROTEX MANUFACTURERS & MUMBAI R.G.S.ELECTRO-PNEUMATICS LTD.UK
21.	THERMOCOUPLE CABLE	KEI INDUSTRIES LTD., INDIA POLYCAB WIRES PVT. LTD UNIVERSAL CABLES LTD., INDIA THERMO CABLES LTD., INDIA CORDS CABLES.,RAJASTHAN DELTON CABLES,FARIDABAD KEI INDUSTRIES LTD ,CHENNAI PARAMOUNT CABLES,ALWAR POLYCAB,DAMAN ASSOCIATED CABLES PVT LTD MUMBAI THERMO CABLES, HYDERABAD	PARAMOUNT DELTON ADVANCE CABLES TECHNOLOGIES, BANGALORE GOYOLENE FIBRES, MUMBAI INCAB, PUNE KERPEN CABLES,GERMANY TC COMMUNICATION, DELHI GUPTA POWER INFRASTRUCTURE, BHUBANESHWAR SUYOG ELECTRICALS, BARODA MANSFIELD CABLE , NOIDA BICC CABLES LIMITED.UK BRIMSON CABLES PVT.LTD.DELHI ELKAY TELELINKS LIMITED FARIDABAD GEMSCAB INDUSTRIES LTD.ALWAR GOVIND CABLE INDUSTRIES KOLKATA KEC INTERNATIONAL LIMITED CHENNAI LEONI KERPEN GMBH CHENNAI RADIANT- RSCC SPECIALTY CABLES PVT. HYDERABAD SARK CABLES PVT.LTD. PALAKKAD SERVEL UDYOG (P) LTD. FARIDABAD SCOT INNOVATION WIRES & CABLES NEW DELHI THERMO ELECTRIC





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
			INTERNATIONAL NETHERLANDS UNIFLEX CABLES LIMITED VALSAD
22.	INSTRUMENT SIGNAL CABLE	CORDS CABLES.,RAJASTHAN TCL KEI POLYCAB THERMO CABLES DELTON CORDS CABLES, RAJASTHAN DELTON CABLES, FARIDABAD INCAB, PUNE KEI INDUSTRIES LTD, CHENNAI PARAMOUNT CABLES, ALWAR POLYCAB, DAMAN THERMO CABLES, HYDERABAD	TC COMMUNICATION ADVANCE CABLES TECHNOLOGIES, BANGALORE GOYOLENE FIBRES ,MUMBAI KERPEN CABLES,GERMANY - TC COMMUNICATION. DELHI GUPTA POWER INFRASTRUCTURE, BHUBANESHWAR SUYOG ELECTRICALS, BARODA MANSFIELD CABLE , NOIDA ASSOCIATED CABLES PVT LTD MUMBAI BICC CABLES LIMITED.UK BRIMSON CABLES PVT.LTD.DELHI ELKAY TELELINKS LIMITED FARIDABAD GEMSCAB INDUSTRIES LTD.ALWAR GOVIND CABLE INDUSTRIES KOLKATA KEC INTERNATIONAL LIMITED CHENNAI LEONI KERPEN GMBH CHENNAI RADIANT- RSCC SPECIALTY CABLES PVT. HYDERABAD SARK CABLES PVT.LTD. PALAKKAD SERVEL UDYOG (P) LTD. FARIDABAD SCOT INNOVATION WIRES & CABLES NEW DELHI THERMO ELECTRIC INTERNATIONAAL NETHERLANDS UNIFLEX CABLES LIMITED VALSAD
23.	FIBER OPTIC CABLE	BIRLA ERICSON OPTICAL LIMITED VINDHYA TELELINKS	STERLITE TECHNOLOGIES LTD UM CABLES LTD INDIA BOSNET
24.	FURNACE FLAME VIEWING SYSTEM	DURAG DIAMOND POWER SWEDEN AB	TECHFAB HI TECH LUCENT MARCONI MIRION TECHNOLOGIES (IST) LTD.UK TLT ENGG.INDIA PVT.LTD





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
			KOLKATA TOSHNIWAL INDUSTRIES PVT.LTD.RAJASTHAN
25.	ELECTRONIC DRUM LEVEL INDICATOR	NARVIK-YARWAY B.V YARWAY CORPORATION	EMERSON FOSSIL
26.	FLAME SCANNER/ FLAME MONITORING SYSTEM	DURAG,GERMANY FIRE EYE,UK COEN BHARATH	ABB HONEYWELL INDIA CRESCENT CUMBUSTON SYSTEM FORNEY
27.	ACOUSTIC PYROMETER	SEI-GERMANY	BONNEN BERG & DRESCHER ENERTECHNIX US
B.	Class- II Equipments		
1.	JUNCTION BOX	BALIGA LIGHT INSTRUMENTS LTD, INDIA FCG FLAME PROOF CONTROLS, INDIA BALIGA LIGHTING, CHENNAI DEVI POLYMERS, CHENNAI. PYROTECH, UDAIPUR SAJAS ELECTRICALS, India	FLAME PROOF EQUIPMENT, INDIA ROBOTIC INSTRUMENT KS INSTRUMENTS KHODAY CONTROL SYSTEM FICOM ENGG. PVT. LTD, BANGALORE K.S. INSTRUMENTS, BANGALORE. MANISHA ENTERPRISES, PUNE SUCHITRA INDUSTRIES, BANGALORE. CHEMIN CONTROLS, PONIDCHERRY ELECTRO MECHANICAL (INDIA),KOLKATA BALAJI ELECTRO CONTROLS PVT.LTD. BANGALORE PRAMMEN, PUDDOKOTTAI VENKAT ELECTRONICS TRICHY VRL AUTOMATION ENGINEERING & PROJEC BANGALORE
2.	LIE/LIR	CHEMIN CONTROLS PYROTECH CHEMIN CONTROLS, PONIDCHERRY FORBES MARSHAL, PUNE INSTRUMENTATION LIMITED, KOTA PRAMMEN INDUSTRIES PYROTECH, UDAIPUR PYROTECH ELECTRONICS P.LTD	PRESIDENT ROBOT INSTRUMENTS INDIA CONTROLS & SWITCHGEARS ECIL ILK SAJAS ELECTRICALS SYSPRO AUTOMATION PROCON, CHENNAI





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
3.	TERMINAL BLOCK	PHOENIX WAGO ELMAX CONNECTWELL	TECHNOPLAST ESSEN DEINKI
4.	PANELS/CABINETS	RITTAL PYROTECH PYROTECH ELECTRONICS P.LTD	PRESIDENT DIGITAL SYSTEM TURBODINE ILK CHEMIN CONTROLS, PONDICHERRY CONTROLS & SCHEMATICS LIMITED, HYDERABAD DYNASPEDE INTEGRATED SYSTEMS, CHENNAI ELECTRO PORCELAIN DIVN., BANGALORE INDOCHEM INDUSTRIES, MUMBAI NARAIURAN CONTROLS, CHENNAI PRAMMEN INDUSTRIES, PUDUKOTTAI SAJAS ELECTRICALS, TRICHY SHIBSHA INSTRUMENTS (INDIA) P.LTD., CHENNAI
5.	INTERPOSING RELAYS	PARAMOUNT, INDIA OMRON PHOENIX, INDIA OEN H&B SCHNEIDER JYOTI ABB	
6.	ROTAMETERS	CHEMTROL EUREKA, PUNE FLUIDYNE INSTRUMENTS, MUMBAI IEPL, HYDERABAD PLACKA INSTRUMENTS INDIA PVT LTD, CHENNAI	ASHWIN ABB TRAC, HYDERABAD ASIAN INDUSTRIAL VALVES AND INSTRUM, India SCIENTIFIC DEVICES (BOMBAY) PVT L, INDIA TRANSDUCER & CONTROLS PVT LTD, India
7.	PROXIMITY SENSOR/SWITCH	P&F HONEYWELL INDI	ROTEX INDIA PVT LTD SWITZER JAI BALAJI
8.	SPEED SENSOR	P&F HONEYWELL INDIA BRAUN GERMANY	ROTEX INDIA PVT LTD VIBRO METER





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
9.	SPEED TRANSMITTER / SWITCH	P&F HONEYWELL INDIA	
10.	PRESSURE GAUGE/DRAFT GAUGE	GENERAL INSTRUMENTS CONSORTIUM IND. AN INSTRUMENTS PVT. LTD., INDIA WIKA INSTRUMENTS, INDIA WAREE H GURU A N INSTRUMENTS PVT LTD, KOLKOTTA, ASHCROFT INDIA (earlier PRECISION INDUSTRIES, AHMADABAD) FORBES MARSHALL LTD, HYDERABAD GENERAL INSTRUMENTS CONSORTIUM, GOA/MUMBAI GOA THERMOSTATIC INSTRUMENTS, GOA H.GURU INSTRUMENTS MANOMETER, MUMBAI WAAREE INDUSTRIES, MUMBAI WIKA, INDIA BUDENBERG GAUGE CO LTD.UK MANOMETER (INDIA) PVT.LTD., India WIKA INSTRUMENTS INDIA PVT.LTD, India	TRAFAG INDIA, INDIA ITT BOURDON PYROELECTRONICS GLUCK, MUMBAI ODIN, AHMADABAD / CHENNAI WALCHAND INDUSTRIES LTD., DHARWAD BAUMER TECHNOLOGIES INDIA PVT.LTD VAPI WIKA ALEXANDER WIEGAND GMBH & CO., Germany
11.	DP GAUGE	GENERAL INSTRUMENTS CONSORTIUM AN INSTRUMENTS PVT. LTD., INDIA WIKA INSTRUMENTS, INDIA WAREE H GURU A.N.INSTRUMENTS PVT. LIMITED KOLKATA H GURU INSTRUMENTS (SI) P.LTD. BANGALORE GENERAL INSTRUMENTS CONSORTIUM MUMBAI SWITZER INSTRUMENT LTD. CHENNAI WIKA INSTRUMENTS INDIA PVT.LTD PUNE	TRAFAG INDIA, INDIA ITT BOURDON





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
12.	TEMPERATURE GAUGE	<p>TRAFAG INDIA, INDIA GENERAL INSTRUMENTS CONSORTIUM IND. PYROELECTRIC INSTRUMENTS GOA PVT. LTD AN INSTRUMENTS PVT. LTD., INDIA WIKA INSTRUMENTS, INDIA WAREE H GURU A N INSTRUMENTS PVT LTD, KOLKOTTA, ASHCROFT INDIA FORBES MARSHALL, HYDERABAD GENERAL INSTRUMENTS CONSORTIUM, GOA/MUMBAI GOA THERMOSTATIC INSTRUMENTS, GOA H.GURU INSTRUMENS WAREE,DADRA WIKA, INDIA SWITZER INSTRUMENT LTD. CHENNAI PYRO ELECTRIC INSTRUMENTS GOA P LTD</p>	<p>BAUMER TECHNOLOGIES INDIA PVT.LTD, VAPI BUDENBERG GAUGE CO LTD.,UK GOA INSTRUMENT INDUSTRIES PVT LTD</p>
13.	PRESSURE SWITCH	<p>SWITZER INDIA PVT LTD GIC WIKA TRAFAG INDIA, INDIA INDFOSS ASHCROFT INDIA GIC MUMBAI INDFOS INDUSTRIES LTD, GAZIABAD SOR INC, USA SWITZER INSTRUMENT CO, CHENNAI TRAFAG-INDIA, RANIPET WAREE, VAPI SOR EUROPE LIMITED ENGLAND DAG PROCESS INSTRUMENTS GENERAL INSTRUMENTS CONSORTIUM SWITZER INSTRUMENT LTD VASU TECH LIMITED</p>	<p>WAREE UNITED ELECTRIC REGULATEURS GEORGIN FRANCE ALLEN BRADLEY BAUMER TECHNOLOGIES INDIA PVT.LTD, DELTA CONTROLS LIMITED, UK KDG INSTRUMENTS LTD., UK WIKA ALEXANDER WIEGAND GMBH & CO., Germany</p>
14.	DP SWITCH	<p>SWITZER INDIA PVT LTD TRAFAG INDIA, INDIA GENERAL INSTRUMENTS CONSORTIUM MUMBAI</p>	<p>GIC PYRO ELECTRIC UNITED ELECTRIC REGULATEURS GEORGIN FRANCE</p>





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
		SOR EUROPE LIMITED ENGLAND SWITZER INSTRUMENT LTD.,CHENNAI INDFOS INDUSTRIES LTD., CHENNAI SOR INC , USA	BAUMER TECHNOLOGIES INDIA PVT.LTD
15.	CONDUCTIVITY TYPE LEVEL SWITCH	LEVCON INSTRUMENTS PVT LTD PUNE TECHTROL PVT LTD CHEMTROLS ENGG PVT LTD LEVELSTATE SOLARTON LEVELSTATE, UK / HI-TECH, KOLKATA SOLARTON / MOBREY, UK / RAMAN INSTRUMENTS, MUMBAI YARWAY CORPORATION,USA	SIEMENS,CANADA/TOSHBRO,INDIA MOBREY LTD.,UK HI-TECH SYSTEM&SERVICES LTD, India
16.	CAPACITANCE TYPE LEVEL SWITCH	LEVCON INSTRUMENTS PVT LTD CHEMTROLS ENGG PVT LTD DK INSRTUMENTS, KOLKATA LEVCON INSTRUMENTS P LTD, KOLKATA S.B.ELECTRO-MECHANICALS PVT LTD, PUNE V.AUTOMAT&INSTRUMENTS PVT LTD,INDIA	PUNE TECHTROL PVT LTD SIEMENS
17.	FLOAT / DISPLACER TYPE LEVEL SWITCH	LEVCON INSTRUMENTS PVT LTD CHEMTROLS ENGG PVT LTD SBEM CHEMTROLS SAMIL, MUMBAI DK INSRTUMENTS, KOLKATA LEVCON INSTRUMENTS P LTD, KOLKATA S.B.ELECTRO-MECHANICALS PVT LTD, PUNE CHEMTROLS SAMIL (INDIA) P.LTD D.K.INSTRUMENTS PVT. LTD	PUNE TECHTROL PVT LTD SIGMA INSTRUMENTS COMPANY, MUMBAI ASIAN INDUSTRIAL VALVES AND INSTRUM GENERAL INSTRUMENTS CONSORTIUM TRANSDUCER & CONTROLS PVT LTD V.AUTOMAT & INSTRUMENTS P.LTD
18.	SMART POSITIONERS	SIEMENS ABB DRESSER INSTRUMENTATION LTD. KERELA	METSO AUTOMATION FISHER SAMSON ILP CCI KELTRON CONTROLS AROOR R.G.S.ELECTRO-PNEUMATICS LTD UK





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
19.	AIR FILTER REGULATOR	SHAVO NORGREN (I) PVT LTD., INDIA PLACKA JRU INSTRUMENTS, CHENNAI SHAVO NORGREN VELJAN HYDRAIR JRU INSTRUMENTS (formerly PLACKA), CHENNAI	FISHER,INDIA
20.	LIMIT SWITCH	HONEYWELL INDIA JAI BALAJI, CHENNAI BHARATIYA CUTLER AND HAMMER, FARIDABAD	OMRON,INDIA
21.	SOLENOID VALVES	ASCO ROTEX AUTOMATION INDIA AVCON CONTROLS, MUMBAI NORGREN,INDIA ASCO NUMATICS (INDIA) PRIVATE LTD. CHENNAI IMI NORGREN HERION PVT.LTD NOIDA ROTEX AUTOMATION LIMITED VADODRA U.V.INTERNATIONAL CHENNAI	VELJAN HYDRAIR, HYDERABAD JEFFERESON,UK ESCO COMP AIR SYSTEMS (REGD) MUMBAI NUCON INDUSTRIES PVT.LTD. HYDERABAD VKE VALVES INDUSTRIES P.LTD. MUMBAI
22.	FLOW SWITCH	SWITZER GENERAL INSTRUMENTS CONSORTIUM, GOA/MUMBAI KROHNE MARSHALL PUNE SWITZER INSTRUMENT CO, CHENNAI	

10.5 List of Sub-Vendors – Civil & Structural Supply Portion

a. Building Materials

SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
1.	FLUSH DOORS	Kutty flush doors & Furniture Co. Pvt. Ltd Shakti Met-Dor Ltd Greenply Industries Ltd., National Plywood Industries Pvt. Ltd. Kitply	Diamond Flush Doors Vidarbha Veneer Industries Wood Crafts- Pondicherry Western India Plywood Godavari Plywood Art Plywood P J Timbers & Ply (Niki Door).
2.	PLYWOOD PRODUCTS PARTICLE BOARDS	Novapan Particle Boards Kitply	IPM Bhutan Boards





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
		Nuwood Particle Boards Greenply Industries Limited Century Plyboards (I) Ltd. (CPIL),	Indian Wood & Wood Products,
3.	STEEL DOORS, WINDOWS AND VETILATORS	Shakti Met-Dor Ltd Steeltech Industries Godrej-Boyce NCL Seccolor Ltd., San-Harvice Multiwyn Supersteel Delhi Doorwyn	Deccan Structural Systems Agew steel manufacturers pvt ltd Chamundeshwari Rani shutters, Pondy Royal fabricators Vinayaga, Chennai
4.	ALUMINIUM DOORS, WINDOWS, PARTIONING	Alfab Products Ajith India Pvt Limited. Ajith India Limited Kalco-Alu Systems Pvt Limited Godrej Aardee Indal	Noble Associates Glaze India Harsha Aluminium Company Ajit Alumilite
5.	FRP DOORS	Meena FRP, Pondy	Limras FRP Doors, Coimbatore Ideal Fibre Glass Industry, Bangalore.
6.	WATER PROOFING COMPOUNDS/CONSTRUCTION CHEMICALS	Fosroc SICA Material of construction Sika India Private Limited STP Limited. Krishna Conchem Products Limited. CICO Accoproof	Rofee Magnum & Co., Impermo Fairmate Baucheme
7.	PAINTS AND DISTEMPERS	Berger Paints Snowcem Asian Paints Berger paints J&N Paints Shalimar paints ICI Goodlass Nerolac	Spectrum Decors Supa coat Garware
8.	HARDWARE FITTINGS & FIXTURES	H&R Johnson Limited Godrej Industries Limited Parryware Hindware	Acme





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
9.	METALLIC FLOOR HARDENER	Ferro Chem India Sika India.	Dolphin Floats Pvt Ltd.
10.	WATER STOPS - (PVC / RUBBER)	PVC Water Stop Seals - Tata Rubber Corporation	Kanta Rubber Pvt Limited.
11.	EXPANSION JOINTS	STP Limited Krishna Conchem Products Limited.	Choksey Chemicals Private Limited
12.	WATER PROOF CEMENT PAINTS AND EMULSION PAINTS	Super Snowcem India Ltd., M/S. NITCO Paints Pvt Ltd., Asian Paints Berger Paints J&N Paints Shalimar Paints.	Supercem
13.	METAL CLADDING SYSTEM	Pennar Industries Lloyds Insulation (India) Limited Tata Blue Scope steel Multi-Color steel India Pvt Limited Inter Arch Noida	Roof & ceiling India Pvt. Ltd. Mumbai Colour roof India Pvt. Ltd Metal Kraft Rollforming Industries, Hyderabad.
14.	GLAZING GLASS / WIRED GLASS	Triveni Saint Gobain Glass India Limited Modi guard. (Gujarat Guardian Ltd)	Asahi India glass limited
15.	PU COATING	Good Earth Minerals Private limited.	
16.	PLASTICIZER	Krishna Conchem Products Limited Sika India Private Limited	C Mix India
17.	SS PIPES	Apex Tube Private Limited Shree Tube Manufacturing Co. Pvt. Ltd.	Divine Tube Pvt. Ltd Reliable Pipe & Tube Ltd. Ratnamani

b. Sanitary and Water Supply Work (internal) (first quality to be used)

SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
18.	PVC PIPES & UPVC PIPES AND SPECIALS	Finolex Industries Limited. Supreme Dutron Polymers Limited Prince	Kissan Truebore
19.	GI PIPES AND SPECIALS	Jindal Saw. Bharat Steel Tube, New Delhi Tata steel Tube investments of India Limited,	Zenith Tube Co. Kolaba Gujrat Steel Tube Sekhar Iron works, Calcutta Khandelwal tubes, Nagpur





SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
		India Steel Pipes. Mahalakshmi Seamless limited. Indian Tube Company, Calcutta Kalinga Tubes Limited, Cuttack Shivmoni Steel tubes Ltd., Bangalore Jain tubes, Ghaziabad Jindal pipes Tata Heavy & Medium Class.	
20.	W.C. PAN WASH BASIN, URINALS, SINK LOW DOWN FLUSING CISTERN & EWC	E I D PARRY, Chennai. Hindustan Sanitaryware, Calcutta CERA H&R Johnson India Limited Nuchem plastics Ltd. Faridabad	Mahalakshmi seamless Neyveli Ceramics, Tamil Nadu Raasi ceramics- Secundrabad Commander Mumbai Bestolite Jasco sales Mumbai
21.	COLOUR/WHITE GLAZED TILES, CERAMIC TILES & VETRIFIED TILES	Kajaria Ceramics Limited H&R Johnson Tiles Naveen Ceramics Johnson Tiles Spartek Somani Pilkingtons Co., Haryana Bell Ceramics	Nitco Limited Nycer Company

c. RCC Items

SL. NO.	ITEM DESCRIPTION	CATEGORY-I	CATEGORY-II
22.	CEMENT	ACC Limited Ambuja Cements Limited UltraTech Cement Limited J.K Cement Limited Birla Corporation limited Chettinad Cements.	
23.	REINFORCEMENT STEEL	TISCON SAIL RINL	JSW
24.	STRUCTURAL STEEL	TATA Steel SAIL RINL JSW	



BHEL LIST OF PROPOSED SUB-VENDORS FOR BROUGHT OUT ITEMS FOR " FUEL OIL UNLOADING & STORAGE SYSTEM"			
SL. NO	CATEGORY OF INSPECTION	ITEM	PROPOSED SUB-VENDORS
A. FUEL OIL HANDLING SYSTEM			
2	*III	CS Pipes- ERW	TISCO/SAIL/SURYA ROSHNI/JINDAL /AJANTA TUBES
3	*III	CS Pipes -Seamless	Maharashtra Seamless/ISMT/BHEL, Trichy
4	III	Pipe Fittings	MS Fittings/Siddhartha & Goutam/EBY/Bharat Forge/Tube Product/Nitin Profile
5	III	Rubber Hoses	D Wren & Co/Sudeep Industries/Hydrokimp/Presidency Rubber
6	III	Metallic Hoses	Tubex India/Vega Flex/Vardhman Hoses/SMB Hydrolics & Pneumatics/G.C. Sales
10	II	Suction Heater	Parkaire Engg/Reynold Engineering
11	II	Duplex Strainer	Filtration Engineers/Multitex Filtration/Jaypee Industries/Otoklin Plants & Eqpt.
15	II	Pressure Reducing Valve/ Station	Mazda /JN Marshall/Leader Valves/Thermax/Darling Muesco India
16	II	Control valve	IL/MIL CONTROL/CONTINENTAL VALVES LTD./DRESSER VALVE INDIA PVT. LTD/FORBES MARSHALL/SAMSON
17	III	Safety Relief valve	JN Marshall/Leader Valves/Key stone / Cresnet Valves
18	III	Steam Traps	Spirax Marshall/Pennat Engg./Leader Valves/Crescent Valves
20	III	Aluminium Cladding	Hindalco/Balco/Nalco/Indian Aluminium company
28	III	Level Indicator (Float & tape type)	SBEM/Levcon/Sigma/Khrone Marshall/Siemens/E&H
LEGEND:			
CAT I :INSPECTION BY OWNER (DPL/DCPL),BHEL/BHEL NOMINATED TPIA & B&R .MDCC WILL BE ISSUED BASED ON INSPECTION REPORT			
CAT II:INSPECTION BY BHEL/BHEL NOMINATED TPIA & B&R. MDCC WILL BE ISSUED BASED ON INSPECTION REPORT			
CAT III: MDCC WILL BE ISSUED BASED COC & MTC ISSUED BY B&R AND VERIFICATION BY BHEL/OWNER IN LINE WITH APPROVED QAP/CHECK LIST			
NO PHYSICAL INSPECTION DONE ON IBR PIPES,VALVES,TRAPS BY ANY AGENCY /MDCC WILL BE ISSUED BASED ON IBR TC & COC			
NOTES:. For(*) - In case material is dispatched directly from Approved sub-vendor plant/stockyard or from dealer stocking material from approved make with correlated test certificate, then inspection category will be III & incase material is procured from dealer stocking material from approved makes without corelated test certifiante, then inspection category will be II and BHEL witness shall be applicable (Hydro test shall be witnessed by BHEL for S.No 2 &3)			



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X500MW LIGNITE FIRRED UNITS, NEYVELI**

SPECIFICATION NO. PE-TS-400-166-A001

VOLUME II B

SECTION C

REV - 00

DATE - 10.08.2014

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

ANNEXURE-V

(MANDATORY SPARES FOR FUEL OIL SYSTEM)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORGAE SYSTEM
2X500MW LIGNITE FIRRED UNITS, NEYVELI**

SPECIFICATION NO. PE-TS-400-166-A001

VOLUME II B

SECTION C

REV - 00

DATE - 10.08.2014

MANDATORY SPARES

Bidder to supply the following mandatory spares for Fuel oil unloading system:

S.N	ITEM	QTY
1	HFO pump suction filter-Gasket	3 sets *
2	HFO u/l Pump	
2.1	Rotor assembly complete (cartridge)	2 nos
2.2	Bearings	2 sets
2.3	Relief valve spring	2 nos of each type
2.4	Coupling inserts	2 nos
2.5	Motor of each type	1 no

Note: - * One (1) set means total numbers as required for one complete replacement for one equipment.



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORAGE SYSTEM
2X500MW LIGNITE FIRRED UNITS, NEYVELI**

SPECIFICATION NO. PE-TS-400-166-A001

VOLUME II B

SECTION C

REV - 00

DATE - 10.08.2014

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

ANNEXURE-VI

(DOC REQUIRED DURING BIDDING STAGE)



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



**TECHNICAL SPECIFICATION FOR
FUEL OIL UNLOADING & STORGAE SYSTEM
2X500MW LIGNITE FIRRED UNITS, NEYVELI**

SPECIFICATION NO. PE-TS-400-166-A001

VOLUME II B

SECTION C

REV - 00

DATE - 10.08.2014

ANNEXURE-VI

Bidder shall submit following drawings / documents along with their bid:

- a. Copy of pre-bid clarification, if any, duly signed and stamped.
- b. Copy of electrical scope between BHEL & vendor dully signed and stamped.
- c. Electrical equipment specification for Fuel oil system duly signed and stamped.
- d. Electrical load list dully filled
- e. Deviation schedule with reference to specific clauses of the specification along with reason for such deviation.
- f. Copy of unpriced price bid indicating "QUOTED / NOT QUOTED" / " NOT APPLICABLE" as the case may be.
- g. Copy of drwg/doc schedule given at ANNEX-VII dully signed and stamped.

OFFER WILL BE CONSIDERED AS INCOMPLETE IN ABSENCE OF ANY OF THE ABOVE DOCUMENTS.

DOCUMENTS OTHER THAN ABOVE, IF ANY, SUBMITTED WITH THE OFFER WILL NOT FORM PART OF CONTRACT AND ACCORDINIGLY WILL NOT BE CONSIDRED FOR BID EVALUATION.

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

ANNEXURE-VII

(DRWGS/DOCS REQUIRED DURING DETAIL ENGINEERING)



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

DRAWING / DOC SUBMISSION SCHEDULE DURING DEAIL ENGINEERING					
PROJECT : 2X500MW NEW NEYVELI TPP					
PACKAGE : FUEL OIL UNLOADING & STORAGE SYSTEM					
S.N.	Drawing No	Drg Title	Sch submission week from LOI	Cat	Resubmission after incorporating comments
1	PE-V0-400-166-A001	P & I Diagram for HFO, LDO, Steam & condensate system	4	A-CUST	WITHIN 1 WEEK
2	PE-V0-400-166-A002	Control Philosophy and control write up	4	A-CUST	WITHIN 1 WEEK
3	PE-V0-400-166-A003	Design calculation of HFO & LDO tanks (including day tank)	6	A-CUST	WITHIN 1 WEEK
4	PE-V0-400-166-A004	Steam consumption calculation, Pipe sizing and sizing calculation of PRS, steam trap, insulation thickness & floor coil heater	4	I-CUST	WITHIN 1 WEEK
5	PE-V0-400-166-A005	Datasheet, GAD & cross sectional details, performance curves of unloading/transfer pumps & motors, drain oil pumps & motors and Oil recovery pumps & motors	12	I-CUST	WITHIN 1 WEEK
6	PE-V0-400-166-A006	NPSH & pump head calculation for all pumps under FO system scope	6	A-CUST	WITHIN 1 WEEK
7	PE-V0-400-166-A007	Design calculation and GA of suction heater	10	I-CUST	WITHIN 1 WEEK
8	PE-V0-400-166-A009	Stress analysis for provision of expansion joints & anchor points in steam, HFO & LDO lines	10	I-CUST	WITHIN 1 WEEK
9	PE-V0-400-166-A010	Design calculation and GA for OWS	8	I-CUST	WITHIN 1 WEEK
10	PE-V0-400-166-A012	Painting schedule	4	A-CUST	WITHIN 1 WEEK
11	PE-V0-400-166-A013	Datasheet and GAD of valves- Ball, gate, Plug, NRV type etc	14	I-CUST	WITHIN 1 WEEK
12	PE-V0-400-166-A014	Datasheet of instruments - All gauges, indicators, switches, transmitters, flow meter with totalisers, junction boxes & motorised actuator	10	I-CUST	WITHIN 1 WEEK
13	PE-V0-400-166-A017	Piping layout in tank farm area of FO system	10	A-CUST	WITHIN 1 WEEK
14	PE-V0-400-166-A018	GA of FO system for CCOE approval	12	A-CUST	WITHIN 1 WEEK
15	PE-V0-400-166-A019	Suggestive electrical layout drawing showing location of all motors, junction boxes, control panel, field instrument and cable routing with support details	10	I-CUST	WITHIN 1 WEEK
16	PE-V0-400-166-A021	GA of HFO storage tanks along with nozzle orientation	10	A-CUST	WITHIN 1 WEEK
17	PE-V0-400-166-A023	Fabrication drawing for HFO storage tanks , LDO storage tank & LDO day tank	18	I-CUST	WITHIN 1 WEEK
18	PE-V0-400-166-A024	GAD of drain oil tank & flash tank	10	I-CUST	WITHIN 1 WEEK
19	PE-V0-400-166-A025	Civil input drawing for tank farm area, unloading pump house, road tanker unloading area and LDO day tank area	16	I-CUST	WITHIN 1 WEEK
20	PE-V0-400-166-A026	QAP for plates & structures, pipes & fittings, insulation & cladding	14	I-CUST	WITHIN 1 WEEK
21	PE-V0-400-166-A027	QAP for Screw pumps (unloading/ transfer & drain pumps), valves, strainers, PRS, temperature control valve etc	16	I-CUST	WITHIN 1 WEEK
22	PE-V0-400-166-A028	QAP for motors	14	I-CUST	WITHIN 1 WEEK
23	PE-V0-400-166-A029	QAP for all gauges, indicators, switches, transmitters, flow meter with totalisers, junction boxes, motorised actuators	16	I-CUST	WITHIN 1 WEEK
24	PE-V0-400-166-A031	Valve, instrument and pipes schedule	20	I-CUST	WITHIN 1 WEEK
25	PE-V0-400-166-A033	Electrical Load data	16	I-G-P	WITHIN 1 WEEK
26	PE-V0-400-166-A034	Isometric drawings with complete BOQ	10	I-CUST	WITHIN 1 WEEK
27	PE-V0-400-166-A035	Sub-vendor list with inspection categorisation plan	4	A-CUST	WITHIN 1 WEEK

28	PE-V0-400-166-A036	Instrument installation diagram	20	I-CUST	WITHIN 1 WEEK
29	PE-V0-400-166-A039	Insulation application procedure on tanks & piping, valves and <u>any other item required to be insulated</u>	20	I-CUST	WITHIN 1 WEEK
30	PE-V0-400-166-A040	Steam tracing installation procedure	20	I-CUST	WITHIN 1 WEEK
31	PE-V0-400-166-A042	Fuel oil system commissioning procedure	20	A-CUST	WITHIN 1 WEEK
32	PE-V0-400-166-A044	O & M manual of Fuel oil system	20	I-CUST	WITHIN 1 WEEK
33	PE-V0-400-166-A045	Cable Schedule for FOHS	16	I-G-P	WITHIN 1 WEEK
34	PE-V0-400-166-A046	Design calculation of Drain oil & Flash tanks	6	A-CUST	WITHIN 1 WEEK
35	PE-V0-400-166-A047	Datasheet, GAD & cross sectional details, performance curves of <u>Sump pumps & motors</u>	12	I-CUST	WITHIN 1 WEEK
36	PE-V0-400-166-A048	Datasheet and GAD of strainers of pumps , pipes & fittings, <u>insulation & cladding</u>	14	I-CUST	WITHIN 1 WEEK
37	PE-V0-400-166-A049	Datasheet and GAD of PRS & Temperature control valve	14	I-CUST	WITHIN 1 WEEK
38	PE-V0-400-166-A050	Piping layout inside fuel oil unloading pump house	10	A-CUST	WITHIN 1 WEEK
39	PE-V0-400-166-A051	Piping layout in & around road tanker unloading area of Fuel oil <u>system</u>	10	A-CUST	WITHIN 1 WEEK
40	PE-V0-400-166-A052	Piping layout in & around LDO day tank area	10	A-CUST	WITHIN 1 WEEK
41	PE-V0-400-166-A053	GA of LDO storage tanks along with nozzle orientation	10	A-CUST	WITHIN 1 WEEK
42	PE-V0-400-166-A054	GA of LDO day tank along with nozzle orientation	10	A-CUST	WITHIN 1 WEEK
43	PE-V0-400-166-A055	Fabrication drawing of drain oil tank & flash tank	18	I-CUST	WITHIN 1 WEEK
44	PE-V0-400-166-A056	Fabrication drawing for Floor coil heater	18	I-CUST	WITHIN 1 WEEK
45	PE-V0-400-166-A057	Drwgs & docs related control system(DCS based)	10	A-CUST	WITHIN 1 WEEK

NOTES

1. Finally approved documents / drawings to be provided in editable format(MS office/Autocad format) for onward submission to end customer.
2. Bidder to note that during detailed engineering, drwg/doc will be submitted through web based document management system in addition to hard copies to be submitted as per drawing/document distribution schedule. Procedure for the same shall be informed after award of contract.
3. For doc no. PE-V0-400-166-A057, Drwgs & docs related to control system (DCS based), bidder to refer the list of docs required under C&I portion of specification.

SIGNATURE:
NAME:
DESIGNATION:
COMPANY:
DATE:

COMPANY SEAL

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

**ANNEXURE-VIII
(CUSTOMER SPECIFICATION)**



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



3.4.13 Oil unloading & Transferring System

A pump house will be envisaged for accommodating the pumps, filters, MCC, instrumentation & Controls. Contractor to furnish the layout of the pump house showing the equipment, piping, necessary ventilation facilities & material handling facilities.

3.4.13.1 Unloading Headers for Heavy fuel oil (HFO) and LDO System

The unloading header will be complete with minimum 6 nos. for HFO & minimum 3 nos. for LDO of unloading points and each point will have 6 meter long 80 NB flexible metallic hose conforming to BS: 1435 with suitable flange and coupling to connect the road tanker with unloading header. One plug type isolating valve and a hose stand will also be required for each unloading point. Three (3) no of HFO unloading pumps and two (2) no of LDO unloading pumps will be envisaged.

LDO unloading pump (rotary positive displacement screw pump) will be complete with isolating, drain and vent valves. Necessary supporting arrangements for unloading arrangement will also be provided by the Contractor.

The unloading header for HFO service will be steam heat traced and insulated. HFO unloading pump will be horizontal rotary positive displacement screw pumps, steam jacketed with simplex filter in upstream of HFO unloading pumps.

3.4.13.2 Storage tank for HFO & LDO System

Bulk storage oil tanks will conform to IS 803 -1976 (vertical tanks). Two nos. HFO storage tanks of capacity 2000 m³ each is considered for two units. The tank will be insulated and heated by means of steam heating coil to maintain the HFO at desired temperature of around 60°C. HFO tanks would be fitted with steam heated floor coils heaters for initial heating and to supply fuel oil at the required temperature to the inlet of pump. The tank will be insulated except at tank roof with mineral wool blanket of minimum 75 mm thickness and cladded with aluminium sheet of 22 swg thickness. The H.F.O. will be maintained at the correct temperature inside the storage tank by means of steam heating coil heated with auxiliary steam.

Total storage capacity of the LDO storage would be 400m³ with 2 tanks of 200m³ is considered.

Each tank will be provided with:

- Inlet, outlet, over flow drain, vent connection, return oil connection, interconnection between tanks, pump return oil to tank.
- Inside cat ladder.
- Outside spiral staircase with hand railings.
- Tank top periphery is also provided with hand railings.
- Pocket for instrumentation such as level indicators, level switches, temperature indicators etc.
- Float type level indicator for high & low level of oil in tank.
- Water draw-off connection with drain valves.
- Flame arrestor on vent pipe.





- Two nos. of spare nozzles.
- Tank earthing & lightning protection.
- Interconnecting walkways between two tanks.

3.4.13.3 HFO Transfer Pump

- ~~1. HFO will be sent to the steam generator from 3 x 100% capacity steam jacket horizontal positive displacement screw type supply pumps, filters complete with a non-return valve on the delivery side and a relief valve on each pump along with isolating, drain and vent valves. Under normal operation two pumps will be in operation for 2 units while the third pump will act as a common standby for the system.~~
- ~~2. The H.F.O. pumps deliver filtered heavy fuel oil in a common header kept at the correct pressure by means of a control pressure station on a recirculation line to the storage tanks; the pressure holders are installed to assure the minimum pressure required by the burners during trip of one pump and start up of the stand-by pump. Downstream of pressure holder three H.F.O. heaters are provided, which increase the H.F.O. temperature, by means of auxiliary steam, to obtain the correct viscosity value required from burners.~~
- ~~3. All drains and leakages from strainers, pumps, piping, etc., are recovered in a oil drain tank, from which, by means of a pump, the oil can be sent again to the H.F.O. storage tanks or can be discharged to bins. All lines, pumps, filters will be provided with steam tracing to maintain the H.F.O. at the required temperature.~~
- ~~4. HFO System will be complete with respect to HFO tank heating arrangement, steam and condensate system and fuel oil drain system, condensate and oily water collection and separation system.~~

~~Pumps with steam jacketed/Electrically traced rotary positive displacement type heavy fuel oil pumps with motor, coupling guards etc.~~

~~Steam coil heaters, each heater with individual oil temperature control valve, bypass control valves, isolating valves and relief valves to relieve excess oil pressure.~~

~~Steam jacketed self cleaning motorized or coarse duplex filters at heavy fuel oil pumps suction and Self cleaning motorized or fine duplex filters at fuel oil heater(s) discharge.~~

~~Steam tracing will be provided for all the heavy fuel oil lines. There will be no cooled legs in oil supply and recirculation piping.~~

~~Fuel oil burners complete with diffusers, tips extension pipes, atomizers, burner shut off valves, flexible hoses and all other ancillaries.~~

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~~Oil connections to each burner from ring main with fine filters as near as possible to each burner and means for determination of oil flow to each burner.~~

~~HEA/Light oil igniters for each burner.~~

Relief valves will be provided on larger section of fuel oil pipes, which can be isolated.

Isolation valves will be provided both on up stream and down stream sides for all in-line items like pumps, heaters, flow meters, filters, control valves etc., which are required to be taken out for maintenance.

~~Facility will be provided for complete flushing of heavy fuel oil handling system by LDO.~~

Complete Piping along with auxiliary steam piping, oil drain piping, vent piping, tracing steam piping, recirculation piping, all protection & instrumentation controls, suitable hangers, support, pipe trestles, etc. Adequate local and equipment mounted instrument and devices with adequate signalling and connects/connections required for pressure, temperature and other controls for supervision and interlocking with all associated auxiliary during purging, shut down and of sensing device to remain unaffected by oil fill dirt or by ambient where it will be put, will be provided.

3.4.13.4 LDO Transfer Pump

~~LDO will be sent to the steam generator from 3 x 100% capacity horizontal screw type supply pumps complete with filters, isolating, drain and vent valves. Under normal operation two pumps will be in operation for 2 units while the third pump will act as a standby for the system.~~

~~A common re-circulating line with a pneumatic control valve is foreseen to re-circulate the light fuel oil to the L.D.O. storage tanks in order to control the value of the L.D.O. pressure at the boilers inlet. One pressure holder is supplied to assure the minimum pressure required by the burners in case of trip of one pump.~~

~~On the boilers common inlet line three 100% capacity (one for each boiler + one standby) simplex filters will be provided, complete of isolating valves, drain and vent valves. All oil drains and leakages from strainers, pumps, piping, etc. are recovered in a Tank.~~

The light fuel oil system will have the following design features:

Relief valves will be provided on larger section of fuel oil pipes, which can be isolated.

Isolation valves will be provided both on up stream and down stream sides for all in-line items like pumps, heaters, flow meters, filters, control valves etc., which are required to be taken out for maintenance.

For LDO handling system, steam flushing system will be provided for cleaning during commissioning.







~~Adequately sized pressure accumulators will be provided on fuel oil lines to individual Steam Generator for maintaining constant oil pressure. Each accumulator will be complete with a pressure gauge, stop cock and isolation valves to ensure maintainability of nitrogen pressure.~~

3.4.13.5 Filters

Location

- (i). At suction of HFO and LDO unloading & firing Pumps
- ~~(ii). At outlet of each oil heater in fuel oil pump house area~~
- ~~(iii). At common line in boiler area supplying oil to the boiler.~~

Type:

- Duplex/Simplex/twin simplex.
- Coarse filter at suction of pumps
- ~~• Fine filters at heater outlet and at common line in boiler area supplying oil to the boiler.~~ For HFO service steam jacketed type filters will be provided.
- Filter element : SS
- Pressure rating : Suitable for the duty condition
- Filters will be provided with isolating valves.
- Filters will be provided with basket type straining elements permitting easy removal and replacement.

~~Removable temporary filters, if required, during initial operation to prevent burner/ignitor choking will also be provided by the Contractor. If permanent strainers are recommended by the Contractor, as per his experience, in burner front the same will be provided by him and will have 100% standby facility for on-line cleaning along with differential pressure indication and alarm facility.~~

The filters will be so designed that the pressure drop across it will be maximum 0.1 kg/sq. cm when the filter is clean and 0.3 Kg/Sq. cm when the filter is 50% clogged. The strainer mesh will be so selected as to ensure no chokage of pumps and burners.

3.4.13.6 Design/Sizing criteria for various pumps will be based on the following:

S.No	Particulars	HFO Pump	LDO Pump	Drain oil pump	Sump Pump
1	Type of fluid handled	HFO	LDO	HFO	Oil & Water
2	Temp of fuel oil	90°C	Atmospheric	90°C	50-85°C
3	Pump design construction code	HI Standard, ASTM, ASME or equivalent			
4	No of pumps	3	3	2	2
5	Capacity of each pump	To cater 30% of BMCR requirement	To cater 7.5 % of BMCR requirement	Contractor to furnish	

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S.No	Particulars	HFO Pump	LDO Pump	Drain oil pump	Sump Pump
6	Pump discharge head	To meet the fuel burner requirement	To meet the fuel burner requirement	To suit the site requirement	
7	Type of pump	Rotary, positive displacement, horizontal pump with relief valve			
8	Type of drive	Constant speed squirrel cage, induction motor with flexible couplings			
9	Type of bearing	Antifriction			
10	Type of heater	Shell & tube type			
11	Heater tubes	Seamless			

3.4.13.7 Interconnecting pipe line

Quantity: As required to suit the site condition and piping layout within the oil farm area as well as upto the consuming points.

Capacity: Suitable to handle maximum quantity of fuel oil at the specified parameters of respective oil unloading pumps.

Construction: Fuel oil pipes will be seamless as per IS: 1978/EN 10216-2/Equivalent, Heavy grade fittings as per IS 1239(Part III)/EN 10253-2,

Erection according EN 13480.

Steam piping: ASTM-A-106-Gr.B - Boiler Quality suitable for duty conditions envisaged with IBR approval.

Interconnecting pipelines will consist of oil pipelines from unloading header to oil pumps and between pump house and bulk oil storage tanks and oil delivery pipeline from bulk storage tanks to the consuming units and return through ring main system and recirculation system to storage tank. Auxiliary steam / tracing steam piping also will be provided. Fuel oil piping will be routed over trestles. However, fuel oil piping from unloading area up to storage area may be routed on pedestals. The head room for FO trestle in outlying area will be 3.0 M except at rail/road crossing where the head room will be 8.0 M. FO trestle legs or supports will be located so as to clear the road spaces, approach to maintenance bays of different equipment buildings located in the route of FO trestle. ~~The ring main will be taken overhead along the shop columns and supported on it wherever possible. Intermediate stockades & trestles will be provided by the Contractor where the shop columns are not available in the building to meet the permissible supporting spans of pipelines.~~

Oil pipelines will be provided with:

- Necessary isolating valves
- Vent pipes with valves
- Drain pipes with valves
- ~~Trestles and supports for oil pipelines & steam pipelines.~~

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- Pipe fittings such as thermal expansion joints, pipe reducers, tee connections, flanges, elbows/bends etc.

3.4.13.8 Piping's, Valves, Fittings, Pipe Support, etc.

The layout of oil piping, valves, flanges, steam traps, fittings and supports etc. will be such as to facilitate maximum flexibility of interconnection of pumps, heaters, strainers. All HFO lines will be steam traced and properly lagged. All lines carrying steam and oil will be provided with adequate drain and vent connection. All fuel oil lines and filters will be provided with steam flushing points at suitable locations. All steam and condensate piping handling fluid of pressure below 20kg/Sq.cm.g will conform to the latest edition of IS: 1239 (Heavy grade) or ASTM-A-106 Gr. B or other approved equivalent standards. ~~Oil pipelines from discharge of pressurising pump to boilers will conform to IS: 1978 or other approved equivalent standard with latest amendments.~~ Oil pipe lines in the unloading area will be of API-5L Gr B or ASTM A Gr 106 B. ~~Double isolation valves will be provided from the discharge of the pressurizing pumps, for inline items that are to be removed for maintenance. This applies to flow meters, filters, isolation valves and the pressure maintaining valves etc. Larger lengths of piping that can be isolated will be provided with thermal relief valves.~~

~~Between the pressure oil line and the return oil line, an interconnecting line will be provided with automatic pressure control system to maintain the pressure of oil to the steam generator at a predetermined value. The interconnecting line will also serve to divert the fuel oil to the return line under conditions when oil supply to the burners is to be cut off or reduced. Suitable non-return valves will be provided on the return oil lines from the steam generators to prevent pressurized fuel oil from going back into the burners in the reverse direction when the quick acting valve closes. The fuel oil lines to individual boilers will be provided with pressure accumulators of adequate size (if warranted by design) to maintain the oil pressure at a constant value.~~

All flanges will conform to IS:6392 or equivalent. The nominal pressure and temperature ratings of flanges will be such as to withstand the design condition of the respective pipe/equipment to which they are attached. Matching counter flanges with nuts, bolts and gaskets will be provided for all the system terminal points on oil, steam/condensate and air lines.

All high pressure pipe fitting will be of butt welded construction, wherever possible and will conform to ASTM-A-234 (carbon steel) or other approved equivalent.

All valves on oil, steam and condensate lines will have cast steel body. Valves for oil service will be fire safe ball valves type, easy to operate, less maintenance prone, leak proof, and self-lubricating type. The valve internals will be chrome-steel for oil, steam / condensate lines. The drain valves will be located at the lowest points in the system to ensure complete draining of the system.

Suitable supports / hangers will be provided for all the piping covered under fuel oil facilities. ~~Piping in the boiler area will be designed with laying up on trestle supports as far as possible. The pipes crossing roads/rails will also be~~

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~~trussle-supported~~. Dead zones in pipes will be avoided as much as possible. The high temperature piping / heat traced piping will be provided with expansion loops to take care of thermal expansion.

The steam traps will be of proven design and provided with integral/separate strainers. The trap body will be of carbon steel and the internals including strainer screen will be of stainless steel conforming to AISI-316.

3.4.13.9 Oil Water Separator

An oil water separator will be installed for collecting water contaminated oil from tank farm area and unloading area. Valves and piping will be included in the scope of work. The water separated will be connected to the nearest storm-water drain by the Contractor.

One drain pump with filter and piping will be provided for pumping the water separated to the drain. One steam heater will be provided for the drain sump.

3.4.13.10 Steam Heat Tracing and Insulation

The entire HFO pipeline will be steam heat traced and insulated with slag wool to maintain heavy oil temperature in the system at $85^{\circ}\text{C} \pm 5^{\circ}\text{C}$. The insulation will be fixed with wire netting & external protection given by 22SWG thick aluminium sheets. Insulation will be carried out as per IS: 7413.

3.4.13.11 Fuel Oil Drains

The fuel oil drains from the different equipment and piping etc., will be brought by gravity to common fuel oil drain tank(s) and then pumped by drain oil pump(s) to the fuel storage tanks.

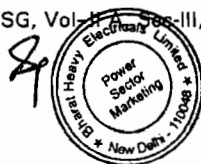
Drain oil system to be furnished by the Contractor will comply with the following requirements :

Total three nos. drain oil tanks will be provided for both the units. One fuel oil drain collection tank of 10 cu.m. capacity will be provided for the fuel oil pump house area. ~~Similarly one such tank of 6 Cu.m capacities will be provided for each boiler area.~~ Each tank will be fitted with positive displacement pump having sufficient head and capacity to deliver drain oil to the storage tanks.

The tanks will be made of IS: 2062 quality steel plates of tested quality. Thickness of plate will be 6 mm (minimum). The tanks will conform to IS: 800. The tanks will be hydraulically tested. Oil drains from different equipments and oil lines will be led to these tank. The location of the tanks and drainpipes routing will be such that drains flow to the tank by gravity. Each tank will be fitted with heating (steam heating coil) arrangement and drain oil pumps. Oil collected in the tanks will be periodically, as and when required, pumped back into the storage tanks. For temperature alarm two numbers of temperature switches will also be provided on the tanks. Also two numbers of level switches will be provided for alarm and pump interlock.

Entire drain oil system will be steam heat traced and insulated. All other fittings and accessories as required by the system will be provided.

The drain oil pumps will be of rotary positive displacement type complete with





drive motor, pressure relief valves, pressure gauges etc. These pumps will transfer oil from the drain oil tanks to the fuel oil storage tanks.

Pump capacity and head for the pumps will be determined by the Contractor based on the layout and system requirement. Sufficient margin will be considered over the calculated values. The filters on the pump suction will be of the duplex type. Other requirements of pumps, filters, pipelines, valves etc. will be as described above.

3.4.13.12 Condensate Flash Tank

Contractor will provide all necessary arrangement to bring all the steam condensate drains of the fuel oil system to a common condensate flash tank.

Capacity of the condensate flash tank, to be provided by the Contractor, will be of 6 cu. m. nominal capacity. The tank will be vertical and cylindrical in shape with dished ends. Tank design will conform to IS: 2825 class II. Material of construction will conform to IS: 2002 grade - II). Location of this tank will be inside / near vicinity of the fuel oil pump house. Vent from the tank will be terminated above the pump house roof. The drain from the flash tank will be led to guard pond in ETP by the Contractor.

~~Similar condensate flash tank of adequate capacity one per boiler/ alternate arrangement as per contractor's practice will be provided in the Boiler area. The drains from these tanks will also be led to the guard pond in effluent treatment plant~~

3.4.14 Oxygenated Treatment – For Once through Boiler

Contractor to provide Oxygenated Treatment for the once through boilers as per the requirement.

3.4.15 Auxiliary Steam System

The auxiliary steam system (Aux. PRDS) will include the high capacity and low capacity pressure reducing stations to meet the continuous and start-up auxiliary steam requirements of the boiler turbine units. The steam source for high capacity PRDS will be the main steam pipes and that for the low capacity PRDS will be the cold reheat (CRH) pipes.

A high temperature unit auxiliary steam header operating at 16 kg/cm² (a) and 310°C taking steam from the above PRDS stations and also a low temperature unit auxiliary steam header operating at 16 kg/cm² (a) and 210°C will be provided.

The auxiliary steam systems of the units will be interconnected through the station auxiliary steam headers.

Contractor will provide auxiliary steam system for meeting internal auxiliary steam requirement for the following services:

- i) Steam coil air pre-heater
- ii) Burner atomizing steam
- iii) Fuel oil heaters
- iv) Steam tracing of fuel oil system



PROJECT

2X500MW LIGNITE FIRED UNITS AT NEYVELI

**SECTION-D
STANDARD TECHNICAL REQUIREMENT**



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



TITLE STANDARD TECHNICAL SPECIFICATION FOR MISC TANKS	SPECIFICATION NO. PE-TS-STD-167-A001	
	VOLUME II B	
	SECTION D	
	REV 00	DATE
	SHEET OF	

1.0 SCOPE

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

2.0 CODES & STANDARDS

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

- 1 IS-800 Code of practice for use of steel in general building construction
- 2 IS-803 Code of practice for design, fabrication and erection of vertical mild steel cylindrical welded oil storage tank.
- 3 IS-804 Specification for rectangular pressed steel tanks
- 4 IS-805 Code of practice for use of steel in gravity water tank.
- 5 IS-816 Code of practice for metal arc welding for general construction in MS .
- 6 IS-817 Code of practice for training and testing for metal arc welder
- 7 IS-2825 Code of practice for unfired pressure vessel
- 8 BS-2594 Specification for carbon steel welded horizontal cylindrical storage tank
- 9 BS-2654 Specification for vertical steel welded storage tanks with butt welded shells for the petroleum industry
- 10 Indian explosive act and statutory requirements of chief controller of explosives, Nagger. (For oil storage tanks.)
- 11 Indian Boiler Regulations
- 12 Indian Factories Act
- 13 American code for oil tanks API 650

3.0 DESIGN REQUIREMENT

3.1 General Requirement

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



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

- 3.1.2 All tanks will be designed for the capacities, dimensions and working conditions as specified in **TANKS DATA SHEET** given under section-C. These tanks will be provided with all necessary connections as specified. The design of tanks will be such as to allow easy inspection, cleaning and repair. Due consideration will be given to wind loading and adequate stiffening will be provided to prevent failure of tank due to buckling when it is empty. A 2.0 mm corrosion allowance until unless specified in **DATASHEET-TANKS** for shells, bottom and roof and beyond the required thickness shall be provided.
- 3.1.3 Vessel seams shall be so positioned that they do not pass through vessel connections.
- 3.1.4 The inside seam should be ground smooth, suitable for application of corrosion resistant primer. Except where otherwise indicated in the specification, if the stiffening of shell and/ or roof is necessary, tanks will be stiffened from outside.
- 3.1.5 Flange faces of all nozzles shall be machined and squared with the vessel center line.
- 3.1.6 All roofs and supporting structures shall be designed to support dead load plus a uniform live load of not less than 150 kg/m² of projected area.
- 3.1.7 The tanks shall be designed to have all courses truly vertical. Adequate distance between vertical joints in adjacent courses shall be taken so that the distortion is reduced to minimum.
- 3.1.8 When removing temporary attachments from shell plates, care should be taken that parent plate is not damaged. Holes in plate work to assist in fabrication / erection should be avoided as far as possible. The location of holes and method of filling shall be indicated in the fabrication drawing. Any projection of metal shall be chipped and ground flush with the plate surface. The plate shall not be gouged or torn in process of removing lugs.
- 3.1.9 In the construction of shell, very care shall be taken to minimize distortion or lack of circularity due to welding or for any other reason.
- 3.1.10 The successful bidder shall furnish design calculations to BHEL during detailed engineering stage for approval along with the Xerox copies of relevant pages of authentic supporting literature e.g. Code, Hand book, National / international Standards etc. Calculation shall be necessarily done in SI UNITS for the followings: -
- The tanks shall be designed as per good engineering practice as applicable and referred code shall be of latest edition.
 - Plate thickness calculation (different courses of shell plate, bottom plate and roof plate thickness), roof curb angle, top wind girder, intermediate wind girder, tank internal pressure vis –a-vis. allowable value.
 - Design of roof and roof structures for vertical storage tanks shall be designed based on guidelines given in the book titled “Process equipment design” by Brownell and Young.
 - Tank stability calculation (wind load / seismic / overturning stability) shall be done as per good



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

- e) Vent sizing calculation shall be done as per good engineering practice as applicable and referred code shall be of latest edition.
- f) Sizing calculation for vent, NaOH / KOH breather, seal pot and breather valve.
- g) Weight calculation of plates, appurtenances & structures separately shall be included in the design calculation/GA.
- h) Staircase / access ladder and hand railing shall be provided as per the relevant codes and standards.

3.1.11 Alignment

- 3.1.11.1 Plates to be joined by butt welding shall be matched accurately. Misalignment in completed vertical joints shall not exceed 10% of the plate thickness or 1.5 mm for plates of 20 mm thick and under, whichever is larger.
- 3.1.11.2 In completed horizontal butt joints, the upper plate shall not project beyond the face of the lower plate at any point by more than 20% of the upper plate thickness with a maximum of 3 mm for plate thickness exceeding 8 mm except that for plate thickness 8 mm and under, the maximum shall be 1.5 mm.
- 3.1.11.3 Each tank shall be properly constructed ensuring perfect vertical alignment within 5 mm and tank circularity within 5 mm on diameter. Local bulging and / or depressions at any location of tank particularly shell shall not be permitted.

3.1.12 WELDING

- 3.1.12.1 Tanks and other attachments shall be welded as per AWS and the qualification of welder should be as specified in ASME.
- 3.1.12.2 Welding sequence shall be so adopted that distortion due to welding shrinkage shall be minimum. Welding procedure specification shall be submitted for approval of BHEL giving details of material, welding position, sequence, type of electrode used, pre-heat & post weld requirement etc as per the code of construction. Brand name of electrodes to be used with proper classification (e.g. E 6013) shall be as per BHEL's approval.
- 3.1.12.3 Welding shall not be carried out when the surface is wet and during periods of rain and high winds unless the welder and the work are properly shielded which should meet the approval of the purchaser.
- 3.1.12.4 Inspection of all welds shall be carried out in accordance with the governing code of construction. All material used by the purchaser such as electrodes, gaskets, bolts, nuts etc shall be conforming to relevant standards of repute and approved by the purchaser prior to use.
- 3.1.13 Each tank shall be complete with access staircase and fittings like drain connection, overflow connection, tank inlet and outlet covers, level gauge glass, fittings with isolation cocks and protection covers, tank vent connection etc all complete with needed accessories for the completeness of the tanks and as specified in data sheet -A.



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

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

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

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

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

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

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


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

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

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

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

3.2 **VERTICAL CYLINDRICAL STORAGE TANKS**

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3.2.1	The vertical cylindrical storage (non- pressure) tanks shall be of mild steel welded construction and shall be designed in accordance with API-650 / AWWA D - 100. The vertical cylindrical storage tanks shall have slightly sloping bottom towards an adequately sized sump inside the tank to enable complete draining of the tank. The tank shall be designed for a wind pressure and seismic coefficient as specified. While worst of these two shall be increased as per API.		
3.2.2	Conical roof shall be self-supported over the tank periphery. The roof shall have a slope of not less than 1 in 16 to ensure drainage of rainwater. Needed roof rafters and purlins adequately designed shall be provided.		
3.2.3	All plates to be used for fabrication of tank shall be checked and all sides trimmed to make them square.		
3.2.4	All bottom plates shall have lap weld joints on all sides with overlap not less than five times the plate thickness.		
3.2.5	All shell course plates shall be taken during bending to prevent plate skewing. For butt weld joints, edges shall be prepared which shall be uniform and smooth throughout. To maintain needed root penetration gap at any butt weld joint, sufficient numbers of erection cleats shall be provided on all sides of outer periphery of each shell plate. Plates for tanks shall be straightened by pressing or by other non-injurious methods.		
3.2.6	Each shell course shall be of uniform width throughout longitudinal weld in plates. Make up for the course width shall not be permitted. Shell plates in each course width shall be so arranged that all vertical joints are staggered having a minimum of 600 mm stagger. Shell thickness could be reduced in upper courses depending on design requirements but in no case the plate thickness shall be less than 6 mm.		
3.2.7	The tank height shall be completed by the provision of top curb/ angle which shall be butt welded to the adjacent tank plate courses. The outstanding leg of the curb angle shall be kept outside the tank periphery. All butt weld joints shall be full strength welds but for design of shell plate thickness adequate weld efficiency as recommended by applicable code(s) shall be used.		
3.2.8	Tank roof shall be supported over steel fabricated central column(s). Adequately sized and spaced rafters and purlins shall be provided. All rafters shall have sliding bolted connections at one end and preferably on the tank periphery side. The roof supporting frame shall have needed tie rods or bracing sets.		
3.2.9	Roof plates shall have lap joints with lap not less than 25 mm and lap weld over the top surface only. Roof plates shall have continuous fillet welds around the tank curb angle. No joint of roof plate over the supporting frame shall be made.		
3.2.10	Needed openings for mounting various specified accessories shall be well reinforced in accordance with application codes and as approved. Manhole shall be bolted and shall have hinged covers unless otherwise specified.		
3.2.11	All inlet pipe nozzles located at the top of tanks shall be provided with internal piping up to 500 mm high above the tank's bottom inside with suitable weir plate at bottom. The inside piping shall be adequately supported and shall be provided with adequately sized vent connection at pipe top.		



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- 3.2.12 The manhole shall be of hinged & bolted type with nuts, bolts and gaskets with minimum size of 600 mm.
- 3.2.13 NaOH / KOH breather and seal pot shall be located in the bottom / ground level and necessary connection from tank vent to NaOH / KOH breather shall be provided through 200 NB SS pipe. The sizing of NaOH breather and Seal pot shall be decided based on emptying and filling rate of tanks. A tentative rate of 5 cum/hr may be considered for both emptying and filling of tank. However, the complete information shall be provided to vendor during detail engineering.
- 3.2.14 Material of construction of all pipes, fittings, valves, nozzles, flanges and counter flanges shall be as per datasheets given at the end of this section.
- 3.2.15 Material of construction for standpipe (if applicable) shall be stainless steel (SS) and size shall not be less than NB 100 unless otherwise specified in Datasheet-A for tanks given at the end of section.
- 3.2.16 Two (2) nos NaOH / KOH breather shall be provided by the bidder for each tank, out of which one shall be used for in-breathing purpose and the other shall be used for out-breathing purpose.
- 3.2.17 The size of the drain and vent valve of standpipes shall be 25 NB and size of the isolating valves (2 nos) for standpipe shall be 50 NB unless otherwise specified in the specification.
- 3.2.18 The overflow pipe from overflow nozzle shall be connected to seal pot.
- 3.2.19 All stair treads and platforms shall be made from gratings

3.3.0 RECTANGULAR TANKS

- 3.3.1 Rectangular tanks shall be fabricated from steel material and shall be designed to withstand internal hydrostatic pressure. In addition these shall be checked for a wind pressure and seismic coefficient as specified wherever applicable. While worst of these two shall be considered, the permissible stress shall be increased as per IS when their effect considered with tank load.
- 3.3.2 Tank bottom and / or side plates shall be of minimum 6 mm thick plate. Corrosion margin of at least 2 mm shall be provided over the design thickness of bottom and / or side plates.
- 3.3.3 To support tank plates and to maintain required unsupported plate length, adequately sized and spaced steel structural closed frame shall be provided inside the tank. Longitudinal and / or vertical structural members to connect and adequately support these frames shall be provided at corners. Horizontal diagonal members / sway bracings at corner shall also be provided.
- 3.3.4 Tank plates cut to size shall be welded on these frames. Plate butt weld joints at other locations shall be eliminated to avoid warping of the plates at free joints. Adequate openings in the structural frames, particularly at the bottom shall be provided to ensure complete unrestricted drainage of tank at one point.
- 3.3.5 Complete assembled tank shall have at its bottom longitudinal steel fabricated bearer beams welded to it. The tank with bearer will rest over number of concrete blocks to be provided by purchaser. The tank shall be adequately bolted / welded to the concrete blocks. Needed inserts / anchor bolts shall be furnished by the bidders. Grouting of tank over concrete blocks in approved manner shall be included in bidder's scope of work, if erection is also awarded to the bidder.



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

3.4 **HORIZONTAL CYLINDRICAL TANK**

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

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

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

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

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

4.1 **General**

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

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

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

4.2 **TESTING AND INSPECTION FOR TANKS**

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

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

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



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- iii) All the plates of thickness 50 mm or more shall be ultrasonically tested to ensure freedom from laminations.
- iv) Ensuring the relevant weld procedure and welder qualification tests are in accordance with stipulated code requirements.
- v) Inspection of dished end flanges and alloy steel bolting where required.
- vi) Inspection during fabrication at appropriate stages including fit ups.
- vii) For all butt welds, the root run and final run shall be subjected to dye penetrant or magnetic particle inspection. For all fillet welds the final run shall be subjected to dye penetrant / magnetic particle examination.
- viii) Examination of radiographs including radiographic techniques, supervision of other non - destructive tests and heat treatment procedure as required by codes and specifications.
- ix) Examination of internal cleanliness before final closure.
- x) Dimensional examination of completed vessel including axis marking, proof marking, match marking etc.
- xi) Witnessing of hydrostatic, pneumatic or vacuum tests or special tests as required by the code and specification. In case of hydrostatic tests, the test pressure must be kept for a minimum of two hours.
- xii) Witnessing cleanliness, preservation, packing and marking.
- xiii) Stamping of vessel and issue of certificates.

4.2.2 NON - PRESSURE TANKS

FIELD TESTING

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

- 4.2.2.1 Identification of materials to manufacturer's test certificates.
- 4.2.2.2 Inspection of plates, edges after edge preparation and checking curvature against template if shell plates sent after rolling.
- 4.2.2.3 Checking of dimension and match marking.
- 4.2.2.4 DPT / MPI on all welds (100%).
- 4.2.2.5 All cross / Tee joints and butt welds to be 10% Radio graphed.
- 4.2.2.6 For the offered tanks, fill test shall be carried out for at least 24 hours. Atmospheric storage tanks on inside surface shall be leak tested before painting.



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

4.2.3 REPAIR OF LEAKS

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

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

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

5.0 PAINING REQUIREMENT

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

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

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

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

6.0 OTHER TECHNICAL REQUIREMENTS

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

2X500MW LIGNITE FIRED UNITS AT NEYVELI

FUEL OIL UNLOADING & STORAGE SYSTEM

**TECHNICAL SPECIFICATION FOR ELECTRICAL
PORTION OF FO SYSTEM**



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



TITLE : ELECTRICAL EQUIPMENT SPECIFICATION FOR FUEL OIL SYSTEM 2x500 MW NEYVELI NEW THERMAL POWER STATION (NNTPS)	SPECIFICATION NO. PE-TS-400-552- A000
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1.0 **EQUIPMENT & SERVICES TO BE PROVIDED BY BIDDER:**

- a) Services and equipment as per “Electrical Scope between BHEL and Vendor”.
- b) Any item/work either supply of equipment or erection material which have not been specifically mentioned but are necessary to complete the work for trouble free and efficient operation of the plant shall be deemed to be included within the scope of this specification. The bidder without any extra charge shall provide the same.
- c) Supply of mandatory spares as specified in the specifications of mechanical equipments.
- d) Erection and commissioning spares.
- e) Erection & Maintenance tools & tackles.
- f) Electrical load requirement for Fuel oil System.
- g) All equipment shall be suitable for the power supply fault levels and other climatic conditions mentioned in the enclosed project information.
- h) 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.
- i) Various drawings, data sheet as per required format, quality plans, calculations, test reports, test certificates, operation and maintenance manuals etc shall be furnished as specified at contract stage. All documents shall be subject to customer /BHEL approval without any commercial implications to BHEL.
- j) Motor shall meet minimum requirement of specification AC/DC motors.
- k) Technical requirements shall be as per specifications listed in Clause 4.1 to 4.9. In case of any discrepancy between Basic technical features for HT or LT motors and BHEL standard specification, Basic technical features for HT or LT motors shall prevail.

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

Refer “Electrical Scope between BHEL and Vendor”.

3.0 **DOCUMENTS TO BE SUBMITTED ALONG WITH BID**

3.1 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 System” and sheet “Electrical Scope between BHEL and Vendor” with bidder’s signature and company stamp.
- b) List of Erection and Commissioning spares.
- c) List of Erection & Maintenance tools & tackles.
- d) 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.- 3 sheets
- 4.2 Std. Technical specification for LV motors.- 5 sheets
- 4.3 Std. Technical specification for Cabling installation.- 6 sheets
- 4.4 Basic technical features for HT LT motors – 7 sheets
- 4.5 Electric sub-vendor list for LT motors – 1 sheet
- 4.6 Data Sheets (A) for 415V Electric Motors.- 2 sheets.
- 4.7 Data Sheets (C) for 415V Electric Motors- 2 sheets.
- 4.8 Quality plan for motor below 55kW.- 2 sheets
- 4.9 Quality plan for motor above 55kW.- 9 sheets
- 4.10 Load data format.- 1 sheet

**Electrical scope sheet for Scope between BHEL & Vendor
(Fuel Oil unloading & storage System)**

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
1	415V MCC	BHEL	BHEL	<p>1. 415 V AC/240 V AC supply shall be provided by BHEL based on load data provided by vendor at contract stage for all equipment supplied by vendor as part of contract including power supply equipment (battery charger etc) required for the PLC/control panel (as applicable) for the system supplied by vendor.</p> <p>2. Interposing relays (RE 302 of Jyoti make or equivalent), if required for PLC and microprocessor based systems, shall be provided by BHEL in MCCs. Requirement of these relays shall be furnished by vendor during detailed engineering stage.</p>
2	Local Push Button Station (for motors)	BHEL	BHEL	Located near the motor.
3	<p>Power cables, control cables and screened control cables for</p> <p>a) both end equipment in BHEL's scope</p> <p>b) both end equipment in vendor's scope</p> <p>c) one end equipment in vendor's scope</p>	<p>BHEL</p> <p>BHEL</p> <p>BHEL</p>	<p>BHEL</p> <p>Vendor</p> <p>BHEL</p>	<p>1. Sizes and quantity of cables required shall be informed by vendor at contract stage (based on inputs provided by BHEL). Finalization of cable sizes shall be done by BHEL. Vendor shall provide lugs & glands accordingly.</p> <p>2. Laying of cables by BHEL except for cabling in vendor scope.</p> <p>3. Termination at BHEL equipment terminals by BHEL.</p> <p>4. Termination at Vendor equipment terminals by Vendor.</p>
4	Any special type of cable like compensating, co-axial, prefab, MICC, fibre optical etc.	Vendor	Vendor	

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
5	Cable trays, accessories & cable trays supporting system	BHEL	BHEL	
6	Cable glands and lugs for equipment supplied by Vendor	Vendor	Vendor	1. Double compression Ni-Cr plated brass cable glands 2. Solder less crimping type heavy duty tinned copper lugs for power cables 3. Solder less crimping type heavy duty copper lugs for control cables.
7	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. Makes of conduits shall be subject to customer/ BHEL approval at contract stage.
8	Lighting	BHEL	BHEL	
9	Equipment grounding & lightning protection	BHEL	BHEL	
10	Below grade grounding	BHEL	BHEL	
11	LT Motors with base plate and foundation hardware	Vendor	Vendor	Makes shall be subject to customer/ BHEL approval at contract stage.
12	Mandatory spares	Vendor	-	Vendor to quote as per specification.
13	Recommended O & M spares, E & C spares, erection & maintenance tools & tackle.	Vendor	-	As per specification
14	Any other equipment/material/service required for completeness of system but not specified above (to ensure trouble free and efficient operation of the	Vendor	Vendor	

S.NO	DETAILS	SCOPE SUPPLY	SCOPE E&C	REMARKS
	system).			
15	a) Input cable schedules (C & I) b) Cable interconnection details for above c) Cable block diagram	Vendor Vendor Vendor	- - -	Cable listing for C & I systems for vendor supplied equipment shall be furnished during detail engineering by vendor in soft copies in the BHEL cable schedule format.
16	Equipment layout drawings	Vendor	-	For ensuring cabling requirements are met, vendor shall furnish layout drawings (both in print form as well as in AUTOCAD) of the complete plant (including electrical area) indicating location and identification of all equipment requiring cabling, and shall incorporate cable trays routing details marked on the drawing as per PEM interface comments. Electrical equipment layout drawing shall be to BHEL approval.
17	Electrical Equipment GA drawing	Vendor	-	For necessary interface review.
18	Junction Boxes	Vendor	Vendor	Junction boxes shall be used to minimize/optimize the runs of cables between equipment


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. For skid mounted system, 2 nos. (1W+1S) supply of 415 V, 3 phase AC shall be provided by BHEL. Complete electrical distribution for the skid including changeover between feeder/starters/LCP/inter-locks/protection devices / any other supply etc. shall be in bidder's scope.

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	BOARD 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

ANNEXURE-II

NOTES: 1. COLUMN 1 TO 12 & 18 SHALL BE FILLED BY THE REQUISITIONER (ORIGINATING AGENCY); REMAINING COLUMNS ARE TO BE FILLED UP BY PEM (ELECTRICAL)
2. 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 (dc): 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.	391	ORIGINATING AGENCY		PEM (ELECTRICAL)	
		PROJECT TITLE	2x500 MW NEYVELI NEW THERMAL POWER STATION (NNTPS)	NAME		DATA FILLED UP ON	
		SYSTEM	FUEL OIL SYSTEM	SIGN.		DATA ENTERED ON	
		DEPTT. / SECTION	ELECTRICAL	SHEET 1 OF 1	REV. 00	DE'S SIGN. & DATE	Page 144 of 303

TITLE :
GENERAL TECHNICAL REQUIREMENTS
FOR
LV MOTORS

SPECIFICATION NO.
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GENERAL TECHNICAL REQUIREMENTS

FOR

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SPECIFICATION NO.: PE-SS-999-506-E101 Rev 00



TITLE :
GENERAL TECHNICAL REQUIREMENTS

FOR

LV MOTORS

SPECIFICATION NO.
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1.0 INTENT OF SPECIFICATION

The specification covers the design, materials, constructional features, manufacture, inspection and testing at manufacturer's work, and packing of Low voltage (LV) squirrel cage induction motors along with all accessories for driving auxiliaries in thermal power station.

Motors having a voltage rating of below 1000V are referred to as low voltage (LV) motors.

2.0 CODES AND STANDARDS

Motors shall fully comply with latest edition, including all amendments and revision, of following codes and standards:

IS:325	Three phase Induction motors
IS : 900	Code of practice for installation and maintenance of induction motors
IS: 996	Single phase small AC and universal motors
IS: 4722	Rotating Electrical machines
IS: 4691	Degree of Protection provided by enclosures for rotating electrical machines
IS: 4728	Terminal marking and direction of rotation rotating electrical machines
IS: 1231	Dimensions of three phase foot mounted induction motors
IS: 8789	Values of performance characteristics for three phase induction motors
IS: 13555	Guide for selection and application of 3-phase A.C. induction motors for different types of driven equipment
IS: 2148	Flame proof enclosures for electrical appliance
IS: 5571	Guide for selection of electrical equipment for hazardous areas
IS: 12824	Type of duty and classes of rating assigned
IS: 12802	Temperature rise measurement for rotating electrical machines
IS: 12065	Permissible limits of noise level for rotating electrical machines
IS: 12075	Mechanical vibration of rotating electrical machines

In case of imported motors, motors as per IEC-34 shall also be acceptable.

3.0 DESIGN REQUIREMENTS

3.1 Motors and accessories shall be designed to operate satisfactorily under conditions specified in data sheet-A and Project Information, including voltage & frequency variation of supply system as defined in Data sheet-A

3.2 Motors shall be continuously rated at the design ambient temperature specified in Data Sheet-A and other site conditions specified under Project Information
Motor ratings shall have at least a 15% margin over the continuous maximum demand of the driven equipment, under entire operating range including voltage & frequency variation specified above.

3.3 Starting Requirements

3.3.1 Motor characteristics such as speed, starting torque, break away torque and starting time shall be properly co-ordinated with the requirements of driven equipment. The accelerating torque at any speed with the minimum starting voltage shall be at least 10% higher than that of the driven equipment.

3.3.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.



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The limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value as per Data Sheet - A during the starting period of motors.

3.3.3 The following frequency of starts shall apply

- i) Two starts in succession with the motor being initially at a temperature not exceeding the rated load temperature.
- ii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature. (not to be repeated in the second successive hour)
- iii) Motors for coal conveyor and coal crusher application shall be suitable for three consecutive hot starts followed by one hour interval with maximum twenty starts per day and shall be suitable for minimum 20,000 starts during the life time of the motor

3.4 **Running Requirements**

3.4.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.

3.4.2 Motor shall not stall due to voltage dip in the system causing momentary drop in voltage upto 70% of the rated voltage for duration of 2 secs.

3.5 **Stress During bus Transfer**

3.5.1 Motors shall withstand the voltage, heavy inrush transient current, mechanical and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.5.2 Motor and driven equipment shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.6 Maximum noise level measured at distance of 1.0 metres from the outline of motor shall not exceed the values specified in IS 12065.

3.7 The max. vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 **CONSTRUCTIONAL FEATURES**

4.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. Outdoor motors shall be installed under a suitable canopy

4.2 Motors upto 160KW shall have Totally Enclosed Fan Cooled (TEFC) enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362.

Motors rated above 160 KW shall be Closed Air Circuit Air (CACA) cooled

4.3 Motors shall be designed with cooling fans suitable for both directions of rotation.



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- 4.4. Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.5 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.6 In case Class 'F' insulation is provided for LV motors, temperature rise shall be limited to the limits applicable to Class 'B' insulation.
In case of continuous operation at extreme voltage limits the temperature limits specified in table-1 of IS:325 shall not exceed by more than 10°C.
- 4.7 Terminals and Terminal Boxes**
- 4.7.1 Terminals, terminal leads, terminal boxes, windings tails and associated equipment shall be suitable for connection to a supply system having a short circuit level, specified in the Data Sheet-A.

Unless otherwise stated in Data Sheet-A, motors of rating 110 kW and above will be controlled by circuit breaker and below 110 kW by switch fuse-contactor. The terminal box of motors shall be designed for the fault current mentioned in data sheet "A".
- 4.7.2 unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.7.3 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A, C, B or U W & V respectively.
- 4.7.4 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.
- 4.7.5 Motor terminals and terminal leads shall be fully insulated with no bar live parts. Adequate space shall be available inside the terminal box so that no difficulty is encountered for terminating the cable specified in Data Sheet-A.
- 4.7.6 Degree of protection for terminal boxes shall be IP 55 as per IS 4691.
- 4.7.7 Separate terminal boxes shall be provided for space heaters.. If this is not possible in case of LV motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression brass glands shall be provided in terminal boxes.
- 4.7.8. Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree for LV motors.
- 4.7.9 Cable glands and cable lugs as per cable sizes specified in Data Sheet-A shall be included. Cable lugs shall be of tinned Copper, crimping type.
- 4.8 Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor of size given in Data Sheet-A shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.



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- 4.9.1 Motors provided for similar drives shall be interchangeable.
- 4.9.2 Suitable foundation bolts are to be supplied alongwith the motors.
- 4.9.3 Motors shall be provided with eye bolts, or other means to facilitate safe lifting if the weight is 20Kgs. and above.
- 4.9.4 Necessary fitments and accessories shall be provided on motors in accordance with the latest Indian Electricity rules 1956.
- 4.9.5 All motors rated above 30 kW shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Unless otherwise specified, space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.
- 4.9.6 Name plate with all particulars as per IS: 325 shall be provided
- 4.9.7 Unless otherwise specified, the colour of finish shall be grey to Shade No. 631 and 632 as per IS:5 for motors installed indoor and outdoor respectively. The paint shall be epoxy based and shall be suitable for withstanding specified site conditions.

5.0 INSPECTION AND TESTING

- 5.1 All materials, components and equipments covered under this specification shall be procured, manufactured, as per the BHEL standard quality plan No. PED-506-00-Q-006/0 and PED-506-00-Q-007/2 enclosed with this specification and which shall be complied.
- 5.2 LV motors of type-tested design shall be provided. Valid type test reports not more than 5 year shall be furnished. In the absence of these, type tests shall have to be conducted by manufacturer without any commercial implication to purchaser.
- 5.3 All motors shall be subjected to routine tests as per IS: 325 and as per BHEL standard quality plan.
- 5.4 Motors shall also be subjected to additional tests, if any, as mentioned in Data Sheet A.

6.0 DRAWINGS TO BE SUBMITTED AFTER AWARD OF CONTRACT

- a) OGA drawing showing the position of terminal boxes, earthing connections etc.
- b) Arrangement drawing of terminal boxes.
- c) Characteristic curves:
(To be given for motor above 55 kW unless otherwise specified in Data Sheet).
 - i) Current vs. time at rated voltage and minimum starting voltage.
 - ii) Speed vs. time at rated voltage and minimum starting voltage.
 - iii) Torque vs. speed at rated voltage and minimum voltage.
For the motors with solid coupling the above curves i), ii), iii) to be furnished for the motors coupled with driven equipment. In case motor is coupled with mechanical equipment by fluid coupling, the above curves shall be furnished with and without coupling.
 - iv) Thermal withstand curve under hot and cold conditions at rated voltage and max. permissible voltage.

NEYVELI NEW THERMAL POWER PROJECT (NNTPP)

2 X 500 MW LIGNITE FIRED UNIT AT NEYVELI.

(SG & TG PACKAGE)

**BASIC TECHNICAL FEATURES
FOR HT/LT MOTORS**

(FOR BHEL-PEM SCOPE PACKAGES)

DOC. NO. PE-DC-400-565-E003

REVISION 01



BHARAT HEAVY ELECTRICALS LIMITED

POWER SECTOR

POWER PROJECT ENGINEERING INSTITUTE

NOIDA (U.P), INDIA



**2x500 MW NEW NEYVELI TPP
(SG & TG PACKAGE)**

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

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1.0 This document covers the basic technical features of high tension (HT) and low tension (LT) squirrel cage induction AC motors employed for driving auxiliaries of BHEL-PEM scope packages in 2x500 MW New Neyveli Thermal Power project.

2.0 CODES AND STANDARDS

The motors shall generally conform to IS 325/IEC-60034. LT motors of continuous duty (S1) shall be energy efficient IE2 conforming to IS-12615.

3.0 DESIGN REQUIREMENTS

3.1 General Requirements

The design ambient temperature shall be 50 deg C.

3.2 Supply system and rated voltage of motors

KW rating	Supply system	Rated voltage of motor
Above 750 kW	11 KV	11 KV
Above 160 kW up to & including 750 kW	3.3 KV	3.3 KV
From 220W up to & including 160 kW	415 V	415 V
Below 220W	240V	240V

3.2.1 Supply voltage & variations shall be as follows:-

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

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

3.3 Motor Rating

Motor ratings shall be adequate to meet the requirements of the drive equipment. Motors shall be continuously rated at the design ambient temperature of 50 degree C and relative humidity of 85%. Maximum continuous motor ratings shall have at least a 15% margin above the maximum load demand of the driven equipment under entire operating range including voltage & frequency variation.

3.4 Starting Requirements

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

3.4.2 Motors shall be capable of starting and accelerating the load with direct on line starting without exceeding acceptable winding temperature.

For motors rated up to 1500 KW, the limiting value of voltage at rated frequency under which a motor will successfully start and accelerate to rated speed with load shall be taken to be a constant value of 85 (eighty five) percent rated voltage at motor terminals.



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3.4.3 ~~The locked rotor current of the 11 kV motors (except MDBFP motors & CWP motors) shall not exceed six times full load current inclusive of tolerance as per IS:325 and for 3.3 kV motors locked rotor current shall not exceed six times full load current subject to IS tolerance as per IS:325. For LT motors of continuous duty (S1) type motors, starting current shall be as per IS: 12615.~~

3.4.4 The following frequency of starts shall apply

- i) Three nos. consecutive cold starts in succession with the motor being initially at a temperature not exceeding the ambient temperature.
- ii) Two nos. consecutive hot starts in succession with the motor being initially at a temperature not exceeding the rated load operating temperature.
- iii) Three equally spread starts in an hour the motor being initially at a temperature not exceeding the rated load operating temperature.(not to be repeated in the second successive hour)
- iv) ~~In case of multiple start motors like conveyor motors three starts shall be allowable from hot condition with maximum 20 starts per day & minimum 20,000 starts during life time of motors.~~

3.4.5 Locked motor withstand time of motors under hot condition at 110% rated voltage shall be as follows:

For HT Motors

- a) For motors more than starting time by at least 3 sec or 15% of the accelerating time whichever is greater.

For LT Motors

- a) For motors with starting time up to 20 sec.
 - at least 2.5 sec. more than starting time.
- b) For motor with starting time above 20 secs but not exceeding 45 secs.
 - at least 5.0 sec. more than starting time.
- c) For motors with starting time above 45 secs.
 - at least 10%. more than starting time.

The starting time of the motor referred above is at minimum permissible voltage. For motors and in cases where the above requirements are not complied with, speed switches of approved make & type shall be provided to bypass the locked rotor protection for a pre-selected time during starting of motors. The speed switches shall have one NO & one NC contacts having maximum interrupting capacity of 5 Amps at 240V AC and 0.25 amps at 220 V DC.

3.5 Running Requirements

3.5.1 Motors shall run satisfactorily at a supply voltage of 75% of rated voltage for 5 minutes with full load without injurious heating to the motor.



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3.5.2 Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.

3.6 Stress during bus Transfer

3.6.1 Motors shall withstand the voltage and torque stress developed due to the application of 150% of the rated voltage for at least 1 sec. caused due to vector difference between the motor residual voltage and the incoming supply voltage during occasional auto bus transfer.

3.6.2 Motor windings shall be adequately braced to satisfactorily withstand the mech. Stresses during above condition.

3.6.3 Motors shall be capable of withstanding heavy in-rush transient current caused by bus transfer without damage.

3.6.4 Motor and driven eqpt. Shafts shall be adequately sized to satisfactorily withstand transient torque under above condition.

3.7 Noise level

Maximum noise level measured at distance of 1.5 metres from the outline of motor shall not exceed 85 db(A) in line with IS 12065.

3.8 Vibration

The maximum vibration velocity or double amplitude of motors vibration as measured at motor bearings shall be within the limits specified in IS: 12075.

4.0 CONSTRUCTIONAL FEATURES

4.1 Degree of Protection

4.1.1 Indoor motors shall conform to degree of protection IP: 54 as per IS: 4691. Outdoor or semi-indoor motors shall conform to degree of protection IP: 55 as per IS: 4691 and shall be of weather-proof construction. The degree of protection for terminal boxes shall be IP 55 for outdoor area & IP 54 for indoor area as per IS 4691.

4.1.2 The stator laminations shall made from suitable silicon steel/magnetic steel sheet varnished on both sides and pressed to form a rigid core.

4.1.3 The rotor shall be of rigid cage construction with die cast aluminium / copper alloy / copper bars firmly wedged in bar slots and brazed to the end rings. The rotor cage shall be designed to operate satisfactorily under respective starting and load duty cycle.

4.2 Enclosure and Cooling

4.2.1 Motors shall generally have totally enclosed fan cooled (TEFC) or totally enclosed tube ventilated (TETV enclosures, the method of cooling conforming to IC-0141 or IC-0151 of IS: 6362. ~~Motors may~~



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~~have Closed Air circuit Air (CACA) method of cooling conforming to IC-0161 of IS: 6362 for motor rated 3000kW & above.~~

- 4.2.2 Motors shall not be provided with any electric or pneumatic operated external fan for cooling the motors.
- 4.2.3 Frames shall be designed to avoid collection of moisture and all enclosures shall be provided with facility for drainage at the lowest point.
- 4.3 Class of Insulation
- HT/LT motors shall have class F insulation. The temperature rise of all motors shall be limited to the limits applicable to Class 'B' insulation. In case of continuous operation at extreme voltage limits, 10deg C rise above the temperature limits specified in IS: 325 shall be permissible.
- 4.4 Bearings
- 4.4.1 Horizontally mounted motors shall have grease lubricated ball/roller or sleeve bearings. For MV motors, the bearings shall be regreasable type and for LV motors, these bearings can be either sealed life lubricated type or regreasable type as per manufacturer's standard.
- 4.4.2 The vertical motors shall have a combined thrust and guide bearing on top and guide bearing at bottom. If the ball or roller bearings can take vertical thrust, thrust and guide bearing need not be provided.
- 4.4.3 After taking all motor driven equipment loads and thrust (if any) into account , the bearings shall be suitable for min. 40,000 working hours. Re-greasable bearings shall be provided with grease nipples and relief holes for on-line re-greasing and shall be suitable for 8000 working hours without changing of the grease.
- 4.4.4 The bearings of solidly coupled motors shall be of the same type as those of the driven equipment.
- 4.4.5 For motors upto 2 kW, double sealed type bearings shall be provided.
- 4.4.6 Motors rated above 1000kW shall be provided with insulated end shield on non-driving end to prevent flow of shaft current.
- 4.5 Terminals and Terminal Boxes
- 4.5.1 Motors of rating 90 kW and up to 160kW will be controlled by air circuit breaker & shall be provided with comprehensive numerical motor protection relays. For all motors of rating 45 kW & above but less than 90kW shall be provided with MCCBs with CT operated electronic over load relays. Motors of rating above 18.5 kW & below 45 kW shall be provided with MCCBs and motors of rating up to 18.5 kW shall be provided with MPCBs. The terminal box of motors shall be designed for the fault current of 44 kA, 0.25 secs and 50 kA, 0.25 secs for HT & LT motors respectively.
- 4.5.2 Unless otherwise specified or approved, phase terminal boxes of horizontal motors shall be positioned on the left hand side of the motor when viewed from the non-driving end.
- 4.5.3 For MV motors, the main terminal box shall be of phase-segregated type with clamping arrangement for the terminals.



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4.5.4 Connections shall be such that when the supply leads R, Y & B are connected to motor terminals A B & C or U, V & W respectively, motor shall rotate in an anticlockwise direction when viewed from the non-driving end. Where such motors require clockwise rotation, the supply leads R, Y, B will be connected to motor terminals A,C,B or V, W & U respectively.

4.5.5 Permanently attached diagram and instruction plate made preferably of stainless steel shall be mounted inside terminal box cover giving the connection diagram for the desired direction of rotation and reverse rotation.

4.5.6 Motor terminals and terminal leads shall be fully insulated with no bar live parts.

4.5.7 Separate terminal boxes shall be provided for space heaters and temp. Indicators. If this is not possible in case of LT motors, the space heater terminals shall be adequately segregated from the main terminals in the main terminal box. Detachable gland plates with double compression tinned brass glands shall be provided in terminal boxes.

4.5.8 Phase terminal boxes shall be suitable for 360 degree of rotation in steps of 90 degree.

4.5.9 Cable glands and cable lugs as per selected cable sizes shall be provided in line with cable erection philosophy. For single core cable termination, gland plates shall be of non-magnetic material.

4.6 Grounding

Two separate earthing terminals suitable for connecting G.I. or MS strip grounding conductor shall be provided on opposite sides of motor frame. Each terminal box shall have a grounding terminal.

4.7 General

4.7.1 Motors provided for similar drives shall be interchangeable.

4.7.2 An arrow block shall be screwed on the body of the motors on the non-driving end to indicate the direction of rotation of the motors.

4.7.3 Motors for Fuel oil unloading and drain oil pumps located in hazardous areas shall be with flame-proof enclosures in accordance with IS 2148 / IEC 60079.

5.0 ACCESSORIES

5.1 SPACE HEATERS

All motors rated 30KW and above shall be provided with space heaters to maintain the motor internal air temperature above the dew point. Space heaters shall be suitable for a supply of 240V AC, single phase, 50 Hz.

The leads from space heaters of each motor shall be brought out to a separate terminal Box. Space heaters shall be mounted inside the motor in accessible places so that their removal and replacement is simple.

5.2 RESISTANCE TEMPERATURE DETECTORS (RTDs)



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5.2.1 ~~HT motors stator windings shall be provided with 12 nos. (4 per phase) Simplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of winding temperature. The leads from RTDs of each motor shall be brought out to a separate terminal Box.~~

5.2.2 ~~For HT motors, each bearing shall be provided with 1 no. Duplex 3 wire Platinum RTDs with 100 ohms resistance at 0 deg C for remote monitoring of bearing temperature. The leads from these RTDs shall be brought out to a separate terminal Box or the terminal box same as for winding RTDs.~~

~~5.3 DIAL TYPE TEMP. INDICATORS~~

~~5.3.1 For HT motors, each bearing shall be provided with 1 no. Mercury-in-steel Dial type temperature indicator for local indication of bearing temperature. The indicators shall have 2 nos. NO contacts rated for 5A, 240 V AC and 0.5 A, 220 V DC for alarm/trip purpose.~~

~~5.4 Vibration monitoring pads~~

~~5.4.1 Provision shall be made in all HT motors for mounting vibration detectors.~~

6.0 NAME PLATE

Motors shall have stainless steel name plate with all particulars as per IS: 325 / NEMA-MG-1. In addition, the following information shall be shown on motor rating plates:

- i) Type of bearing & recommended lubricants along with location of insulated bearing.
- ii) Temperature rise in deg.C under normal/abnormal conditions.
- iii) Year of manufacturing.

7.0 PAINTING

The paint shall be corrosion proof epoxy based of approved class and paint thickness shall be within 100 to 150micron.

8.0 TESTING

8.1 Type Tests

For HT & LT Motors above 50kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening viz. February 2012 shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.

8.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.



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FOR

CABLING INSTALLATION

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FOR

CABLING INSTALLATION

SPECIFICATION NO.: PE-SS-999-507-E111 REV 0



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GENERAL TECHNICAL REQUIREMENTS
FOR
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1.0 INTENT OF SPECIFICATION

1.1 This specification covers the activities mentioned below, as applicable to various areas of power station:

- b) Laying and termination of cables.
- c) Testing and charging of cables.
- d) Supply and erection of miscellaneous items for completion of the cabling system.
- e) All associated work for completion of cabling system.
- f) Receipt of cables and cabling materials supplied by purchaser/others.
- g) Site handling and storage of material.
- h) Minor civil works.

1.2 The scope of supply of cabling materials as a part of cable installation work includes supply of all accessories including, but not limited to, cable clamps, ferrules, cable tags, nuts, bolts, and consumables like anti-corrosive paints, welding electrodes etc. required to complete the cabling system. All other sundry materials for minor civil work shall also be supplied by vendor.

1.3 WORKS EXCLUDED FROM VENDOR'S SCOPE

- a) Major civil works like excavation and concreting of concrete trenches, plate embedments on cable trenches, ceiling and floors.
- b) Civil works for ducting for crossing of roads & rail tracks.
- c) Conduits and pipes embedded in walls, floors etc.

2.0 CODES AND STANDARDS

2.1 Installation of cabling work shall comply with the latest edition of following Indian standards rules, regulations and acts. However, if Specification specifies conformance to any other international standard, equivalent BS / IEC / ISO / any other standard shall be applicable.

- a) IS:1255 Code of practice for installation and maintenance of power cables up to and including 33 kV rating.
- b) IS:732 Electrical wiring installation (system voltage not exceeding 650 V).
- c) IS:5216 Guide for safety procedures and practices in electrical works.
- d) IS:226 Structural steel (Standard Quality).
- e) IS:800 Code of practice for use of structural steel.
- f) IS:316 Code of practice for use of metal arc welding for general construction in mild steel.
- g) IS:1363 Hexagonal bolts, nuts and screws.
- h) IS:1572 Electroplated coatings of cadmium on iron and steel.
- i) IS:2629 Code of practice for hot dip galvanizing for iron and steel.
- j) IS:2633 Method of testing uniformity of coating on zinc coated articles.
- k) Indian Electricity Act.
- l) Indian Electricity Rules.
- m) Fire insurance regulations.
- n) Regulations laid down by the Chief Electrical Inspector of the State.
- o) Regulations laid down by the Factory Inspector of the State.
- p) Any other regulations laid down by the authorities.

2.2 In case any clause of contradictory nature arises between standards and this specification, the latter shall prevail.

3.0 CABLING MATERIALS TO BE PROVIDED



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- 3.1 Trefoil Cable Clamps shall be provided for clamping single core cables carrying alternating current and shall be of aluminium alloy or nylon material as per Specification.
- 3.2 Omega Cable Clamps shall be provided to fasten the individual multi-core cable above 35mm outer diameter and shall be of aluminium alloy or mild steel.
- 3.3 Strip Cable Clamps shall be provided to fasten the group of multi-core cables up to 35mm diameter and shall be of mild steel or aluminium
- 3.4 Self Locking Clamps shall be shall be provided of nylon material with self locking feature when the cord is looped and shall provided with manual lock release.
- 3.4 Steel clamps shall be hot dip galvanized as per the requirements given in Specification.
- 3.5 Ferrules shall be provided for individual core of control cables and shall be of plastic material.
- 3.6 Cables shall be provided with cable number tags for identification Cable tags shall be of durable fibre, aluminium or stainless steel sheets as per Specification.
- 3.7 Miscellaneous items required for the buried cables such as cable markers, bricks, sand, protective slabs etc. shall be to provided by the vendor.

4.0 **CABLING CONCEPT**

- 4.1 In the plant building, substations, switchgear rooms, control rooms etc., power and control cables shall generally be laid on cable trays installed in concrete trenches, tunnels, cable basements, cable vaults, cable shafts or along building and technological structures as the case may be.
- 4.2 In case of multicore cables of diameter up to 30 mm where not more than 3 cables are taken in one run, these can be taken directly along structures, walkways, platforms, galleries, walls, ceiling etc. by proper clamping at regular intervals of 750 mm or less.
- 4.3 Power & control cables installed along buildings, structures, ceilings, walls, etc., which are required to be protected against mechanical damage, shall be taken in GI conduits.
- 4.4 GI Conduits shall also be used for flameproof installations, wherever required, with sealing at both ends.
- 4.5 Entry of cables from trenches/tunnels into buildings shall be by means method duly approved by purchaser approved, which shall be informed to successful bidder during detailed engg stage.
- 4.6 Cables laid exposed in racks/trays and routed from trenches/tunnels/basements etc to individual drive/ control devices etc shall be taken in embedded/exposed/surface-grouted rigid GI conduits and / or flexible conduits unless directly terminated to the equipment in the panels located above trenches, tunnels or basement.
- 4.7 All cables routed along walls or in equipment rooms shall be protected by means of laying them through G.I. pipes or by providing sheet metal covers up to a height of 2000 mm from the working floor levels and platforms, for protection against mechanical damage. All vertical risers shall be enclosed type.



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- 4.8 For 415 V power wiring in ancillary buildings, offices and laboratories, cables shall be taken through embedded/exposed GI conduits or rigid PVC pipes as applicable.
- 4.9 Wherever cables are to be laid below roads and railway tracks, the same shall be taken through ducts buried at a suitable depth.
- 4.10 At certain places where hazardous fumes/gases may cause fire to the cables, cable trenches after installation of cables shall be sand-filled.
- 4.11 In corrosive atmosphere, Epoxy painted G.I. conduits shall be used for cables.
- 4.12 Single core cables, when pulled individually, shall be taken through PVC pipes only.
- 4.13 Cables shall be avoided below oil pipes and in the vicinity of steam pipes.
- 4.14 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services
- 4.15 All apparatus, connections and cable work shall be designed and arranged to minimise the risk of fire and ingress of water. All material required to achieve the same shall be included in the cost of installation of cables.
- 5.0 TRANSPORTATION & STORAGE OF CABLE DRUMS**
- 5.1 Transportation and storage of cable drums shall generally conform to the requirements of IS:1255. The cable drums shall be transported on wheels to the place of work.
- 5.2 Transportation of all cables, which shall be provided by purchaser as free issue items, from purchaser's storage area to the work site shall be the responsibility of vendor. Empty cable drums shall be returned to purchaser.
- 6.0 LAYING OF CABLES**
- 6.1 Laying and installation of power, control and special cables shall generally conform to IS:1255.
- 6.2 The cables shall be paid-out in proper direction from the cable drums (opposite to the normal direction of rotation for transportation).
- 6.3 In case of higher size cables, the paid out cables shall run over rollers placed at close intervals and finally transferred carefully on the racks/trays. Care shall be taken so that kinks and twists or any mechanical damage does not occur to cables. Only approved cable pulling grips or other devices shall be used. Under no circumstances cables shall be dragged on ground or along structure while paying out from cable drums, carrying to site and straightening for laying purpose.
- 6.4 All possible care shall be given while handling un-armoured cables.
- 6.5 Additional length of power cables of one loop with permissible bending radius shall be provided. For control cables extra length of 1 - 1.5 metre shall be provided.
- 6.6 The bending radius of various types of cables shall not be less than those specified by cable manufacturers and that specified in IS:1255.



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- 6.7 All cables shall be provided with identification tags indicating the cable numbers. Tags shall be fixed at both ends of cables, at each bend, and both sides of floor/wall crossings.
- 6.8 Single core cables for a. c. circuits shall form a complete circuit in trefoil formation supported by means of trefoil clamps of nonmagnetic material.
- 6.9 Multi-core cables above 1100 V grade shall be generally laid in ladder type trays in one layer with spacings not less than one cable diameter of bigger diameter cable.
- 6.10 All 1100 V grade multicore power cables and single core DC cables shall be placed in single layer, touching each other and clamped by means of single or multiple galvanized MS saddles/ aluminium strips/ nylon cable ties as specified in specification. Cables above 35mm outer diameter shall be clamped individually.
- 6.11 Control cables shall be laid touching each other and may not preferably be taken in more than two layers.
- 6.12 Segregation of the cables on the basis of their types and their functions shall be as under for horizontal formations:
a) HT cables shall be laid in the top tier(s).
b) LT power cables to be laid in the tray(s) below the HT cable trays.
c) LT control cables to be laid in the tray(s) next below to the LT power Cable tray(s).
d) Special control cables including screened control cables to be laid in the bottom most tray(s).
- 6.13 For vertical formations, the tray closest to the wall shall be considered as bottom most tray and the order indicated in clause just above shall be followed.
- 6.14 When it may not be possible to accommodate cables as per the criteria indicated in the clauses 6.12 & 6.13 above, the following rules In hierarchical order shall override the criteria:
a) Control cables are mixed up with the special control cables with clear minimum gap of 100mm between them.
b) LT power cables are mixed up with control cables with clear minimum gap of 150mm between them.
c) LT power cables are mixed up with HT power cables with clear minimum gap of 200mm between them.
However, under no circumstances HT power cables can be mixed up with control cables of any type.
- 6.15 For laying cables along building steel structures and technological structures, the cables shall be taken by clamping with MS saddles screwed to the MS flats welded to the structure. MS saddles and flats shall be galvanized.
- 6.16 For laying cables along concrete walls, ceilings etc., the cables shall be taken by clamping with MS saddles screwed to the MS flats welded on the inserts. Where inserts are not available the saddles shall be directly fixed to the walls using rawl plugs and MS flat spacers of minimum 6mm thickness.
- 6.17 To facilitate pulling of cables in GI conduits, powdered soft stone, plastic soap or other dry inert lubricant may be used but grease or other material harmful to the cable sheaths shall not be used.
- 6.18 No single core cable shall pass through a GI conduit or duct singly except DC single core cables. AC single core cables shall pass through GI conduits/pipes in trefoil formation only.



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6.19 Entry of cables from underground trenches to the buildings or tunnels shall be by some approved method. Necessary precautions shall be taken to make the entry point fully water tight by properly sealing the pipe sleeves wherever they enter directly into the building at trench level. The sealing shall be by cold setting compound. Any alternative sealing arrangement may be suggested with the offer for purchaser's consideration.

7.0 CABLE TERMINATION AND JOINTING

7.1 All cable entries in the equipment shall be sealed by cable glands.

7.2 Power cable terminations shall be carried out in a manner such as to avoid strain on the terminals by providing suitable clamps near the terminals.

7.3 Control cable cores entering switchboard or control panels shall be neatly bunched and strapped with PVC perforated tapes/nylon ties and suitably supported to keep them in position at the terminal block. Spare cores shall be neatly dressed and suitably taped at both ends.

7.4 Cable joint, not more than one in a circuit, shall normally be made at an intermediate point in the straight run of the cable only when the length of the run is more than the standard drum length supplied by the cable manufacturer.

7.5 Junction boxes shall be used, wherever required, for jointing of control cables.

7.6 Termination and jointing shall generally conform to the requirements of IS:1255 and shall strictly conform to the recommendations of termination and jointing kit supplier.

7.3 Cable installation shall be properly coordinated at site with other services and wherever necessary suitable adjustment shall be made in the cable routings with a view to avoid interference with any part of the building, structures, equipment, utilities and services

7.8 All apparatus, connections and cable work shall be designed and arranged to minimise the risk of fire and ingress of water. All material required to achieve the same shall be included in the cost of installation of cables.

10.0 DRAWINGS / DOCUMENTS TO BE SUBMITTED AFTER AWARD OF CONTRACT

10.2 The following documents shall be furnished after award of contract for purchaser's approval.

- a) Final Field Quality Plan.
- b) Final Quality Plan.



TITLE

LV MOTORS**DATA SHEET-A**2x500 MW NEYVELI NEW THERMAL POWER
STATION (NNTPS)

SPECIFICATION NO. PE-TS-400--552-A000

VOLUME II B

SECTION D

REV NO. DATE

SHEET 1 OF 2

- 1.0 Design ambient temperature : 50 °C
- 2.0 Maximum acceptable kW rating of LV motor : 160KW *
- 3.0 Installation (Indoors/ Outdoors) : As required
- 4.0 Details of supply system
- a) Rated voltage (with variation) : 415V ± 10%
 - b) Rated frequency (with variation) : 50 Hz + 3 % to - 5%
 - c) Combined voltage & freq. variation : 10% (sum of absolute values)
 - d) System fault level at rated voltage : 50 kA for 1 sec
 - e) Short time rating for terminal boxes
 - o 90 kW and above (Breaker controlled) : 50 KA for 0.25 sec.
 - o Below 90 kW (Contactor controlled) : 50 KA protected by HRC fuse
 - f) LV System grounding : Solidly
- 5.0 Class of insulation : Class 'F', with temp rise limited to class B.
- 6.0 Minimum voltage for starting (As percentage of rated voltage) : 85% of rated voltage
- 7.0 Power cables data : Shall be given during Detailed engg
- 8.0 Earth Conductor Size & Material : Shall be given during Detailed engg
- 9.0 Space heater supply : 240 V, 1ϕ , 50 Hz(for motors above 30 Kw)
- 10.0 Rating up to which Single phase motor : Acceptable below 0.20 kW
- 11.0 Locked rotor current
- a) Limit as percentage of FLC : As per IS 12615*
- 12.0 Flame-proof motor
- a) Enclosure suitable (As per IS:2148) : As per requirement
 - b) Classification of Hazardous area (As per IS: 5572 part-I) : As per requirement
- 13.0 Makes : BHEL/ Customer approval
- 14.0 Paint shade : Shall be given during Detailed engg
- 15.0 Degree Of protection for motor/ terminal box : As per IS 4691



TITLE

LV MOTORS**DATA SHEET-A**2x500 MW NEYVELI NEW THERMAL POWER
STATION (NNTPS)

SPECIFICATION NO. PE-TS-400--552-A000

VOLUME II B

SECTION D

REV NO. DATE

SHEET 1 OF 2


*** LT motors of continuous duty shall be energy efficient IE2 class conforming to IS12615**

16.0 TESTING**16.1 Type Tests**

For HT & LT Motors above 50kW, type test reports for type tests as per IS: 325/ IS: 12615 conducted on equipment similar to those proposed to be supplied and carried out within last five years from the date of bid opening viz. February 2012 shall be submitted. However, if such reports are not available, one motor of each type shall be subjected to type tests for free of cost.


16.2 Routine Tests

All motors shall be subjected to routine tests as per IS: 325/ IS: 12615 in the presence of customer or customer representative.

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 1 OF 2

S. No.	Description	Data to be filled by successful bidder
A.	General	
1	Manufacturer & country of origin	
2	Motor type	
3	Type of starting	
4	Name of the equipment driven by motor & Quantity	
5	Maximum Power requirement of driven equipment	
6	Rated speed of Driven Equipment	
7	Design ambient temperature	
B.	Design and Performance Data	
1	Frame size & type designation	
2	Type of duty	
3	Rated Voltage	
4	Permissible variation for	
5	a) Voltage	
6	b) Frequency	
7	c) Combined voltage & frequency	
8	Rated output at design ambient temp (by resistance method)	
9	Synchronous speed & Rated slip	
10	Minimum permissible starting voltage	
11	Starting time in sec with mechanism coupled	
12	a) At rated voltage	
13	b) At min starting voltage	
14	Locked rotor current as percentage of FLC (including IS tolerance)	
15	Torque	
	a) Starting	
	b) Maximum	
16	Permissible temp rise at rated output over ambient temp & method	
17	Noise level at 1.0 m (dB)	
18	Amplitude of vibration	
19	Efficiency & P.F. at rated voltage & frequency	
	a) At 100% load	
	c) At 75% load	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			

	TITLE	SPECIFICATION NO.
	MOTOR DATA SHEET - C	VOLUME II B
		SECTION D
		REV NO. 00 DATE
		SHEET 2 OF 2

S. No.	Description	Data to be filled by successful bidder
	c) At starting	
C.	Constructional Features	
1	Method of connection of motor driven equipment	
2	Applicable Standard	
3	DOP of Enclosure	
4	Method of cooling	
5	Class of insulation	
6	Main terminal box	
	a) Type	
	b) Power Cable details (Conductor, size, armour/unarmour)	
	c) Cable Gland & lugs details (Size, type & material)	
	d) Permissible Fault level (kArms & duration in sec)	
7	Space heater details (Voltage & watts)	
8	Flame proof motor details (if applicable)	
	a) Enclosure	
	b) suitability for hazardous area	
	i Zone	O / I / II
	ii Group	IIA / IIB / IIC
9	No. of Stator winding	
10	Winding connection	
11	Kind of rotor winding	
12	Kind of bearings	
13	Direction of rotation when viewed from NDE	
14	Paint Shade & type	
15	Net weight of motor	
16	Outline mounting drawing No (To be enclosed as annexure)	
D.	Characteristic curves/ drawings (To be enclosed for motors of rating $\geq 55KW$)	
	a) Torque speed characteristic	
	b) Thermal withstand characteristic	
	c) Current vs time	
	d) Speed vs time	

NAME OF VENDOR			SEAL	REV.	
NAME	SIGNATURE	DATE			



QUALITY PLAN

SHEET 1 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
SYSTEM	ITEM: AC ELECT. MOTORS 55 KW & ABOVE (LV & MV)	SECTION VOLUME III

1	2	3	4	5	6	7	8	9	10			11
									P	W	V	
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	

BHEL	PARTICULARS	BIDDER/VENDOR
	NAME	
	SIGNATURE	
	DATE	
		BIDDER'S/VENDORS COMPANY SEAL




QUALITY PLAN

SHEET 2 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
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
1.5	SHAFT (FORGED OR ROLLED)	1. SURFACE COND. 2. CHEM. & PHYSICAL PROPERTIES 3. DIMENSIONS 4. INTERNAL FLAWS	MA MA MA CR	VISUAL CHEM. & PHYSICAL TESTS MEASUREMENT UT	100% 1/HEAT NO. OR HEAT TREATMENT BATCH NO 100% -DO-	- MFG. DRG. SPEC. -DO- ASTM-A388	FREE FROM VISUAL DEFECTS RELEVANT IS MANUFR'S DRG. MANUFR'S SPEC. BHEL SPEC.	-DO- SUPPLIER'S TC LOG BOOK -DO-	3 3 3 3	- - - 2	- 2 2 1	VENDOR'S APPROVAL IDENTIFICATION SHALL BE MAINTAINED FOR DIA OF 55 MM & ABOVE
1.6	SPACE HEATERS, CONNECTORS, TERMINAL BLOCKS, CABLES, CABLE LUGS, CARBON BRUSH TEMP. DETECTORS, RTD, BTD'S	1. MAKE & RATING 2. PHYSICAL COND. 3. DIMENSIONS (WHEREVER APPLICABLE) 4. PERFORMANCE/ CALIBRATION	MA MA MA MA	VISUAL -DO- MEASUREMENT TEST	-DO- -DO- SAMPLE 100%	MANUFR'S DRG. SPEC. - MANUFR'S DRG./ SPEC. -DO-	MANUFR'S DRG. SPEC. NO PHYS. DAMAGE, NO ELECTRICAL DISCONTINUITY MANUFR'S DRG. / SPEC. -DO-	-DO- -DO- -DO- INSP. REPORT	3 3 3 3	- - - -	2 2 2 2	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN			CUSTOMER :			PROJECT			SPECIFICATION :		
					BIDDER/ VENDOR			TITLE			NUMBER :		
SHEET 3 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	
1.7	OTHER INSULATING MATERIALS LIKE SLEEVES, BINDINGS CORDS, PAPERS, PRESS BOARDS ETC.	1. SURFACE COND. ETC. 2. OTHER CHARACTERISTICS	MA MA	VISUAL TEST	100% SAMPLE	- MANUF'S SPEC.	NO VISUAL DEFECTS MANUF'S SPEC.	INSPT. REPORT LOG BOOK AND OR SUPPLIER'S TC	3 3	- -	2 2		
1.8	SHEET STAMPING (PUNCHED)	1. SURFACE COND. 2. DIMENSIONS INCLUDING BURS HEIGHT 3. ACCEPTANCE TESTS	MA MA MA	VISUAL MEASUREMENT ELECT. & MECH TESTS	100% SAMPLE -DO-	- MANUFR'S DRG. . MANUF'S SPEC./ RELEVANT IS	NO VISUAL DEFECTS (FREE FROM BURS) MANUFR'S DRG. RELEVANT IS	LOG BOOK -DO- SUPPLIER'S TC	3 3 3	- -	- 2 2		
1.9	CONDUCTORS	1. SURFACE FINISH 2. ELECT. PROP, & MECH. PROP	MA MA	VISUAL ELECT. & MECH. TEST	100% SAMPLES	- RELEVANT IS/ BS OR OTHER STANDARDS	FREE FROM VISUAL DEFECTS RELEVANT IS/ BS OR OTHER STANDARDS	LOG BOOK SUPPLIERS TC & VENDOR'S INSPN. REPORTS	3* 3	- -	2* 2	* 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.	
BHEL			PARTICULARS			BIDDER/VENDOR							
			NAME										
			SIGNATURE										
			DATE			BIDDER'S/VENDORS COMPANY SEAL							



QUALITY PLAN

SHEET 4 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

NUMBER :

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			REMARKS
									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	
1.11	SLIP RING (WHEREVER APPLICABLE)	3.SURFACE FINISH	MA	VISUAL	100%	-	FREE FROM VISUAL DEFECTS	-DO-	3	-	2	
		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	
1.12	OIL SEALS & GASKETS	4.HV/IR	MA	-DO-	100%	-DO-	-DO-	-DO-	3	-	2	
		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	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE									BIDDER'S/VENDORS COMPANY SEAL



QUALITY PLAN

SHEET 5 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
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
2.0	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	MANUF'R'S SPEC./ BHEL SPEC./	-DO-	2	-	1	
2.3	PAINING	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						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 6 OF 9

CUSTOMER :

PROJECT
TITLE

SPECIFICATION :
NUMBER :

BIDDER/
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

SPECIFICATION :
TITLE

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	-	-	
		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 MOTORS OF 2MW AND ABOVE) * ON 10% RANDOM SAMPLE
		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	FOR MV MOTOR
2.6	IMPREGNATION	1.VISCOSITY	MA	PHY. TEST	AT STARTING	-DO-	-DO-	Log Book	2	-	-	
		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	THREE DIPS TO BE GIVEN
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 7 OF 9

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/
VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-007, REV-03

NUMBER :

SPECIFICATION :
TITLE

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
2.7	COMPLETE STATOR ASSEMBLY	4.DURATION 1.COMPACTNESS & CLEANLINESS	MA MA	-DO- VISUAL	-DO- 100%	-DO- -DO-	-DO- -DO-	Log Book Log Book	2 2	- -	1 -	
2.8	BRAZING/COMPRESSION JOINT	1.COMPLETENESS 2.SOUNDNESS	CR CR	-DO- MALLET TEST & UT	-DO- -DO-	-DO- -DO-	-DO- -DO-	Log Book Log Book	2 2	- -	- 1	
2.9	COMPLETE ROTOR ASSEMBLY	3.HV 1.RESIDUAL UNBALANCE	MA CR	ELECT. TEST DYN. BALANCE	-DO- -DO-	-DO- MFG SPEC./ ISO 1940	-DO- MFG. DWG.	Log Book Log Book	2 2	- -	1 1	VERIFICATION FOR MV MOTOR ONLY
2.10	ASSEMBLY	2.SOUNDNESS OF DIE CASTING 1.ALIGNMENT 2.WORKMANSHIP 3.AXIAL PLAY 4.DIMENSIONS 5.CORRECTNESS, COMPLETENESS TERMINATIONS/ MARKING/ COLOUR CODE 6. RTD, BTD & SPACE HEATER MOUNTING.	CR MA MA MA MA MA MA	ELECT. (GROWLER TEST) MEAS. VISUAL MEAS. -DO- VISUAL	-DO- -DO- -DO- -DO- 100%	-DO- -DO- -DO- MFG.DRG./ MFG SPEC. MFG SPEC. RELEVANT IS	-DO- -DO- -DO- MFG. DRG/ RELEVANT IS MFG SPEC. RELEVANT IS	Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2	- - - - -	- - 1 - -	
BHEL			PARTICULARS		BIDDER/VENDOR							
			NAME									
			SIGNATURE									
			DATE									
									BIDDER'S/VENDORS COMPANY SEAL			



QUALITY PLAN

SHEET 8 OF 9

CUSTOMER :			PROJECT TITLE			SPECIFICATION : NUMBER :		
BIDDER/ VENDOR :			QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03			SPECIFICATION : TITLE		
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
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

BHEL			PARTICULARS			BIDDER/VENDOR					
			NAME								
			SIGNATURE								
			DATE						BIDDER'S/VENDORS COMPANY SEAL		



QUALITY PLAN

SHEET 9 OF 9

CUSTOMER :	PROJECT TITLE	SPECIFICATION : NUMBER :
BIDDER/ VENDOR :	QUALITY PLAN NUMBER PED-506-00-Q-007, REV-03	SPECIFICATION : TITLE
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.

Legends for Inspection agency

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	CUSTOMER :			PROJECT			SPECIFICATION :			
			BIDDER/ VENDOR :			TITLE			NUMBER :			
SHEET 1 OF 2		SYSTEM			QUALITY PLAN NUMBER PED-506-00-Q-006, REV-01			SPECIFICATION TITLE				
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	SECTION VOLUME III			
1	2	3	4	5	6	7	8	9	P	W	V	REMARKS
1.0	ASSEMBLY	1.WORKMANSHIP 2.DIMENSIONS 3.CORRECTNESS COMPLETENESS TERMINATIONS/ MARKING/COLOUR CODE	MA MA MA	VISUAL -DO- VISUAL	100% -DO- 100%	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC./ RELEVANT IS	MANUF'S SPEC MFG. DRG./ MFG. SPEC. MFG.SPEC. RELEVANT IS	-DO- -DO- -DO-	2 2 2	- - -	- - -	
2.0	PAINTING	1.SHADE	MA	VISUAL	SAMPLE	MANUFR'S SPEC/BHEL SPEC./RELEVANT STANDARD	BHEL SPEC. SAME AS COL.7	LOG BOOK	2	-	-	
3.0	TESTS	1.ROUTINE TEST INCLUDING SPECIAL TEST AS PER BHEL SPEC. 2.OVERALL DIMENSIONS & ORIENTATION	MA MA	-DO- MEASUREMENT & VISUAL	100% 100%	IS-325/ BHEL SPEC./ DATA SHEET APPROVED DRG/DATA SHEET	SAME AS COL.7 APPROVED DRG/DATA SHEET & RELEVANT IS	TEST REPORT INSPN. REPORT	2 2	1 1	- -	NOTE -1 & NOTE-3 NOTE -1 & NOTE-3
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									



QUALITY PLAN

SHEET 2 OF 2

CUSTOMER :

PROJECT

SPECIFICATION :

BIDDER/ :

TITLE

NUMBER :

VENDOR

QUALITY PLAN
NUMBER PED-506-00-Q-006, REV-01

SPECIFICATION :

SYSTEM

ITEM AC ELECT. MOTORS BELOW 55KW (LV)

TITLE :

SECTION

VOLUME III

SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS 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
		3.NAMEPLATE DETAILS	MA	VISUAL	100%	IS-325 & DATA SHEET	IS-325 & DATA SHEET	INSPN. REPORT	2	1	-	
<p>NOTES:</p> <p>1 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</p> <p>2 WHERE EVER CUSTOMER IS INVOLVED IN INSPECTION, (1) SHALL MEAN BHEL AND CUSTOMERS BOTH TOGETHER.</p> <p>3 FOR EXHAUST/VENTILATION FAN MOTORS OF RATING UPTO 1.5KW , ONLY ROUTINE TEST CERTIFICATES SHALL BE FURNISHED FOR SCRUTINY.</p> <p><u>Legends for Inspection agency</u></p> <p>1. BHEL/CUSTOMER 2. VENDOR (MOTOR MANUFACTURER) 3. SUB-VENDOR (RAW MATERIAL/COMPONENTS SUPPLIER)</p> <p>P. PERFORM W. WITNESS V. VERIFY</p>												
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

ELECTRICAL SUB-VENDOR LIST FOR LT MOTORS (AS ON 16.08.14)

S.No.	VENDOR CODE	VENDOR NAME	ADDRESS	PHONE
1	A24	ABB	14, MATHURA ROAD, FARIDABAD, HARYANA-121003	0129-2567580, 09871799449
2	E1027	BHARAT BIJLEE LTD.	Bharat Bijlee Limited, 1st Floor, 7-B, Rajindra Park, Pusa Road, New Delhi - 110 060.	Tel.: + 91 (11) 25816931-33, 35 & 36 DT: +91 25724318 Fax: + 91 (11) 25819640 M:+ 91 9818 121132
3	C02	CROMPTON GREAVES	3rd Floor, Express Building,9-10, Bahadur Shah Zafar Marg, Near ITO Crossing,New Delhi-110002, India	91 11 23460700 - 999
4	A35	GE-POWER	KAMAK TOWER, 3RD FLOOR, PLOT NO. 12-A, TVK INDUSTRIAL ESTATE, EKKADUTHANGAL, GUINDY, CHENNAI-600032	044-49681447
5	K01	KIRLOSKAR ELECTRIC CO LTD.	P.O. BOX 5555 , MALLESWARAM WEST ,BANGALORE 560055	Tel: +91-80-23374865
6	L04	LAXMI HYDRAULICS PVT. LTD	129/130, INDUSTRIAL ESTATE PATIL NAGAR, HOTGI ROAD SOLAPUR-413003, MAHARASHTRA	0217- 2357001-005
7	M01	MARATHON	Marathon Electric India Private Ltd.Sector - 11, Model Town, Faridabad - 121006	Ph: +91-129-2286421, 2265340, 4006601 to 4006610
8	A35	NGEF	Pocket No.10, Flat No. 37 & 38, Expandable DDA Flats, Nasirpur Dwarka, Phase-I NEW DELHI-110 045	Ph: (011) 2539 7763
9	E1115	RAJINDRA ELECT INDUSTRIES	14 SHAH IND.ESTATE VEERA DESAI RD,ANDHERI(W) MUMBAI-400053	91-22-26730823, 26730789
10	S01	SIEMENS	RC-IN I S NR DEL AREA, JIL BUILDING, TOWER-B, PLOT NO. 78, SECTOR 18, GURGAON-122015, INDIA	0124-2842000, 9873424331

2X500MW LIGNITE FIRED UNITS AT NEYVELI

FUEL OIL UNLOADING & STORAGE SYSTEM

**TECHNICAL SPECIFICATION FOR C&I PORTION OF FO
SYSTEM**



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

Specific Technical Requirements (C&I):

- 1.0 FUEL OIL UNLOADING AND HANDLING SYSTEM shall be controlled from Main Plant DCS (NLC scope of supply). In addition, bidder to provide local control panel for operation and monitoring of FUEL OIL UNLOADING AND HANDLING SYSTEM from local. This local control panel will act as interface between main plant DCS and FOUHS. All the field signals including actuator shall be terminated at this panel.
- 2.0 The Control panel shall include START/STOP push buttons for all drives, status indication lamps etc. and shall also include annunciators (alarm & indication) with TEST/ ACKNOWLEDGE/ RESET push buttons etc. Alarm annunciation with LED lamps shall be driven by main Plant DCS through remote I/O panel. The local panel shall house digital indicators for display of process parameters e.g. level, temperature also and retransmission output (4-20mA) of these indicators shall be transmitted to main plant DCS.
- 3.0 All instruments shall be suitably grouped based on physical locations & terminated on JB's in the field. JB's shall be in bidder scope.
- 4.0 Level transmitters shall be GUIDED WAVE RADAR type for oil tanks.
- 5.0 For cable scope refer to electrical scope between BHEL and vendor defined in electrical specification.
- 6.0 All necessary instruments such as transmitters/gauges etc. shall be provided for safe, efficient and reliable operation and maintenance of the Fuel Oil Handling System.
- 7.0 Since FOHS comes under hazardous area. Instruments shall be provided with explosion proof enclosure suitable for hazardous areas described in National Electric Code (USA), Article 500, Class-I, Division-I or EN60079-14 or shall comply with the essential requirements of ATEX directives. All fittings, cable glands etc. shall be strictly as per NEC recommendation article, 500 to 503.
- 8.0 The quantity of instruments shall be as per tender P&ID and Design Memorandum/Philosophy as a minimum, for bidding purpose. However, bidder shall also include in his proposal all the instruments and devices, which are needed for the completeness of system/equipment, supplied by the bidder, even if the same is not specifically appearing in the P&ID and Design philosophy. During detail engineering if any additional instruments are required for safe & reliable operation of plant, bidder shall supply the same without any price implication.

- 9.0 Bidder to include all fittings, valve manifolds and other accessories for the bidder supplied instruments (PG, PT, DPS, LG, LS, LT, TG, TS etc.) required for the package.
- 10.0 Pressure/Diff. pressure instruments for oil application shall be provided with diaphragm seal.
- 11.0 For regulating type Control Valve, Smart Positioner to be provided by bidder.
- 12.0 For ON/OFF type Control Valve, solenoid valve to be provided by bidder. Solenoid Valve shall be 24VDC rated.
- 13.0 The detailed specification of instruments etc. is enclosed in the subsequent clauses of this technical specification.
- 14.0 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.
- 15.0 In case of any conflict and repetition of clauses in the specification, the more stringent requirements among them are to be complied with.
- 16.0 All motor operated valves/electrical actuators shall be envisaged with non - integral starter. Datasheet & specification is attached.
- 17.0 Bidder's presence is required for 15 Man days (in three visit) at site during commissioning of DCS for assistance related to process correctness. Three visit with total 15 Man days (Excluding travel time) in which one visit shall be of 5 Man days each. All the expenses like boarding, lodging and travel, Air fare etc. shall be in bidder's scope.
- 18.0 Drawings/Documents and data to be furnished after the award of contract for BHEL & NLC review as per attached MDL.
- 19.0 The requirements given are to be read in conjunction with detailed technical specification enclosed in the specification. Further in case of any discrepancy in the requirement within the same section noted by the bidder in the specification, the same will be brought to the notice of BHEL in the form of pre-bid clarification. In absence of any pre-bid clarification, the more stringent requirement as per interpretation of customer shall prevail without any commercial implication.



19. C&I FOR FUEL OIL UNLOADING & ~~FORWARDING~~ SYSTEM

19.1 General

1. The Instrumentation System envisaged shall be complete in all respect and adequate for safe, reliable & efficient operation of the Fuel Oil (LDO & HFO) unloading & ~~forwarding~~ system under normal and worst service and environmental conditions. The scope of work shall include detailed design, supply, erection, testing and commissioning of the Instrumentation System for the Fuel Oil unloading & ~~forwarding~~ system.
2. The design of C&I system shall be such that isolation of any piece of defective equipment would be possible without shutting down the main equipment or disturbing the operation of associated instrument and accessories.
3. The control logics & interlocks for all the equipments of Fuel oil unloading & ~~forwarding~~ system shall be implemented in Owner's Plant DCS. Contractor has to coordinate with Plant DCS Supplier & furnish all the control & interlock schemes for proper implementation as described in Drawings & documents clause
4. Contractor shall supply Fuel Oil unloading & ~~forwarding~~ instrumentation system with all necessary instruments, actuators, interlocks and sequences, annunciator systems, automatic/manual controls, etc.
5. Complete instrumentation cables required for Fuel oil unloading & ~~forwarding~~ System i.e. from field sensors / actuators to JB's, JB's to Plant DCS Remote panel at LCR in MCC room and from MCC / switchgear modules to Plant DCS Remote panel at LCR in MCC room i.e. where one end or both ends equipments is in Contractor's scope, complete Supply, laying, termination, etc shall be in Contractor's scope.
6. The LCR at MCC room shall be provided with Air conditioned environment for Plant DCS remote I/O panel.
7. Plant DCS supplier shall provide Remote I/O panel of Plant DCS in Fuel oil Pump house LCR in MCC room. Supply, laying and termination of all cables between the remote I/O panel and local control panel, fuel oil pump house C&I, Fuel oil pump house MCC are in the scope of SG Contractor. Local panel shall be provided by SG Contractor for fuel oil unloading system for local operation and monitoring and controls shall be from Plant DCS

19.2 Operation & Control philosophy

1. The control objective of the Fuel oil instrumentation and control system is to provide a safe and reliable means of unloading, storing and transferring of diesel oil. The fuel oil handling instrumentation system shall be grouped into two categories: local indication and remote indication. Local indication includes gauges, sight glasses, thermometers etc. Remote indication is measured at the



process equipment and transmitted to the Plant DCS for the purpose of centralized control, monitoring, recording and trending.

2. When the unloading header & the piping at the pump suction becomes filled with oil and the steady supply is ensured by level switch at the suction pipe standpipe, the unloading pumps shall be started manually from push buttons in the local control panel located in the fuel oil unloading pump house. These pumps shall, however, trip automatically in the event of high level in the respective oil (LDO or HFO) storage tank or low level at the suction stand pipe.
3. Standby pump shall start automatically whenever any operating pump trips due to any fault (mechanical/electrical) or discharge header pressure low.
4. The differential pressure across the suction duplex strainer high initiates alarms to change the duplex strainer position.
5. The transfer pumps to day tank shall be started manually from push buttons in the local control panel. These pumps trip automatically when the level in the source storage tank goes low or the level of respective day oil tank goes high. These pumps shall also be prevented from starting in case of low level in the respective source storage tank or high level in respective day oil tank or high pressure drop across the respective suction strainer. Stand-by pump shall start automatically whenever any operating pump trips due to any fault (mechanical/electrical) or discharge header pressure goes low.
6. The drain oil pumps shall start/stop automatically on drain oil tank high/low level initiation. Further there should be provision for alarm also. The standby pump shall also operate automatically in case the operating pump trips.
7. Local emergency stop push button shall be provided for all electrical drives.
8. Steam flow to HFO storage and day tank floor coil heater shall be controlled by pneumatically operated control valve (ON-OFF type) to maintain the desired oil temperature.
9. Steam flow to suction heater of HFO day tanks shall be regulated through pneumatically operated control valve on the steam supply line to the suction heater and the same shall be actuated from heater outlet oil temperature.
10. The Control panel shall include start/stop push buttons for all drives, indicators, status indication lamps etc. and shall also include annunciations (alarm & indication) with TEST/ ACKNOWLEDGE/ RESET push buttons, described below:
 - High & low level in each HFO storage and day tanks.
 - High & low level in LDO storage and day tanks.
 - High & low level in drain oil tanks.
 - High temperature in each HFO storage and day tanks.
 - Low temperature in each HFO storage and day tanks.
 - High differential pressure across each suction strainer for HFO pumps.
 - High differential pressure across each suction strainer at LDO pumps.
 - Unloading pump discharge pressure high.



- Unloading pump suction stand pipe (LDO/HFO) level low.
- Level control for condensate flash tank.

Alarm annunciation with LED lamps shall be driven by Plant DCS through remote I/O panel.

11. The following signals shall also be made available to control room:

- All tanks levels.
- HFO ~~day~~ tank temperature.

**LIST OF VENDOR DELIVERABLES FOR C&I FOR FUEL OIL HANDLING SYSTEM
(2 X 500 MW NNTPP- SG PACKAGE)**

DOCUMENT NUMBER PE-GL-400-145-I100 **SHEET** 1 of 1

SI.No.	DRAWING NO.	DRAWING/DOCUMENT TITLE	CATEGORY
1	PE-V0-400-145-I901	CONTROL & OPERATIONAL WRITE-UP FOR THE SYSTEM	A
2	PE-V0-400-145-I902	CONTROL SCHEME/LOGIC DIAGRAM(TO BE IMPLEMENTED IN DCS)	A
3	PE-V0-400-145-I903	HMI PICTURES/PLANT SCHEMATICS	I
4	PE-V0-400-145-I904	INSTRUMENT SCHEDULE	A
5	PE-V0-400-145-I905	I/O LIST (ANALOG & BINARY)	I
6	PE-V0-400-145-I906	DRIVE LIST/SOLENOID/ACTUATOR VALVE LIST WITH LOCATION DATA	I
7	PE-V0-400-145-I907	FIELD JB TERMINATIONS	I
8	PE-V0-400-145-I908	DATASHEETS FOR INSTRUMENTS, JBs, etc.	A
9	PE-V0-400-145-I909	QUALITY PLANS/CHECK LISTS (For all applicable instruments)	A
11	PE-V0-400-145-I910	THERMOWELL SIZING CALCULATION	I
12	PE-V0-400-145-I912	CABLE SCHEDULE & INTERCONNECTION	A
13	PE-V0-400-145-I913	ANNUNCIATION & SOE LIST	I

NOTES:

1. ANY OTHER DOCUMENT DECIDED DURING DETAILED ENGINEERING SHALL BE PROVIDED BY BIDDER WITHOUT ANY COMMERCIAL/TECHNICAL IMPLICATION.



4. DESIGN PHILOSOPHY

This section covers the design philosophy which shall be used for all control & instrumentation system for steam generator & its auxiliaries.

4.1 Pressure indicators shall be provided wherever indicating type Pressure transmitters are not envisaged. The applications include:

- Suction and discharge lines of pumps ~~/ fans~~, including on header section, if two or more pumps are employed for the same service.
- All input and output lines of process equipments.
- Inlets and outlets of heat exchangers (both the fluid media) ~~and de-super heaters.~~

4.2 Pressure Switches shall be avoided as far as possible and in place, smart pressure transmitters with soft limit value monitoring in Plant DCS shall be provided. The applications shall include the following:

- On all process lines / Equipments where parameter abnormality / status including pre trips alarms to be communicated to the operator in control room.
- For all permissive and protection conditions governed by safety operation of the equipments. e.g. pressure adequate, pressure very high / very low conditions.
- For all interlock conditions, governing starting of standby equipment or subsequent equipments for safety operation of the system.
- Inlet and outlet of filters / strainers.

4.3 Differential Pressure Switches (indicating type) shall be provided for the following applications:

- Across filters/strainers for remote monitoring

4.4 Smart Pressure Transmitter shall be provided for all control applications included in Contractor's scope and as demand by the process. Pressure stubs with isolating valves shall be provided.

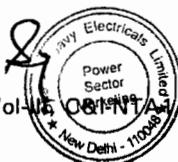
4.5 Differential Pressure Transmitter shall be provided for all the requirements of differential pressure, flow, level measurement. Pressure stubs with isolating valves shall be provided.

4.6 Temperature indicators (Thermometers) shall be provided

- On all process lines where local indication is warranted by the system either for monitoring or testing.
- On the inlet/outlet of equipments such as ~~desuper heaters~~, Heat Exchangers & ~~Coolers~~ for both the fluid media.
- ~~Differential temperature indicator shall be provided across BFP suction and discharge service.~~



- 4.7 Temperature Elements: Thermocouples / RTDs shall be provided for casing metal temperature monitoring and bearing temperature monitoring of 6.6 kV drives/motors.
- All thermocouples and RTDs as required for implementation of control & monitoring in Contractor's system shall be supplied.
 - The elements shall be duplex type with integral thermo well (except for metal thermocouples). K Type Thermocouples shall be used for all temperature measurements wherever possible. However, for high temperature flue gas services R or S type thermocouple shall be provided. For metal thermocouples suitable MS pads, clamps, flexible extension lengths etc. shall be provided. Temperature elements in boiler and air ducts shall be provided with protective tubes. Both the elements of duplex temperature sensors shall be brought to junction boxes.
 - All temperature elements shall be supplied with associated junction box.
 - Compensating cable shall be provided with all thermocouples (except metal thermocouples) for terminating to the control system eg. Plant DCS.
 - 3 wire type Resistance temperature detectors (RTD's) shall be provided for all 6.6 kV motors, for winding temperature monitoring. Six nos of duplex type (2 nos. per phase) or twelve nos. of simplex type (4 nos. per phase) RTDs shall be provided for each motor. RTDs shall be terminated in the external terminal box, for connection to Plant DCS system.
 - 1 no. duplex PRT-100 type RTD shall be provided for each bearing of HT equipment and its driving equipment (motor).
 - For process temperature up to 200 degree C, RTD shall be used. Beyond 200 *C temperature thermocouple to be used.
 - Temperature measurement shall have upscale / down scale protection features not to cause major process upset in case of sensor failure.
 - Temperature Transmitter shall be provided for all metal temperature signals.
- 4.8 Level gauges shall be provided on all tanks and the maximum length of one gauge glass shall not exceed 1 meter. The gauge glasses shall be stacked to cover the complete height of the tanks including over flow level. There shall be an overlap of minimum 100 mm, when more than one level gauge is required.
- 4.9 Level switches: The instrument shall be provided for the following applications:
- On all equipments (storage vessel) where parameter abnormality/status has to be communicated to the operator in the control room.
 - All permissive, interlock and protection conditions governed by the safe operation of the equipment.
 - The instrument shall be external cage type with SW connection with isolation facility for surface mounted tanks and top mounted with still pipe for all sumps. Still pipes shall be provided with adequate supports.





- Conductivity type level switches shall be used for all heaters and drain pots.
 - ~~Radar type level switches shall be used for bulk material bunkers.~~
- 4.10 Level Transmitters Stubs with impulse pipes, root valves for mounting Level transmitters shall be provided on process equipments where continuous remote monitoring and/or control of level is envisaged. Wherever necessary standpipes or float chambers shall be provided and also makeup line for filling up the constant level vessel shall be provided.
- The instrument shall be displacement type for all low pressure and vacuum applications involving two phase media viz: condenser, hotwell and LP heaters level measurements. Optionally, guided wave radar type shall be used.
 - The instrument shall be differential pressure type or torque tube type for other applications.
 - Radar type level transmitter shall be used for fuel oil storage tanks.
 - ~~Admittance or Radar type shall be for sludge and slurry applications.~~
- 4.11 Flow Glasses shall be provided at the outlet of the pipe lines and shall be employed under the following conditions:
- Coolers
 - The instrument shall be rotary type with glass mounted for indication
 - Up to 6 inch pipe on-line flow glasses shall be supplied and above 6 inch pipe bypass type flow glasses shall be provided. Sight flow and variable flow indicators shall be used for low pressure and low temperature applications.
- 4.12 Speed Measurement shall be provided, where variable speed drives are controlled from remote (e.g. Lignite feeders, ID fans etc). ~~All speed sensors shall be non-contact type. All speed transmitters shall be microprocessor based. Microprocessor based speed switches shall be provided for zero speed detection, chain cut detection, locked rotor protection etc. Microprocessor based reverse rotation switch shall be provided for pump protections such as BFP, CEP etc.~~
- 4.13 Pneumatically Operated Control Valves shall be provided for all control application. If the process demands any other control, then control valves shall be provided for those applications also. Where a single control valve cannot meet the turn down ratio as dictated by the process, control valves with split range application shall be provided.

All bypass valves of control valves shall be motor operated valves suitable for inching operation & shall be provided with position transmitters.



All integral bypass valves shall be motor operated. Electro-pneumatic positioners shall be used for all pneumatic control valves.

Pressure test points & drains shall be provided across each control valve

- 4.14 The pneumatically operated control valves shall be provided with Smart Positioners, diagnostics and HART compatibility. Control Valve diagnostics shall be transmitted through the HART Protocol to Plant DCS.
- 4.15 Solenoid Valves shall be provided for all pneumatic control valves hooked up with process interlock requirements and where direct tripping is involved. All solenoid valves shall be uniformly rated for 24V DC or 220V DC. The number of ways for solenoid valve shall be provided as indicated below :
- On line two (2) way solenoid valves shall be provided, where process line of less than 2 inch with low pressure & temperature application is involved.
 - Three (3) way solenoid valves shall be provided commonly, where the pressure is admitted or exhausted from a diaphragm valve or single acting cylinder. E.g.: Pneumatic operated spray water block valve.
 - Four (4) way solenoid valve shall be provided for operating double acting cylinders (If applicable). E.g.: Pneumatically operated on-off type dampers.
 - Single coil Solenoid valves working on De-energised to trip principle shall be supplied for equipment trips/critical applications.
 - Five port solenoid valves shall be used for pneumatic retract/insert mechanism power cylinders for Oil gun, ignition gun etc.
- 4.16 Position Transmitters shall be provided for all motorized inching valves. Position transmitters shall be 24 V DC, 2 wire, non-contact type.
- 4.17 Smart type Electro-Pneumatic positioners shall be provided for all pneumatically operated control valves, power cylinders etc., for converting controller output of 4-20 mA to appropriate pneumatic signal
- 4.18 Air Filter Regulators along with gauges shall be provided in each of the:
- Air supply line to valve positioners /power cylinders
 - Air supply line to pneumatic interlocked block valves
- 4.19 Interposing relay (To be mounted in Control room cabinet) for interface to the following:
- Solenoid valve (if output module cannot directly drive SOV) - Relays with contact rating of minimum 2 Amps.
 - DC Starter (if output module cannot directly drive) - Relays with contact rating of minimum 0.2 Amps.
 - Hardwired signal exchange – as required.
- 4.20 ~~For all HT rotating equipment bearings provision for mounting vibration probes shall be provided.~~



4.21 Junction Boxes/Field termination cabinet: All JB's /FTCs shall be SS. Junction Boxes shall be provided for:

- Termination of all sensors located equipment wise.
- Termination of Duplex Thermocouples / RTDS
- Termination of limit switch, torque switch, position transmitter and control demand, independently for each valve.
- Area wise or Elevation wise bunching of cables.

4.22 Instrumentation & control cables and Prefabricated Cables with Anti-Rodent treatment shall be supplied to:

- Connect field instruments to field junction boxes/Local Panels. For switches, both the SPDT contacts of switches shall be wired up to the J.B.
- Connect limit switches, torque switches and position transmitters to their respective field junction boxes.
- Compensating cable shall be supplied for connection between the element and the respective junction boxes / system cabinets as per guidelines.
- Prefabricated cable for connecting between system cabinets, marshalling cabinet to system cabinet, system cabinet to Relay Rack, system cabinets to Engineering work stations etc. shall be in Contractor's scope.
- Entire I&C cable within the battery limits.

4.23 All field instruments including electronics located outside control room areas shall be tropicalized and shall be designed to work in site specific atmosphere/climatic conditions applicable for Neyveli and enclosed in dust tight, waterproof and weatherproof enclosures. In general, transmitters and switches installed at outdoor location shall be mounted in closed type transmitter enclosure. For other areas (indoor), open type racks may be used for installation of transmitters and process switches.

4.24 Conventional hardwired alarm annunciation system has not been envisaged. All alarm shall be displayed in the Plant DCS HMI/LVS. However where local panels are used for local operation/monitoring, PLC/ DCS driven alarm annunciation system with LED type lamps for local panel shall be provided.

4.25 Pressure, temperature and flow test points shall be provided in line with latest performance test code requirements.

In general, pressure and temperature test points shall be provided for the following services:

- At the discharge of all pumps and ~~fans~~
- At the inlet and outlet of the heat exchangers for the fluid media involved
- ~~Adequate number at the Combustor at different zones~~
- At the inlet and outlet of each control valve



4.26 The ranges of the instruments shall be selected based on the following philosophy:

- For pressure and draft measurements, the maximum operating pressure shall be within 70 to 80% of the maximum scale range.
- For temperature measurement, the maximum operating temperature shall be within 80 to 90% of the maximum scale range.
- For pressure switches and temperature switches, the set points shall fall within 40% to 70% of the scale range selected.
- For level measurement, the maximum of the range shall cover the overflow point or six inches from the top of the vessel and the minimum of the range shall be six inches above the bottom of the vessel. Also, the gauge glasses shall be stacked with overlap to cover permissive, alarm and trip levels.
- For flow measurement, the maximum range shall be fixed at about 10 to 15% above the maximum operating flow
- For electro-chemical measurements (conductivity, pH, dissolved O₂, Silica etc.), the maximum range shall be around 10 to 15% higher than the recommended alarm settings.
- For gas analyzers, the maximum range shall be around 10 to 15% higher than the recommended alarm settings.

4.27 Individual (one for each transmitter) purging line connected to the impulse line before the root valve with required accessories shall be provided for all Air and Flue gas transmitters' impulse lines.

4.28 Spring-loaded/ Cage clamp type terminals shall be used for termination of instrumentation cables at field JB's, FTCs and local panels.

4.29 Signal Exchange Between Contractor's Equipment / System and Plant DCS System

- All the signals required for interlock / alarm / SER purpose (to be implemented in the Plant DCS) shall be hardwired.
- All binary outputs provided from Contractor's cabinet/local panels/sensors for connection to Plant DCS shall be potential free contacts with a rating of 0.2 amps at 220 V DC or 2 amps at 24 V DC or 5 amps at 240 V AC. All check backs to Plant DCS shall only be potential free contacts.
- All analog outputs provided from Contractor's cabinet / local panels/sensors for connection to Plant DCS shall be isolated 4-20 mA DC.
- Command outputs from Plant DCS to Contractor's motorized valve actuator shall be logic level signal (24 V DC) and necessary interposing relays suitable to accept 24 V DC logic level command signal shall be provided in Contractor's MCC module for MOV actuator.
- Monitoring signals through communication link shall be through redundant data highway.



- 4.30 ~~Flow elements for measurements of secondary airflow to the furnace & Primary air flow to Pulverizer shall be provided along with 3 (three) tapping's for measurement & Control and one tapping for test purpose.~~
- 4.31 Airflow shall be measured by aerofoil or venturi or by any special online measurement technique with high accuracy (typically better than +/- 2%) as per proven standard & practice of the Contractor.
- 4.32 All indication lamps shall be LED type.
- 4.33 All interposing relays shall be Plug in type with screw type base & LED for status indication. Relay modules/boards etc. are not acceptable.
- 4.34 All Limit Switch shall be Non-Contact type. If there is constraints because of process conditions/space, mechanical lever actuated Limit switch may be used.





5. DESIGN CRITERIA

This section covers the general design criteria to be adopted in designing the Control & Instrumentation system for the SG Package.

5.1 General Requirements

5.1.1 Ambient Conditions

Instruments, devices and equipment for location in outdoor / indoor / air-conditioned areas shall be designed to suit the environmental conditions indicated below and shall be suitable for continuous operation in the operating environment of a Lignite fired Power plant and also during periods of air conditioning failure without any loss of function, or departure from the specification requirements covered under this specification.

**Table 5.1
Protection Class Requirement**

Ambient Temperature (outside temperature)	Pressure	Relative Humidity	Atmosphere	Required Protection class of panels /cabinets /desks to be provided by Contractor
Outdoor Location				
55 *C max	Atmosphere	100%Max	Air (dirty)	IP 65
4 *C min	Atmosphere	5% Min	Air (dirty)	IP 65
Indoor Location				
55 *C max	Atmosphere	95% Max	Air	IP 54^^
4 *C min.	Atmosphere	5% Min	Air	IP 54^^
Air-conditioned Area				
24 +/- 2 *C normal	Atmosphere	95% Max	Air	IP 42
50 *C Max. ^	Atmosphere	5 % Min	Air	IP 42
^ During Air Conditioning failure ^^ For non-ventilated enclosures. For Ventilated enclosures, protection class shall be IP 42. 1. For hazardous areas the protection class shall be in accordance with the requirements of the relevant NEC code for the location. 2. For PCs, OWS, EWS, Servers, Printers and other peripherals, maximum temperature limit shall be 35 *C. For LVS the same shall be 25 *C & for UPS the same shall be 40 *C				



9. FIELD INSTRUMENTS & FINAL CONTROL ELEMENTS

9.1 General Requirements

1. Measuring instruments/equipment and subsystems offered by the Contractor shall be from reputed experienced manufacturers of specified type and range of equipment, whose guaranteed and trouble free operation has been proven. Further, all instruments shall be of proven reliability, accuracy, repeatability requiring a minimum of maintenance. They shall comply with the acceptable international standards and shall be subject to Owner's approval. All instrumentation equipment and accessories under this specification shall be furnished as per technical specifications, ranges, make/ numbers as approved by the Owner during detailed engineering.
2. 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.
3. All local gauges as well as transmitters, sensors, and switches for parameters like pressure, temperature, level, flow etc. as required for the safe and efficient operation and maintenance as well as for operator and management information (including all computation) of equipment under the scope of specification shall be provided.
4. The necessary root valves, impulse piping, drain cocks, gauge-zeroing cocks, valve manifolds and all the other accessories required for mounting/erection of these local instruments shall be furnished, even if not specifically asked for, on as required basis. The contacts of equipment mounted instruments, sensors, switches etc. for external connection including spare contacts shall be wired out in flexible/rigid conduits, independently to suitably located common junction boxes. The proposal shall include the necessary cables, flexible conduits, junction boxes and accessories for the above purpose. Double root valves shall be provided for all pressure tapplings where the pressure exceeds 40 kg/sq cm.
5. For protection purposes, transmitters can be considered in place of switches.

9.2 Pressure / Differential Pressure / Flow / Level Transmitter

Table 9.1

Specifications for Pressure / Differential Pressure / Flow / Level Transmitter

S.N	Features	Minimum Requirements
1	Type	Microprocessor based 2 wire type, HART protocol compatible
2	Sensor Type	Capacitive/ Piezo-electric
3	Output Signal	4-20 mA signals superimposed with HART signal.
4	Signal Processing Unit	Microprocessor based



S.N	Features	Minimum Requirements
5	Overpressure	150% of max. operating pressure. For vacuum service, the element shall have under - range protection to full vacuum
6	Turn-down Ratio	10:1 for vacuum / very low pressure applications. 100:1 for other applications.
7	Stability	± 0.1% of calibrated span for six months up to 70 Kg/cm ² and ± 0.25% for range more than 70 Kg/cm ² (g).
8	Span and Zero drift	± 0.015% per deg. C at max span & 0.11% per deg. C at min. span.
9	Enclosure Class	Weather proof as per IP 67 with corrosion resistance coating. For hazardous area explosion proof enclosure as described in NEC article 500
10	Zero & span adjustability	Continuous, tamper proof, remote as well as manual from instrument with zero suppression and elevation facility.
11	Local Indicator	To be provided
12	Display	Digital LCD Integral Display (minimum 5 digit) Engineering Unit
13	Process connection	½" NPT (F)
14	Electrical Connection	½ " NPT
15	MOC of Electrical Housing	Aluminum Alloy or better
16	Ambient Temperature	65 Deg. C
17	Operating Voltage	16 – 40 Volts DC
18	Load	600 Ohms (minimum) at 24 Volts DC
19	Accuracy	± 0.075% of span or better
20	Response Time	100 millisecond or better
21	Adjustment/ calibration/ maintenance	Port/provision for Centralised PC based system maintenance.

- All transmitters shall be equipped with all necessary accessories like valve manifolds, mounting bracket etc. Pulsation dampeners shall be used where the process media is unstable for measurement such as at the discharge of a pump. For absolute pressure transmitter, 2 valve manifold; for gauge / vacuum pressure transmitter, 3 valve manifolds and for DP / level / flow transmitter, 5 valve manifold shall be provided. In case if it becomes necessary to use a DP transmitter for pressure measurement then a 3 valve manifold shall be used in place of 2 valve manifold.
- Pressure transmitter shall have easily accessible span, zero and time constant adjustments. A range suppression / elevation device shall be provided wherever required.
- For pressure / differential pressure transmitter, proof pressure shall be 200% of maximum static process pressure.
- All transmitter cases shall be dust – tight and rugged. Weather – proof and explosion – proof cases shall be used in outdoor and hazardous areas respectively. Protection class shall be of IP 67 or better.



3. Transmitters for pressure / DP measurements of liquid and steam shall always be installed below the sampling point, preferably with the connection at the top.
4. Transmitters for pressure / DP measurements for gases and air shall always be installed above the sampling point, preferably with the connection at the bottom.
5. Transmitters with diaphragm seal system shall be considered when
 - The process temperature is outside of the normal operating ranges of the transmitter and cannot be brought into those limits with impulse piping or
 - The process is corrosive and would require frequent transmitter replacement or unusual materials of construction or
 - The process contains suspended solids or is viscous and may plug the impulse piping or
 - There is a need to make density or interface measurements or
 - The process medium may freeze or solidify in transmitter or impulse piping.
6. Diaphragm seal shall be either capillary type or direct mounted type depending upon the application. Parts below the diaphragm shall be removable for cleaning. The entire volume above the diaphragm shall be completely filled with an inert liquid suitable for the application.
7. Differential pressure type level transmitters shall be used for range above 1219 mm, for services requiring purge or where liquid might boil in external portions.
8. Differential pressure type level transmitters for use on corrosive service shall generally be diaphragm wafer with extended filled capillary type. Flush or extended diaphragm type DP transmitter shall be considered for special application. Diaphragm material shall normally be stainless steel or any other special alloy.
9. Differential pressure type flow transmitters shall have in-built square-root extractors.

9.3 Temperature Transmitter

Table 9.2

Specifications for Temperature Transmitter

S.N	Features	Minimum Requirements
1	Type	2-Wire, Smart (HART)
2	Output Signal	4-20 mA signals superimposed with HART signal.
3	Signal Processing Unit	Microprocessor based
4	Accuracy	± 0.075 % of span or better
5	Local Indicator	To be provided (Not applicable for DIN Rail Mounted type)
6	Display	Digital LCD Integral Display (minimum 5 digit)





3. The design of thermocouple assemblies shall be such that replacement on line is possible.
4. Gas-tight ceramic sheaths partially reinforced with stainless steel sheath shall be used as protective tube for Pt Rh – Pt thermocouples. For other type of thermocouple stainless steel tubes shall be used as protective sheaths. For measuring temperature of high pressure process fluid, tapered protection sheath made from solid bar stock shall be used.
5. The time-constant of thermocouples shall suit the process requirement and shall be subject to approval of Owner / Consultant.
6. The thermocouples shall be supplied with factory tested and calibrated assemblies. The assemblies shall be complete with thermo well, sensing element, connection lead, duplex terminal block, extension nipple, compression fittings / unions /flanges etc. to meet all functional requirements as per Owner's / Consultant's approved drawings. The thermocouples equipped with thermo well shall be spring loaded for positive contact with the well.
7. The duplex terminal block shall be constructed with high temperature ceramic base with brass screw type terminals.
8. Thermocouple shall be suitable for steam, water or any other liquid application. For air & flue gas service, suitable protection tubes shall be provided for the thermocouples.
9. All thermocouples (except metal thermocouples) shall be terminated to the nearest junction boxes. The cold junction compensation shall be implemented within the measuring module level, no local/ field cold junction compensation box is allowed.

9.5 Resistance Temperature Detector (RTD)

Table 9.4

Specifications for RTD

S.N	Features	Minimum Requirements
1	Type	3 / 4 wire , Pt-100 (100 ohm at 0 deg C) (as per DIN 43760)
2	No. of Element	Duplex
3	Housing/Head	IP-65/Diecast Aluminium. Plug in connectors are to be provided for external signal cable connection
4	Sheathing of RTD	Metal sheathed , mineral insulated, Compacted MgO packed
5	Calibration and accuracy	As per DIN-43670 Class-A for RTD
6	Stability	Zero & span drift within 0.1% of span for a 6 month period.
7	Characteristic	Linear with respect to temp, within $\pm 1/2$ percent of top range value
8	Standard	As per DIN-43670 for RTD & ASME PTC-19.3 for



S.N	Features	Minimum Requirements	
		Thermowell	
9	Accessories	a)	Adjustable Nipple-Union-Nipple with thermo well connection / plug in connectors
		b)	Compression fittings / unions
		c)	Flanges etc.
		d)	Thermowell as per requirement

- RTDs shall be of duplex, platinum three / four wire type with a nominal resistance of 100 ohms at 0°C and conform to DIN 43760 / BS 1904.
Stability of RTD over full range shall be better than 0.05 ohms and the repeatability figure shall be better than 0.02 ohms. Accuracy shall be of the order of 0.15% or better and response time shall be less than 20 seconds with thermo well.
- The protective-sheath material shall be SS 316, seamless tubes using compacted magnesium oxide packing for insulation. The insulation resistance at 540°C shall not be less than 5 mega-ohms.
- The time constant of the RTD shall suit the process requirements and shall be subject to approval of Owner / Consultant.

9.6 Metal Temperature Thermocouple

Table 9.5

Specifications for Metal Temperature Thermocouple

S.N	Features	Minimum Requirements
1	Measuring medium	Metal Temperature
2	Type	K-Type
3	Wire Gauge	16 AWG
4	No. of Element	Duplex with separate hot junctions, ungrounded type
5	Sheathing/Insulation/Dia.	Metal sheathed (SS 321) , mineral insulated (Magnesium oxide), ceramic packed, 8 mm Dia.
6	Bending Radius	30 mm (minimum)
7	Cold End Sealing	SS pot seal with color coded PTFE headed sleeve insulated flexible tails. Sealing compound – Epoxy Resin
8	Standard	ANSI MC 96.01.1975
9	Thermocouple Length	30 Mtrs. (minimum)
10	Accessories	1/2" NPT SS sliding end connector, weld pad, weld on clamps of heat resistant steel SS310.

- For metal temperature measurement, care shall be taken for proper contact with metal surface. The thermocouples sheath for metal temperature measurement shall have to be thermally insulated to avoid radiation /



- conduction / convection loss. Thermocouple assembly for metal temperature measurement shall suit the functional requirement.
2. The thermocouple shall be attached to the heater tube surface by being furnished with stainless steel welding pads or by the use of thermocouple attachment blocks. The multiple holes in these blocks shall allow for spare thermocouple element for quick replacement.
 3. For boiler metal temperature measurement, the lead wires shall have to be brought into nearest Junction Boxes which are located in accessible safe zones, using suitable protection pipes.
 4. For measurement of wall temperatures at boiler tubes, sheathed thermocouples, dia 3.0 mm NiCr-Ni single thermocouples shall be used. The thermocouple line shall be designed as Teflon-insulated stranded conductor, provided with glass filament insulation and stainless steel wire braiding. The thermocouple shall be welded to the compensation line outside of the boiler insulation, with the welding point spilled hermetically in a coupling element. The area of the boiler penetration shall be designed with an anti-kink spring of stainless steel and a line-fixing sleeve of stainless steel, encapsulated in synthetic resin.
 5. The differential temperature "inside / centre" of the wall shall be measured by means of sheathed thermocouples NiCr-Ni, dia 3.2 mm. For this special protective sleeve shall be used. Particular emphasis shall be put on compliance with the stipulated depth of the bores in the tube wall material.
 6. For SH, RH, metal temperature measurement thermocouples shall be provided as per the specification in Table 9.5.

9.7 Thermowell for Temperature Elements

1. The design of the thermo well shall take into consideration the temperature, pressure, medium and fluid velocity specified in the process in accordance with ASME Standard PTC 19.3, 1974.
2. Thermo wells shall, in general, be of SS 316 and shall be drilled from bar stock except for air and flue gas services. However, selection of thermo well material shall be as per following guideline.

Table 9.6A
Thermowell MOC Selection

S.N	Medium	MOC
1	Lignite-Air mixtures	SS 304
2	Flue gases	Black steel, SS 446
3	Preheater	Black steel, SS 446
4	Steam lines	SS 316 and pipe material compatible for high temperature steam
5	Water lines	Low carbon steel/ SS316
6	Boiler tubes	SS 304 / SS 309 / SS 310



3. Welded type thermo wells with 38 mm O.D. for welding & ½" NPT internal threads shall be used for pressure above 100 kg / sq cm or temperature above 400 deg C. Socket weld type thermo well with 34 mm O.D. for welding & ½" NPT internal thread, shall be used for pressure between 40-100 kg/cm2 and temperature up to 400°C. Screwed type thermo wells with ½" NPT internal threads & M33X2 (M) outer threads shall be used for pressure below 40 kg/cm2 and temperature below 400°C. For pipes having probability of prolonged vibration, seal welding may be done all around after tightening the thermo well within the base.
4. Thermocouples / RTD used in air / flue gas path shall be supported by suitable protection tube of adequate strength with welded cap at the end. The connection size of the temperature detector with the protection pipe shall be adjustable flange type, the ratings of which shall have to be approved by Owner / Consultant. The length of the protection pipe shall be such that it supports at a distance nearly 2/3rd length of the immersed temperature detector inside the duct using a heat insulated ring support in between. The protection pipe details shall have to be approved by Owner / Consultant during detailed engineering stage. If any support is necessary for protection pipe the Contractor shall have to arrange the same.
5. Thermo wells used in Mill classifier Outlet area shall be made of suitable material of sufficient abrasion resistance such as alloy cast iron / 'Ni-hard' / Tungsten Carbide of hardness approx. 400 BHN. The connection shall be flanged type, the details to be approved by Owner / Consultant. Protection rod in front of thermo wells for mill classifier if required shall be provided.
6. Thermo well manufacturing drawing covering material specification, dimensional details, details of special treatment, finish etc. as well as test procedure shall be subject to Owner's / Consultant's approval. Material certificate shall have to be furnished for each thermo well.
7. Wherever any approval is necessary from any recognized body / authority during manufacturing of high pressure wells, the same shall have to be arranged by the Contractor.
8. The thermo well immersion depth (U) shall be sufficient to eliminate conduction error. A general rule which may be followed is to use an immersion length equalling a minimum of 10 times the diameter of the protective tube or well. In general, immersion length of thermo wells for different line sizes shall be as follows:

Table 9.6B

Thermowell Immersion Length

S.N	Line Size	Immersion Length
1	From 4" to 6"	65 mm
2	From 8" & onwards	140 mm



S.N	Line Size	Immersion Length
3	Vessels	400 mm

9.8 Pressure Gauge/ Differential Pressure Gauge/Draft Gauge

Table 9.7

Specification for Pressure Gauge/ DP Gauge/ Draft Gauge

S.N	Feature	Minimum Requirement
1	Type	Bourdon / Bellows / Diaphragm
2	Sensing Element Material	AISI 316 SS
3	Movement Material	AISI 304 SS
4	Case Material / Protection Class	AISI 304 SS / IP 65
5	Dial Size	150 mm For Special application like drum pressure, Main Steam pressure etc. 250 mm shall be used
6	Scale	Black lettering on white background in 270 °C arc
7	Range Selection	Normally operate at 75% of its maximum pressure range. Instruments measuring varying pressures shall operate in a band of 60% of its maximum pressure range.
8	Over range Protection	130% of maximum range by internal stop. External stop below zero.
9	Adjustment	External Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
10	Stop at Max. Reading	Shall be provided
11	Element Connection	Argon welding
12	Process Connection	½" NPT(M) bottom connection for local mounting, back connection for flush panel mounting
13	Accuracy	+/- 1.0 % of full scale or better
14	Operating Ambient Temperature	50 °C (Max. continuous)
15	Safety Feature	Neoprene Safety Diaphragm (Blowout disc) at the back
16	Window	Shatter-proof glass
17	Chemical Seal Unit	SS 316 Flange and Diaphragm, PTFE coated / block, Silicon Oil filling fluid
18	Accessories	Snubbers for pulsating fluid applications / 3-way gauge cock / 2-valve manifold / Pigtail / Siphon for steam service / Gauge Saver, if maximum or Design Pressure is very high than the Operating Pressure / Counter Flanges / Bolts, Nuts, Gaskets / SS Tag Plate

1. Directly connected pressure measuring instruments shall be diaphragm, bourdon or bellow type elements depending upon the services conditions. In



- general, diaphragm elements shall be used in the range of 0 to 1000 mm water column pressure, bellow type element for ranges of 0 to 1 Kg/cm² and bourdon type element for ranges greater than 1 Kg/cm².
2. Primary element material shall be corrosion resistant to process fluid or diaphragm seals shall be provided for protection.
 3. For draft measurement Teflon coated beryllium copper diaphragm shall be used.
 4. Snubbers shall be floating pin type, externally mounted and externally adjustable. It shall be used for all pulsating services.
 5. Diaphragm seals, filled type or mechanical type shall be furnished where plugging of the element may occur or where suitable material is not available in highly corrosive services. When chemical seals are required, they shall be the clean out type with flushing connection.
 6. Over-range protection shall be provided to at least 130 % of range. For vacuum service, the element shall have under-range protection to full vacuum
 7. Ranges of the gauges shall be so selected that the gauge normally operates in the middle third of the scale and conform to IS 3624 standard dials, wherever necessary.
 8. The sensing elements for all gauges shall be properly aged and factory tested to remove all residual stresses and shall be SS 316 with forged socket and tip of the same material. Elements above 70 Kg/sq. cm range shall be bored instead of drawn.

9.9 Temperature Gauge

Table 9.8

Specification for Temperature Gauge

S.N	Feature	Minimum Requirement
1	Type	Mercury filled
2	Sensing Element material	Bourdon AISI 316 SS
3	Movement Materials	AISI 304 SS
4	Case Material/Protection class	SS 304/ IP65
5	Capillary Armouring	SS Flexible
6	Capillary	SS 316 (5 mtr. Length for Local & 15 metre for panel Mounting)
7	Bulb/Stem Diameter	12 mm or 6 mm uniform
8	Dial Size	150 mm
9	Window	Shatterproof glass
10	Scale	Black lettering on white background in 270 °C arc
11	Adjustment	Micrometer screw for zero adjustment. Internal micrometer screw for range adjustment.
12	Pointer	Externally Adjustable



S.N	Feature	Minimum Requirement
13	Range Selection	Normal Process Temperature – approximately two third of Temperature range.
14	Stop at Max. Reading	Shall be provided
15	Over range Protection	130% of FSD
16	Instrument Connection	Bottom connection for local mounting, back connection for flush panel mounting.
17	Process Connection	½" NPT with Thermowell
18	Performance :-	
a	Accuracy	+/-1.0% of full scale or better
b	Repeatability	Less than 0.5% of full range
c	Response Time	30 seconds (max.) with Thermowell and 15 seconds Bare.
15	Operating Ambient Temperature	50 °C (Max. continuous)
16	Accessories	Mounting brackets, Bolts, Nuts, Gaskets / SS Tag plate, SS Thermowell etc.

- Temperature gauges shall be dial thermometers (liquid spring / steam pressure spring / metal expansion thermometer), either rigid stem or capillary tube depending upon application; if this is not possible for design reasons, industry type liquid – in – glass thermometers shall be used.
- Case shall have back or bottom connection with adjustable gland to permit adjustment of thermometer into the thermo well.
- Thermometer stem adjustable gland with union connection and bushing shall be suitable for ½ inch NPT connection.
- Bi-metallic type dial thermometer, if used, shall be hermetically sealed, back or bottom connection type, with 150 mm dial.
- The gauges shall be provided with automatic ambient temperature compensation.
- Scale ranges shall be selected so that normal process temperature is in middle two – third of full scale range

9.10 Level Gauge

Table 9.9A

Specification for Gauge Glass Type Level Gauge for vessels

S.N	Feature	Minimum Requirement
1	Sensing Element & material	Tempered toughened Borosilicate gauge glass steel Armored reflex or transparent type
2	Body Material	Forged carbon steel / 304 SS
3	End Connection	Process connection as per ASME PTC and drain / vent 15 NB





S.N	Feature	Minimum Requirement
4	Accuracy	+/- 2 % of full scale
5	Scale	Linear vertical
6	Range Selection	Cover 125 % of max. of scale
7	Over Range Test	Test pressure for the assembly shall be 1.5 time of the Maximum design pressure at 38 degree C
8	Housing	CS / 304 SS leak - proof
9	Identification	Engraved with service legend or or laminated phenolic Name plate
10	Packing	PTFE Teflon
11	Illumination	220 V, 50 Hz, 25 / 40 Watts either with deflector or diffuser (for transparent type level gauge) / 220V , 50 Hz, 25 /40 Watts with red and green filter for bicolor gauge
12	Accessories	Gasket for all KEL - F shield for transparent type vent and drain valves of CS / SS as per requirement
13	Others	Anti - Frost extension for low temperature service. Heating / cooling arrangement

- Level gauges shall be steel armoured reflex or transparent or bi -colour type, top and bottom connection as per pressure vessel standard of ASME PTC code and 15 mm NB (1/2 inch NPT) Drain and Vent connection.
- Body material and cover material shall normally be forged carbon steel, 304 stainless steel or other superior material.
- Reflex type gauges shall be used for clean and colorless liquids and transparent type for other liquids. For boiler and condensate services, treated water, the transparent type with KEL - F shields shall be used to avoid their attack on the glands.
- The gauge glass must have a rating equal to or more than the vessel design pressure and temperature. The test pressure for the complete design gauge assembly shall be as per Owner's / Consultant's recommendation.
- The maximum length of a single gauge glass shall not exceed 1400 mm. Where large range is required, multiple gauges of preferably equal lengths shall be used with 50 mm over - lapping in visibility.
- The visibility shall cover the operating level range and the maximum and minimum ranges expected considering start - up conditions as well as alarm and shut down points. Internal heating shall be provided for viscous liquids. Integral illuminators shall be used for transparent gauges, if necessary.
- Stand - pipes shall be used for multi - gauge glass and level controller installation and on horizontal drum or exchanger with top and bottom connections to have visibility of the complete span. The stand pipe shall not be used with block valves.
- Primary isolation valves shall be used In addition to the gauge glass valves unless otherwise specified. When the process fluid may create lugging or



leakage problem, gauge valves may be omitted. For low temperature liquid having high vapour pressure at ambient temperature, isolation and gauge valves shall not be permissible. Safety valve shall be provided at the vent connection of the gauge glass where isolation is required.

9. For high pressure service such as boiler water etc., the gauge glass shall be multi – port illuminated type (Bi – colour type). Indication of water space shall be `green` and indication of steam space shall be `red`.
10. Bi – colour level gauges shall have following features:
 - Temperature equalizing column expansion bend and chain patterned hand – wheel
 - Certification by Inspectorate of Boiler

Table 9.9B

Specification for Float & Tape Type Level Gauge for Tanks

S.N	Feature	Minimum Requirement
1	Type	Float & Tape type
2	MOC of Float & Tape	SS 316
3	MOC of Pulley	Aluminium
4	Guide Wire	SS 316
5	Accuracy	+/- 5 mm
6	Indication	Arrow on Circular or Vertical scale Board

9.11 Pressure/ Differential Pressure Switch

Table 9.10

Specification for Pressure/DP Switch

S.N	Feature	Minimum Requirement
1	Type	Piston for high pressure application Bellow/Diaphragm for low pressure application
2	Sensing Element material	AISI 316 SS
3	Wetted Parts material	AISI 316 SS
4	Case Material	Epoxy coated Die Cast Aluminium
5	Setter Scale	Black graduation on white linear scale. Graduation 0 – 100% with red pointer for set points.
6	Over range for Pressure / Vacuum Switch	130% of maximum pressure
7	Set Point	Adjustable throughout switch operating range.
8	Static Pressure for Differential Pressure Switch	Maximum Line Pressure or Static Pressure on either side without permanent deformation or loss of accuracy.
9	Adjustments	Internal – set point



S.N	Feature	Minimum Requirement
		Differential adjustable feature
10	Process Connection	½" NPT(M) bottom connected
11	Switch Configuration	2 SPDT / 1 DPDT
12	Switch Rating	230 V, 5A AC / 220 V, 0.25 A DC/24 V, 2A DC
13	Switch Type	Snap acting, shock and vibration-proof
14	Cable Connection	½ " ET conduit connections or compression gland
15	Enclosure Class	Weather proof as per IP 65 with corrosion resistance coating.
16	Accuracy	1% of span up to 3Kg/cm2 0.5% of span for more than 3 Kg/cm2.
17	Repeatability	0.5% of span
18	Accessories	
a)		Snubbers for pulsating fluid application.
b)		Tag Number, service engraved in SS tag plate
c)		Teflon back-up sheath protection, as required.
d)		i) Remote diaphragm seal with SS 316 armored capillary for typical application. MOC of seal material shall be as per process fluid requirement. ii) Silver coated diaphragm for corrosive services like chlorinated water.
e)		Retention ring and screws for surface mounting.
f)		3-way Gauge Cock (SS 316) for PS / 5-Valve Manifold (SS 316) for DPS.
g)		Mounting bracket / Clamp for 2 " pipe, bolt & nut.

- The pressure switches shall have sensing elements made of copper alloy or stainless steel sealed diaphragm and piston actuated for high pressure service and bellows for low pressure / vacuum service.
- Low differential pressure switches for low static pressure ranges shall be diaphragm type with snap action switch elements.
- Low differential pressure switches for high static pressure shall be elbows and torque tube type and snap – action switch elements and metric scale dial indicators.
- For corrosive, viscous process fluids diaphragm sealed with completely filled inert liquid shall be provided. Material of diaphragm and wetted parts shall be selected considering the nature of process fluid.
- The sensing elements shall be properly aged and factory tested to remove all residual stresses. They shall be able to withstand at least 130 % the full scale pressure without any damage or permanent deformation.
- Actuation set point, dead band shall be internally adjustable throughout the range with tamper proof facilities.
- Electrical connection for the switch devices shall be suitable for plug in type connection.



8. Process connection shall be ½ inch NPT. Process piping connections shall include necessary union, nut, nipple, tail pipe, isolation valve and test connection to permit servicing, testing, calibration and removal of the instrument device.
9. Instrument for steam & hot water service, shall be connected through siphon, of stainless steel or suitable material. Pulsation dampeners shall be provided for all pulsating fluids.
10. Pressure switches shall be tested as per BS – 6134.

9.12 Conductivity Type Level Switch

Table 9.11

Specification for Conductivity Type Level Switch

S.N	Feature	Minimum Requirement
1	Sensing elements	Conductivity type
2	Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
6	Probe length	As per requirement
7	Mounting	Flanged- on external cage
8	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
9	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
10	Enclosure	IP 65
11	Housing	Cast aluminum epoxy coated weather proof
12	Ambient Temperature	60°C (max.)
13	Electrical Connection	Plug-in type
14	Cable connection	½ " NPT with cable gland
15	Set point	Adjustable
16	Accessories	All mounting accessories

9.13 Capacitance Type Level Switch

Table 9.12

Specification for Capacitance Type Level Switch

S.N	Feature	Minimum Requirement
1	Type	Capacitance type
2	Probe	Rod or Suspended Electrode
3	Material	SS 316
4	Insulation	PTFE/PP/Kynar part/full as required
5	Repeatability	± 0.5 % of full range or better
6	Accuracy	± 0.5 % of full scale or better



S.N	Feature	Minimum Requirement
7	Working temperature	As per process requirement
8	Probe length	As per requirement
9	Probe Mounting	1 ½" Flanged
10	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
11	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
12	Enclosure	IP 65
13	Housing	Cast aluminum epoxy coated weather proof
14	Cable connection	½ " NPT with Cable gland
15	Ambient Temperature	60°C (max.)
16	Electrical Connection	Plug-in type
17	Accessories	Counter flange, Cable gland, Prefab cable etc.
14	Set point	Adjustable
15	Accessories	All mounting accessories

9.14 Float/Displacer Type Level Switch

Table 9.13

Specification for Float/Displacer Type Level Switch

S.N	Feature	Minimum Requirement
1	Type	Float/Displacer type
2	Float/Stem/Displacer Material	SS 316
3	Repeatability	± 0.5 % of full range or better
4	Accuracy	± 0.5 % of full scale or better
5	Working temperature	As per process requirement
7	Process connection	As per requirement
8	Over-range proof	150% of max. design pressure
9	No. of contact	2 NO. + 2 NC, SPDT, snap action type dry contact
10	Rating of contacts	5A, 240 V AC / 2A, 24 V DC / 0.25 A, 220V DC
11	Enclosure	IP 65
12	Hydro Test	Chamber – 100% at 1.5 times rated pressure or as per ANSI flange rating Float – 1.1 times of operating pressure
13	Electrical Connection	Plug-in socket
14	Accessories	All mounting accessories

1. Level Switch shall work on gland less magnetically coupled float or displacer operated mechanism having separate float chamber.
2. Float, stem and displacer shall be 316 stainless steel.





3. Level switch body, cage and process connections shall be designed to withstand the maximum pressure and temperature of the operating fluid.
4. A setting adjustment on the level set point of + / - 25 mm shall be provided. The adjustment shall be made externally to the switch.
5. The accuracy & repeatability of the switch shall be within +/- 0.5 % of full-scale range. On - Off differential shall be adjustable.
6. Process connections of the cage shall be 25 NB male plain nipples connected through socket / welded isolation valves of adequate rating.
7. Level switch connections shall also include 15 NB test and drain connections to permit servicing, testing, calibration of the instrument.
8. The switching elements shall be snap-acting, shock-proof and vibration-proof. All switches shall have two electrically isolated SPDT contacts with provision of external adjustment of set points and dead bands. The contact ratings shall be 5 amps at 230 V AC 50 Hz or 0.25 amps at 220 V DC.
9. Switch enclosures shall be cast aluminium, weather-proof, NEMA -4X type with cable entry through compression type cable glands / 3/4 "NPT conduit connections. Switches located in hazardous areas shall have dust-ignition-proof enclosure as per NEC article 500 provisions.

9.15 Ultrasonic Level Transmitter

Table 9.14
Specification for Ultrasonic Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement in silos, sump water level etc.
2	Medium	Coarse, hard solid materials like ash etc. Materials may be slowly falling through the detection range.
3	Type	Non contact Microprocessor based 2 wire type, HART protocol compatible Ultrasonic Transmitter. Transmitter shall be remote type or shall be configurable from remote controller/Configurator.
4	Principle	Time of flight
4	Sensor Material	Corrosion resistant material to suit individual application requirement.
5	False signal tolerance	Transmitter shall be capable of ignoring false echoes from internal tank / sumps obstructions such as pipes, heating coils or agitator blades. Also transmitters shall have adjustable damping circuitry.
7	Range	Capable of covering the complete level span of tank/vessel taking care of blocking distance, frequency, attenuation due to surface, obstructions, vapours etc.



S.N	Feature	Minimum Requirement	
8	Output	4 - 20 mA DC with 600 ohms load with HART compatibility.	
9	Display	Minimum 4 characters display with Integral keypad, access protected by user code.	
10	Diagnostics	Loss of echo alarm etc.	
11	Resolution	+/- 0.1 % of range or better	
12	Accuracy	+/- 2 mm or 0.2% of span	
13	Repeatability	3 mm or better	
14	Operating temperature	0 to 60° C	
15	Power supply	24 V DC + / - 10 %	
16	Mounting	Flanged connection at top of covers / side walls as per requirement.	
17	Accessories	a)	All weather canopies for protection from direct sunlight and direct rain.
		b)	For hazardous areas, explosion proof enclosure as per NEC article 500 shall be provided.
		c)	All mounting hardware and accessories required for erection and commissioning. Mounting fittings material shall be SS 316.

1. The power and frequency of transmission for the transmitter shall be selected to assure a sufficient signal / noise ratio.
2. The transmitter shall be designed with an electronic circuit having the features such as temperature compensation, rejection of unnecessary echoes and noises and adjusting 'zero' and 'span'. It shall consist of sensors, electronic unit and accessories.

9.16 Radar Type Level Transmitter

Table 9.15

Specification for Radar Type Transmitter

S.N	Feature	Minimum Requirement
1	Application	Level measurement of vessel under vacuum or low pressure application/ Fuel oil storage tanks
3	Type	Guided wave radar for vessel under vacuum or low pressure and Radar type for Fuel oil storage tanks
4	Principle	TDR (Time domain reflectometry)
5	Probe Material	SS 316



S.N	Feature	Minimum Requirement
6	Accuracy	5 mm or better
7	Resolution	+/- 0.1 % of range or better
8	Signal Output	4 - 20 mA DC with 600 ohms load with HART compatibility
9	Power Supply	24 V DC + / - 10 %
10	Display	Integral
11	Mounting	External cage type
12	Transmitter housing Protection Class	IP-65 with corrosion resistance coating
13	Accessories	a) All weather canopies for protection from direct sunlight and direct rain.
		b) For hazardous areas, explosion proof enclosure as per NEC article 500 shall be provided.
		c) All mounting hardware and accessories required for erection and commissioning. Mounting fittings material shall be SS 316.

9.17 RF Type Level Switch

Table 9.16

Specification for RF Type Level Switch

S.N	Feature	Minimum Requirement
1	Application	Solids
2	Particle size	Fine dust to 400 mm
3	Process Temperature	0 - 100°C
4	Vessel pressure	up to 60 bar
5	Insertion length	As required
7	Mounting	Side or top or top vertical at $\pm 15^\circ$
8	Process connection	40 NB thread or flanged
9	Protection Class	IP 67
10	Electronics	Remote
11	Cable connection	½ "NPT cable gland
		Plug-in cable connector



9.25 Control Valves

A. Introduction

The control valves and accessories equipment furnished by the Contractor shall be designed, constructed and tested in accordance with the latest applicable requirements of code for pressure piping ANSI B 31.1, the ASME Boiler & Pressure Vessel code, Indian Boiler Regulation (IBR) & ISA or acceptable equal standards.

B. Control Valve Design & Sizing

1. The design of all valve bodies shall meet the specification requirements and shall conform to the requirements of ANSI for dimensions, material thickness and material specification for their respective pressure classes.
2. The valve sizing shall be suitable for obtaining maximum flow conditions with valve opening at approximately 80% of total valve stem travel and minimum flow conditions with valve stem travel not less than 10% of total valve travel. All the valves shall be capable of handling at least 120% of the required maximum flow. Further, the valve stem travel range from minimum flow condition to maximum flow condition shall not be less than 50% of the total valve stem travel. The sizing shall be in accordance with the latest edition of ISA Handbook on control valves. While deciding the size of valves, Contractor shall ensure that valves outlet velocity does not exceed 8 m / sec. for liquid services, 150 m/sec. for steam services and 50% of sonic velocity for flashing services. Contractor shall furnish the sizing calculations clearly indicating the outlet velocity achieved with the valve size selected by him as well as noise calculations, which shall be subject to Consultant's / Owner's approval during detailed engineering.
3. Control valves for steam and water applications shall be designed to prevent cavitations, wire drawing, flashing on the downstream side of valve and downstream piping. Thus for cavitations / flashing service, only valve with anti-cavitations trim shall be provided. Detailed calculations to establish whether cavitations shall occur or not for any given application shall be furnished.
4. Trim shall be multistage type having sufficient number of discrete pressure drop turns (stages) to ensure elimination of vibration, erosive - action, cavitations. Contractor shall identify the number of pressure drop turns in proposed equipment and shall also provide calculation demonstrating compliance to the trim exit velocity.
5. To prevent flow induced vibration and to protect the valve internals from foreign particles such as weld slag flow, direction shall be a flow to close (over the plug) configuration for liquid applications. To maximize noise attenuating benefits and to allow for constant fluid expansion, flow direction shall be under the plug for steam and gas applications.



6. Control valves for application such as SH spray control, RH spray control, Heavy oil pressuring & control system shall have permissible leakage rate as per leakage class V. All other control valves such as low and high range feed control valves etc shall have leakage rate as per leakage class IV.
7. The control valve induced noise shall be limited to 85 dBA at 1 meter from the valve surface under actual operating conditions. The noise abatement shall be achieved by valve body and trim design and not by use of silencers.
8. The characteristic of the control valves shall be determined based on the application / service.
9. On supply air or electrical failure for pneumatic / electrical drive, the valve shall remain full closed, open or stay – put position as per process safety requirement.

C. Valve Construction

1. Proper selection of valve type and material of construction to meet operating requirement.
2. All valves shall be of globe body design and straightaway pattern with single or double port unless otherwise recommended by the manufacturer to be of angle body type. Rotary valve may alternatively be offered when pressure or pressure drops permit.
3. Valves with high lift cage guided plugs & quick change trims shall be supplied.
4. Cast iron valves are not acceptable.
5. Bonnet joints for all control valves shall be of the flanged and bolted type for easy dis – assembly. Bonnet joints of internal threaded or union type shall not be acceptable.
6. Plug shall be of one – piece construction either cast, forged or machined from solid bar stock. Plug shall be screwed and pinned to valve stems or shall be integral with the valve stems.
7. All valves connected to vacuum on downstream side shall be provided with packing suitable for vacuum applications (e.g. double vee type chevron packing).
8. Valve characteristic shall match with the process characteristics.
9. Extension bonnets shall be provided when the maximum temperature of flowing fluid is greater than 280 *C.
10. Flanged valves shall be rated at not less than ANSI pressure class of 300 lbs.

Teflon shall be used for valve gland packing to suit process requirement.





12. The valve body shall be marked to show direction of flow.

D. Valve Materials

1. The control valve body material shall be
 - Carbon steel as per ASTM – A216 GR WCB for non – corrosive, non – flashing and non – cavitations services below 275 deg c temperature like Auxiliary Steam flow to Deaerator, CRH flow to Deaerator, Condensate flow to Deaerator etc.
 - Alloy steel as per ASTM – A217 GR WC 9 for severe flashing / cavitations services like low load and full load feed water control, HP and LP heaters emergency drains, Deaerator overflow drain to Hotwell etc.
 - Alloy steel as per ASTM A – 217 GR WC 6 for low flashing / cavitations services like HP heaters & LP heaters normal drain control, drain cooler normal level control, gland steam cooler minimum flow etc.
 - 316 SS for condensate service below 300 deg C like condensate normal and emergency make – up controls etc.
2. The control valve trim material shall be
 - 17 – 4 PH SS for severe services listed under item D.1, 2nd point & 3rd point above
 - 316 SS for services listed at D.1, 4th point above and
 - 316 SS with stellite faced guide parts and bushings for remaining applications.
3. However, Contractor may offer valves with body and trim materials better than specified materials and in such cases Contractor shall furnish the comparison of properties including cavitations resistance, hardness, tensile strength, strain energy, corrosion resistance and erosion resistance etc. of the offered material vis – a – vis the specified material for Owner's / Consultant's consideration and approval.

E. End Preparation

Valve body ends shall be either butt welded / socket welded, flanged or screwed as finalized during detailed engineering and as per Owner's / Consultant's approval. The welded ends wherever required shall be butt welded type as per ANSI B 16.25 for control valves of sizes 65 mm and above. For valves sizes 50 mm and below welded ends shall be socket welded as per ANSI B 16.11. Flanged ends wherever required shall be of ANSI pressure – temperature class equal to or greater than that of the control valve body.

F. Valve Actuator

1. The regulating control valves shall be furnished with pneumatic actuators. The Contractor shall be responsible for proper selection and sizing of valve actuators in accordance with the pressure drop and maximum shut



off pressure and leakage class requirements. The valve actuators shall be capable of operating at 60 *C continuously.

2. Valve actuators and stems shall be adequate to handle the unbalanced forces occurring under the specified flow conditions or the maximum differential pressure specified. An adequate allowance for stem force, at least 0.15 kg / cm² per linear millimeter of seating surface, shall be provided in the selection of the actuator to ensure tight seating unless otherwise specified.
3. The travel time of the pneumatic actuators shall not exceed 10 seconds.
4. For quick opening / closing services (such as fuel oil shut – off valve), the actuator shall be pilot solenoid operated pneumatic drive; the rating of solenoid shall be 24 V DC.
5. Selection of actuator shall be such that it meets the requirements of thrust / torque, stroke length, angular movement, full scale travel time, repeatability & accurate positioning for successful operation of final control element.
6. All the actuators shall have also provision for manual operation during emergency / maintenance along with graduated local position indicator.

G. Control Valve Accessory Devices

All control valve accessories such as air locks, hand wheels / hand-jacks, limit switches, SMART positioners, diffusers, external volume chambers, reversible pilot for positioners, tubing and air sets, solenoid valves and junction boxes etc. shall be provided as per the requirements.

**Table 9.24(i)
Specification for E-to-P converter**

S.N	Feature	Minimum Requirement
1	Air Supply	1.5 Kg/Sq. cm
2	Input Signal	4-20 mA DC
3	Output Signal	0.2 to 1.0 Kg/ Sq. cm
4	Linearity	0.5 % of span or better
5	Hysteresis	0.1 % of span or better
6	Ambient Temperature Effect (-20 to + 60 *C)	<0.2 % of span per Degree centigrade
7	Mounting	Close to Actuator
8	Protection class	IP-65
9	Enclosure	Die cast Aluminium
10	Drift	+/- 2% of set point per hour



Table 9.24(ii)

Specification for Smart Positioners

S.N	Feature	Minimum Requirement
1	Input	4-20 mA DC
2	Power Supply	24 V DC Loop powered
3	Type of Electronics	Microprocessor based with self diagnostic facility & digital communication by means of HART Protocol
4	Valve position sensing	Non-Contact type with 4-20 mA DC Output
5	Enclosure Type/Material	Weather & Dust proof to IP-65/ Die cast Aluminium
6	Ambient conditions	Suitable for - 30 to +80 *C temperature & 0-95% Humidity
7	Operating Range	Suitable for Full range & Split Range operation
8	Modes of operation	Suitable for Direct & reverse valve action
9	Flow characteristics	Suitable for Linear & Equal percentage Characteristics
10	Fail safe/Freeze feature	Required
11	Air Capacity	Sufficient to handle the Valves Selected/Boosters to be supplied if required.
12	Air supply pressure	To suite the Air Supply Pressure / Quality available
13	Process Connection	1/4" NPT
14	Characteristic Deviation	< = 0.5% of span
15	Ambient Temperature effect	< = 0.01%/Deg C or better
16	Configuration	Remote Calibration, Auto & Manual Calibration shall be possible
17	Cable Entry	½" NPT, Side or Bottom Entry to avoid water ingress
18	Accessories	a) Display with push buttons for configuration and Display on the positioner itself (Password Protected / Hardware Lock).
		b) For Supply & Output Pressure, Filter Regulator and other accessories shall be provided as on required basis for making system complete
		c) Valves Mounting Assembly For Sliding Stem / Rotary / Single Acting / Double Acting on required basis

1. SMART positioner shall be a Double stage positioner. The first stage of the positioner shall be typically a flapper-nozzle that serves as a high-gain pre-amplifier. This sensitivity shall be maintained over a wide range of dynamic conditions. Second stage shall be a power amplifier that provides power to drive the actuator. Preferably this shall be a pneumatic relay. Spool Driven type SMART positioners are not preferred due to Higher Dead Band and Poor responsiveness. The SMART positioner shall have pressure sensors to measure the pneumatic outputs to the actuator.



2. The control algorithm for the positioner shall use feedback signal from the motion of the pneumatic relay beam instead of pressure feedback to minimize pneumatic related effects and for stable and smooth response of the control valve. The SMART positioner shall have user adjustable tuning sets to identify the optimum tuning for the total valve assembly. SMART Positioner with HART Communication facility shall communicate all the valve diagnostics to Plant DCS.

Table 9.24(iii)

Specification for Air Filter Regulator (AFR)

S.N	Feature	Minimum Requirement
1	Type	Constant Bleed type
2	Inlet Pressure	10 Kg/Sq. cm (maximum)
3	Output	Adjustable from 0-2 Kg/Sq. cm or 0-7 Kg/Sq. cm (Continuous) as required
4	Filter Element	5 microns
5	Filter Element Material	Phosphor Bronze
6	Bowl Material	Metallic
7	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
8	Process connection	¼ " NPT
9	Accessories	All mounting accessories. 2" dial size Pressure gauge.

Table 9.24(iv)

Specification for Position Transmitter

S.N	Feature	Minimum Requirement
1	Power Supply	24 V DC Loop powered
2	Type	Non-Contact/ LVDT type
3	Output	4-20 mA DC/ Linear
4	Accuracy	+/- 1%
5	Enclosure Protection class/ Material	IP-65/ Die cast Aluminium
6	Cable Entry	½ " NPT, Side or Bottom Entry to avoid water ingress.
7	Accessories	All mounting accessories

Table 9.24(v)

Specification for Limit Switch (Non Contact Type)

S.N	Feature	Minimum Requirement
1	Type	Non-contact type inductive Proximity
2	Sensing distance	10 mm minimum
3	Hysteresis	Maximum 10% of sensing distance
4	Indicator	LED indication



S.N	Feature	Minimum Requirement
5	Protection class	IP 67
6	Integral Cable	1 mtr.
7	Power supply	24 V DC/ 8 V DC
8	Mounting	Flush mounting with check nut
9	Other Feature	Explosion proof enclosures shall be provided wherever required by the application. Shock & Vibration proof.

G. Test & Examination

1. All valves shall be tested in accordance with the quality assurance programme agreed between the Owner / consultant and the Contractor which shall meet the requirement of IBR and other applicable codes.
2. The tests shall include but not but limited to the following:
 - Non-destructive test as per ANSI B – 16.34.
 - Hydrostatic shell test in accordance with ANSI B16.34 prior to seal leakage test.
 - Valve closure test and seal leakage test in accordance with ANSI B16.34 and as per the leakage class indicated under clause no. B.6.
 - Functional test: The fully assembled valves including actuators control devices and accessories shall be functionally tested to demonstrate times from open to close position.
 - All control valves shall be tested with the positioners for accuracy of positioning and reproducibility over the full range of travel.
 - CV Test : CV test shall be carried out as type test on each size, type and design of the valves as per AISA 75.02 standard and test report shall be furnished for Owner's / consultant's approval.
 - Magnetic particle inspection shall be performed on all machined surfaces of valves having ASA rating of 1500 lbs ASA or greater. All carbon steel valves with 1500 lbs ASA or greater shall receive 100% radio graphic examination in accordance with ASTM – E71.
3. Contractor shall submit test certificates for the tests mentioned in above paragraphs in accordance with ASME and ASTM requirements. In addition Contractor shall also submit for the above equipment, certificate of manufacture and test as required by the Indian Boiler Regulations. The certificate shall be in the prescribed forms III A & III C and shall be endorsed by an Inspection Authority recognized by the Indian Boiler Regulations.



H. General Requirements

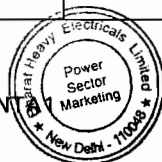
1. Contractor shall furnish all the control valves as finalized during detailed engineering stage without any price repercussions whatsoever depending on the process requirements.
2. Following documents to be furnished by the Contractor after the award of contract.
 - a. Final data sheet for all control valves.
 - b. Detailed dimensional and cross-sectional drawing of control valves, indicating end to end dimensions, various clearances required, weight etc.
 - c. Test certificate for the following :
 - Hydrostatic test for all control valves
 - Magnetic particle inspection for all control valves.
 - Radiographic examination of control valves.
 - Seal tightness test for control valves
 - Materials test certificate for control valves.

9.26 Pneumatic Power Cylinder

Table 9.25

Specification for Pneumatic Power Cylinder

S.N	Feature	Minimum Requirement	
1	Applicable standard	ISO 6431	
2	Mounting Type	Fixed Position mounting/ Trunion mounting	
3	Material	Cylinder	Seamless Steel Tube
		Piston rod	Hard Chrome Plated Steel
		Tie rod	Stainless steel
		End Cover	Cast Iron
		Sealing	Polyurathane
4	Control Signal	4-20 mA DC signal to Smart positioner with HART protocol for modulating purpose. Solenoid valve operating on pneumatic line for open & closing purpose of ON-OFF Damper.	
5	Supply Air	0-7 Kg/cm ²	
6	Accuracy	Better than +/- 1%	
7	Repeatability	Better than 0.5 % of full travel	
8	Hysteresis	Less than +/- 0.2% of full travel	
9	Dead Band	+/- 0.1%	
10	Selection	Based upon thrust/torque, stroke length, angular movement, full scale travel time, repeatability, space factor etc. Provision for air-to-open or air-to-close operation	





S.N	Feature	Minimum Requirement
11	Accessories	Air lock relay, hand wheel, AFR, Volume booster, Limit switch, Positioner, Solenoid valve, position transmitter & all required mounting accessories etc.
12	Fail safe operation	Stay put for regulating duty

9.27 Lignite Feeder Instruments

Table 9.26

Specification for Speed Switch

S.N	Feature	Minimum Requirement
1	Type	Microprocessor based
2	Power supply	230 VAC/110 VAC/ 24 VDC
3	Input	Pulses from Sensor Probe
4	Sensor Probe	Inductive/Capacitive type proximity sensor
5	Speed Range	Programmable
6	Output	Potential free contact output
7	Contact Rating	5A, 240 V AC, 0.5A, 220 VDC
8	Time Delay	Selectable for start up & Trip
9	Enclosure	SS 316, IP-67(for outdoor mounting)/IP-55 (for mounting inside JB/panel)
10	Accessories	All required mounting accessories

Table 9.27

Specification for Speed Probe

S.N	Feature	Minimum Requirement
1	Type	Proximity type (inductive / NAMUR)
2	Frequency Response	0-10 KHz
3	Housing	SS 316/ Polyurethane tip
4	Sensing distance	10 mm minimum (2mm for embedded type)
5	Enclosure class	IP67
6	Power supply	24 V DC/8 V DC (for NAMUR)
7	Cable	Integral Cable 6 mtr.
8	Mounting	Flush with check nut
9	Accessories	Flexible conduit, Non-conductive mounting plates etc.



Table 9.28

Specification for Speed Transmitter

S.N	Feature	Minimum Requirement
1	Type	Microprocessor based Programmable
2	Enclosure Protection	IP-67
3	Accuracy	+/- 1 RPM
4	Power Supply	24 V DC
5	Range	Programmable
6	Resolution	0.1 RPM
7	Output	4-20 mA
8	Input signal	Pulse Input from Proximity Probe
9	Display	LCD display

Table 9.29

Specification for Flow/No Flow detector switch

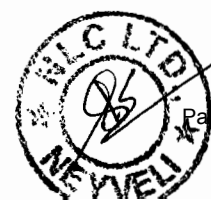
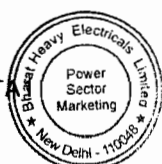
S.N	Feature	Minimum Requirement
1	Operating Principle	Microwave
2	Detection Range	Adjustable
3	Power Supply	230 V AC, 50 Hz
4	Housing	SS 316
5	Protection Class	IP 67
6	Output	Potential free contact output
7	Contact Rating	5A, 240 V AC; 0.5A, 220 VDC
8	Time delay for contact Changeover	Adjustable
9	Accessories	All required mounting accessories

9.28 Solenoid Valves

Table 9.30

Specification for Solenoid Valves

S.N	Feature	Minimum Requirement
1	Operating Principle	Electromagnetic (noiseless), Pilot operated
2	Coil Voltage Rating	24 V DC (in general)/220 V DC/230 V AC/ 110 V AC as required
3	Ways	3 ways in general others as required
4	Port size	¼ " NPT all ports
5	Body	SS Bar stock/Brass





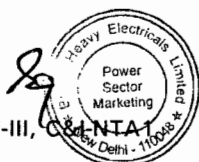
S.N	Feature	Minimum Requirement
6	Trim	AISI 316 SS
7	Manual Operation	In built
8	Duty	Suitable for continuous Energisation
9	Sealing	Airtight & leak proof
10	Coil Enclosure	SS 316/Moulded type
11	Insulation class	Class H
12	Coil Casing	IP-67
13	Mounting	Suitable for mounting On pipe or in panel
14	Cable connection	½ " NPT Cable gland
15	Accessories	Mounting Bracket, nuts, bolts etc.
16	Other Features	LED Indication

9.29 Dew Point Meter

Table 9.31

Specification for Dew Point Meter

S.N	Feature	Minimum Requirement
1	Type	Sensor- Hyper Thin Film high capacitance Al2O3, Transmitter- Microprocessor based 2-wire loop powered
2	Accuracy	± 5.5°F (± 3°C)
3	Repeatability	± 0.9°F (± 0.5°C)
4	Storage temperature	-40°F to + 176°F (-40°C to + 80°C)
5	Local Indication	To be provided
6	Input Resolution	0.1°C dew point
7	Power Supply	24 VDC
8	Output	4 - 20mA
9	Enclosure material	Die - cast Aluminium
10	Enclosure protection	Weatherproof IP 65
11	Electrical connections	½ " NPT
12	Process connection	As per requirement
13	Accessories	All required mounting accessories.





10. PROCESS CONNECTION PIPING

The Contractor shall provide, install and test all required material for completeness of impulse piping system, sample piping system and air piping system as per the requirements of this clause on as required basis for the connection of instruments and control equipment to the process and make the system complete. However, the Contractor shall furnish during detailed engineering all relevant drawings, material and technical specifications of various items service wise for Owner/Consultants approval.

Control and instrument piping & connections shall generally be designed in accordance with the following criteria and these criteria shall be closely co-ordinated with Mechanical Piping Contractor / Erector to fulfill the Mechanical Design Criteria also. This is a guideline for Piping design & selection. OEM standard proven practice in these regard are also acceptable if it is complying with applicable international standard.

1. Pressure connections and piping up to the root valves for all pressure indicators, pressure switches, pressure transmitters, etc., shall be as indicated for miscellaneous piping.
2. Temperature indicators, temperature controllers, temperature switches, temperature detectors, and test well connections shall be as follows:
 - Main steam -- 40 mm NPT.
 - Extraction steam -- 40 mm NPT.
 - Boiler feed water -- 32 mm NPT.
 - Reheat steam -- 40 mm NPT.
 - Duct temperatures -- 25 mm NPT.
 - All others -- 19 mm NPT.
3. Draft pressure connections on steam generator walls and ducts shall be 50 mm pipe couplings.
4. Flow transmitter connections and piping up to the root valves shall be 25 mm for all piping except orifice flanges, where 15 mm piping and valves shall be used.
5. Level switch connections and piping up to root valves shall be 25mm.
6. Level controllers and level transmitters of the displacement type shall have connections and piping up to root valves of 50 mm.
7. Level controllers and level transmitters of the differential pressure type shall have connections and piping up to root valves of 25 mm.
8. Instrument columns at tanks and pressure vessels shall generally be 65 mm minimum.



10.1 Design Pressure and Temperature

Instrument primary piping design pressure and temperature shall be selected consistent with the requirements discussed in Mechanical Design Criteria of this specification, for the process pipe to which the instrument primary piping is connected. The following general criteria shall also apply:

Instrument primary piping for steam and other systems shall be designed for 1-½ times the maximum sustained process pressure and temperature (plus 20°C).

10.2 Sizes of Instrument Primary Piping

Instrument primary piping shall not be smaller than the connection at the process pipe root valve and/or the following (metric sizes are nominal):-

1. 20 mm for pressure measurement piping with a design pressure equal to or less than 42.0 bar and a design temperature equal to or less than 400°C.
2. 25 mm for pressure measurement piping with a design pressure greater than 42.0 bars or a design temperature greater than 400°C.
3. Flow and level measurement by differential pressure shall also use primary piping conforming to the above requirements; however, flange tap connections may be of 13 mm size.
4. Float actuated level switch devices shall be supported on connecting piping not smaller than 25 mm.
5. Level controllers and transmitters of the displacement float type shall be supported on connecting piping not smaller than 50 mm.
6. Instrument columns for float actuated level switches and displacement float devices shall be piping of not less than 65 mm.
7. Primary piping internal diameter shall not be less than 8 mm between the process connection and instrument blow down valve.

10.3 Materials for Instrument Primary Piping

Material for instrument primary piping connecting to the root valve shall preferably be the same as that used in the process system to which it is connected. Higher strength materials may be substituted in the interest of standardization; however, welding procedures at the point of joining the instrument primary piping to the process piping must be appropriate to the combination of materials involved. Copper may be used only for compressed air services that use copper process piping.

10.4 Insulation of Instrument Primary Piping

Instrument primary piping connecting to high temperature systems, which might become hot enough to injure personnel during blow down of the



instrument line, shall be insulated where such hazard exists. Insulation materials, exterior finish, and metal lagging shall conform to the standards adopted for the process piping.

All materials supplied shall be suitable for intended service, process, operating conditions and type of instruments used and shall fully conform to the requirements of this specification. The material offered by the Contractor shall be from reputed, proven manufacturer.

10.5 Process Connection Size

Size of tapping point, Stub No. and size of Root valves for different type of measurements.

These shall be as follows:

**Table 10.1
Process Connection Stub & Root valve**

S. N.	Quantity of root valves (Nos.)	Size of stub and root valves	Service condition
A. Pressure and Differential pressure measurement			
1	2	25NB	> = 62 bar or 425degree C
2	1	15NB	< 62 bar and 425 degree C
B. Level Gauge and Switch			
1	2	25 NB	> = 62 bar or 425 degree C
2	1	25NB	< 62 bar and 425 degree C
C. Level Transmitter (Displacement Type)			
1	2	40NB	> = 62 bar or 425degree C
2	1	40NB	< 62 bar and 425 degree C
D. Stand pipe for Level measuring instrument			
1	2	80 NB	> = 62 bar or 425degree C
2	1	80 NB	< 62 bar and 425 degree C
E. Flow measurement			
1	2	25NB	> = 62 bar or 425degree C
F. Level measurement			
1	1	25NB	< 62 bar and 425 degree C



S. N.	Quantity of root valves (Nos.)	Size of stub and root valves	Service condition
G. Sampling system measurement (system and water service)			
1	2	25 NB	> = 62 bar or 425degree C
2	1	25 NB	< 62 bar and 425 degree C
H. Air and Flue gas Tapping points			
The Air and Flue Gas Tapping points shall be 40 NB. These tapplings shall be of "Y" type to have access for removing the choke. One arm of the "Y" piece shall be closed with leak proof threaded cap with chain. The other arm shall be with reduced diameter suitable to connect to 25 NB impulse pipes.			

10.6 Impulse Piping, Tubing, Fittings, Valves & Valve Manifolds

All impulse pipes shall be of seamless type conforming to ANSI B36.10 for schedule numbers, sizes and dimensions etc. The material of the impulse pipe shall be same as that of main process pipe. For various applications specification of impulse pipe materials and associated fittings and valves shall be as given in Table –10.2 (Process Connection Piping).

**Table 10.2
Process Connection piping**

S. N	Service	Size		Impulse tube material	Impulse tube material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
1	Main steam / Saturated steam	SCH.XXS 21.34mm OD	1.7 mm ODX 1.65HK	SS 316	ASTM-A-335-Gr-P-22 (alloy steel)	ASTM-A-182-Gr-F-22	ASTM-A-182-Gr-F-22
						9000 LBS	2500 SPL. Class
2	Hot reheat / extraction to HPH	SCH.80 21.34mm OD	12.7 mm ODX 1.65mm THK	SS 316	ASTM-A-335-Gr-P-22 (alloy steel)	ASTM-A-182-Gr-F-22	ASTM-A-182-Gr-F-22
						9000 LBS	2500 SPL. Class





S. N	Service	Size		Impulse tube material	Impulse tube material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
3	Cold reheat / extraction / heater drains / condensate system; aux. steam	SCH.80 21.34mm OD	12.7 mm ODX 1.65mm THK	SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	400LBS
4	Water system	SCH.80 21.34mm OD	12.7 mm ODX 1.65mm THK	SS316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	400LBS
5	LDO system; lube oil system	SCH.80 21.34mm OD		SS316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
6.	Instrument air system	SCH.40 21.34mm OD(pipe through out)	12.7 mm ODX 1.65mm THK	SS316	IS 1239 Heavy Class (Galvanised)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
7.	Service air system	SCH.40 21.34mm OD	12.7 mm ODX 1.65mm THK	SS 316	IS 1239 Heavy Class (Black)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS
8.	Boiler fuel gas / air system	SCH.8021 .3 mm OD (pipe through out)		SS 316	ASTM-A-106-Gr-B (carbon steel)	ASTM-A-105-Gr-II	ASTM-A-105-Gr-II
						3000LBS	150LBS





S. N	Service	Size		Impulse tube material	Impulse tube material	Impulse line fitting material	valves material
		Pipe	Tube			ANSI rating	ANSI Rating
9.	Vacuum	SCH.40 21.34mm OD	7 mm ODX1.6 5mm THK	SS 316	ASTM-A- 106-Gr-B (carbon steel)	ASTM-A- 105-Gr-II	ASTM-A- 105-Gr-II
						3000LBS	150LBS
10.	Make up water system	SCH.40 21.34mm OD	12.7 mm ODX1.6 5 mm THK	SS 316	ASTM-A- 312-TP-316 (SS)	ASTM-A- 182-Gr-IF6a	ASTM-A- 182-Gr- IF6a
						3000LBS	150LBS

Notes:-

1. Impulse pipe thickness shall be selected as per ANSI B 36.10. based on the schedule indicated against each service.
2. Wherever impulse tubes are provided, all the fittings required for these shall be SS316.

The following guidelines shall also be considered along with the Table 9.1 for size, material and rating for impulse line/tube fittings and accessories:

a. Impulse line / tube fittings and accessories

1. Nipple shall be provided for root valve size more than ½ inch and the nipple size shall be same as the root valve size. Reducer / adapter shall be provided to suit instrument connection, where nipple, root valve size is more than ½ inch.
2. Bulk head fitting socket welded type to be provided at instrument rack / enclosure.

b. Fittings

1. All fittings except the last fitting connecting to the instrument shall be socket welded. The size of the fittings shall be same as the impulse line size.
2. The fitting connecting to the instrument shall have a size and thread to suit the instrument connection.



c. **Drain**

Drain shall be provided for all water / steam and non-inflammable / non-corrosive fluids only.

d. **Drain Valve**

1. Two numbers of globe drain valves shall be provided for process conditions of 425 degree C or 62 bar and higher.
2. One number globe drain valve shall be provided for process conditions of less than 425 degree C and 62 bar.
3. The valve size shall be same as impulse piping / tubing size.

e. **Funnel with drain header**

1. This shall be provided in the racks for blowing / draining out the process fluid in the impulse tubings.
2. The size of drain header shall be 1"
3. When instruments are mounted local to the tapping point and are not mounted in rack, or panel or enclosure. The drains shall be connected to the nearest floor level or plant drain.

f. **Instrument Valves**

1. Type of the valve shall be needle valve with built in drain valve.
2. Sizing of the valve shall be ½".

g. **Right / left threaded fittings**

This shall be provided for installation / removal of instruments without disturbing the tubing / piping.

- h. A suitable adapter shall be provided to install the instruments on ½" right-left threaded fittings.
- i. A ½" vent line with a ½" isolation valve shall be provided in the instrument rack for air and compressible fluids or otherwise if the installation call for eg. for liquid service where the transmitter is located at a higher elevation than the tapping point.
- j. For air / flue gas measurement a drain pot with plug shall be provided in place of drain valves.

10.6.1 Stainless steel tube shall be provided inside enclosures and racks from tee connection to valve manifold and then to instrument. For high pressure/temperature applications (piping class A,B,C &D of the Table 9.1) the



- material shall be ASTM A 213 TP 316H and for other applications material shall be ASTM A 213 TP 316L. The wall thickness of the tube shall be in accordance with the ANSI B31.1 standard.
- 10.6.2 All fittings shall be forged steel and shall conform to ANSI B16.11. The material of forged tube fittings for shaped application (e.g. tee, elbow etc.) shall be ASTM A182 Gr. 316 H for high pressure/ temperature applications (as defined above) and ASTM A182 Gr. 316L for other applications. The material for bar stock tube fitting (for straight application) shall be 316 SS. Metal thickness in the fittings shall be adequate to provide actual bursting strength equal to or greater than those of the impulse pipe or SS tube, with which they are to be used.
- 10.6.3 The source shut-off (primary process root valve) and blow down valve shall be as per Table 10.2. The disc and seat ring materials of carbon steel and alloy steel valves shall be ASTM A-105 and ASTM A-182, Gr. F22, hard faced with stellite (minimum hardness - 350 BHN.) The surface finish of 16 RMS or greater is required in the area of stem packing. The valve design shall be such that the seats can be re-conditioned and stem and disc may be replaced without removing the valve body from the line.
- 10.6.4 The valve manifolds shall be of 316 s Furnishing Recommended protection interlock logics stainless steel with pressure rating suitable for intended application. 2 valve manifold and 3 valve manifold shall be used for pressure measurements using pressure transmitters/ pressure switches and differential pressure transmitters/ switches respectively. 5 valve manifold shall be used for remaining applications like DP, flow and level measurements.
- 10.6.5 For Pressure/D.P gauges in fluid application two-way globe valve on each impulse line to the instrument and in air/flue gas application two way gate valve on each impulse line to the instrument shall be provided near the instrument. These shall be in addition to the three way gauge cock provided along with the pressure/D.P gauges.

**Table 10.3
Specification for Seamless SS Pipe**

S.N	Property	Requirement
1	Reference	ASTM A-312 TP-316
2	Material Grade	TP-316
3	Type	Seamless/Plain end
4	Size	½" NB
5	Schedule	40/60/80
6	Standard Length	5 metre



Table 10.4

Specification for Seamless SS Pipe Fittings

S.N	Property	Requirement
1	Reference	ASTM A-182 F-316
2	End Connection	Socket welded
3	Type	Forged conforming to ANSI B16.11
4	Size	½" NB
5	Rating	3000/6000/9000 lbs
6	Type of Fittings	Reducing coupling, Male-Female reducer, Straight coupling, Equal Tee, Three Piece Union, Elbow, Cap etc.

Table 10.5A

Specification for Seamless SS Tube (1/2")

S.N	Property	Requirement
1	Reference	ASTM A-213 TP-316
2	Material Grade	TP-316
3	Type	Cold Drawn annealed, pickled, passivated, descaled, hydraulically cleaned seamless tube.
4	Size	½" OD X 2.1 mm thick
5	Properties	Tube shall be free from scratches & suitable for bending & capable of being flared by hardened & tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80
6	Test Pressure	400 Kg/Sq mm minimum
7	Tolerance	+/- 0.13 mm for outside dia. +/- 15% for wall thickness
8	Test	Flare, Hardness, Ball & Bubble test
9	Standard Length	5 metre

Table 10.5B

Specification for Seamless SS Tube (1/4")

S.N	Property	Requirement
1	Reference	ASTM A-269 TP-316
2	Material Grade	TP-316
3	Type	Cold Drawn annealed, pickled, passivated, descaled, hydraulically cleaned seamless tube.
4	Size	1/4" OD X 1.2 mm thick
5	Properties	Tube shall be free from scratches & suitable for bending & capable of being flared by hardened & tapered steel pin. The expanded tube shall show no crack or rupture. Hardness shall be RB 80
6	Test Pressure	400 Kg/Sq mm minimum
7	Tolerance	+/- 0.13 mm for outside dia. +/- 15% for wall thickness



S.N	Property	Requirement
8	Test	Flare, Hardness, Ball & Bubble test
9	Standard Length	5 metre

Table 10.6

Specification for Seamless SS Tube Fittings

S.N	Property	Requirement
1	Reference	ASTM A-182
2	Material Grade	SS 316 forged
3	Type	Double ferrule double compression
4	Ferrule	SS 316
5	Size	To suit SS tubing & NPT end connection
6	Type of fittings	Male/Female connectors, elbow, Equal & Unequal Tee, Cross, Straight connector, bulk head unions, etc. as required to suit the installation.

Table 10.7

Specification for Instrument Valve Manifolds

S.N	Property	Requirement
1	Type	Two valve manifold/Three Valve Manifold Five valve manifold
2	Mounting	Remote 2" pipe mounting
3	Construction	Single Block (Bar Stock)
4	Material	Forged body & bonnet AISI 316 SS
5	Ports	½" NPT
6	Rating	420 Kg/ cm2 at ambient
7	Packing	PTFE Wafer
8	Seat & Stem	AISI 316 SS
9	Plug	AISI 316 SS free to turn on stem/ 17-4 PH
10	Handle	AISI 316 SS
11	Connection	Straight
12	Accessories	Plug for all ports Mounting Bracket, nut, bolts etc.

Table 10.8

Specification for Condensate Pot

S.N	Property	Requirement
1	Reference	ASTM A 182 F22/ ASTM A105
2	Material	Alloy Steel/Carbon Steel as per application
3	Construction	Drilled Bar stock
4	End Connection	3 nos. ½" SW



S.N	Property	Requirement
5	Accessories	Vent Valve

10.7 Air Supply Piping

1. All pneumatic piping, fittings, valves, air filter cum regulator and other accessories required for instrument air for the various pneumatic devices/ instruments shall be provided.

This shall include as a minimum air supply to pneumatically operated control valves, actuators, instruments, continuous and intermittent purging requirements of Local Instrument Enclosures (LIE) etc.
2. For individual supply line and control signal line to control valve, 1/4 inch size light drawn tempered copper tubing conforming to ASTM B75 shall be used. The thickness of copper tubing shall not be less than 0.065 inch and shall be PVC coated. The fittings to be used with copper tubes shall be of cast brass, screwed type.
3. All other air supply lines of 1/2 inch to 2 inch shall be of carbon steel hot dipped galvanized inside and outside as per IS-1239, heavy duty with threaded ends. The threads shall be as per ASA B.2.1. Fittings material shall be of forged carbon steel A234 Gr. WPB galvanized inside and outside, screwed as per ASA B2.1. Dimensions of fittings shall be as per ASA B16.11 of rating 3000 lbs.
4. For air supply to various devices mentioned above, the Contractor shall provide 2 nos., 2 inch size GI pipe header with isolation valve, one for boiler area and one for turbine area. In the boiler area the 2 inch head shall be provided up to top most elevation of boiler floor and from this 2 inch header, 1 inch sub-header shall be branched off at each floor with isolation valve. From this 1 inch sub-header, branch line of 1/2 inch, with isolation valve shall be provided up to various devices. Similar air supply piping shall be done in the turbine area also. Similar system is to be followed for service air required for intermittent purging in the Local Instrument Enclosures (LIEs) etc.
5. Instrument air filter cum regulator set with mounting accessories shall be provided for each pneumatic device requiring air supply. The filter regulators shall be suitable for 10 kg/ sq.cm max. inlet pressure. The filter shall be of size 5 microns and of material sintered bronze. The air set shall have 2 inch size pressure gauge and built in filter housing blow down valve. The end connection shall be as per the requirement to be finalised during detailed engineering.
6. All the isolation valves in the air supply line shall be gate valves as per ASTM B62 inside screw rising stem, screwed female ends as per ASA B2.1. Valve bonnet shall be union type & trim material shall be stainless steel, body rating 150 pounds ASA. The valve sizes shall be 1/2 inch to 2 inch.
7. **Purge Air Connection for Air and Flue Gas Applications**



- a) The continuous purging with instrument air shall be done, for all air and flue gas measurements excepting instrument air and service air instruments, at the process source connection end. Necessary arrangements required for continuous purging shall be provided inside all the air and flue gas local instrument enclosures.
- b) For intermittent purging with service air, necessary arrangements inside all the air and flue gas Local Instrument enclosures/racks shall be provided. The SS three way valve provided in the SS tubing shall be used for isolating the transmitter and connecting the service air quick disconnect line.
- c) One air filter regulator, purge Rotameter and blow down device per instrument shall be provided in the transmitter rack/enclosure.

Table 10.9

Specification for Instrument Air Header

S.N	Property	Requirement	
		For Panel	For Field
1	Material	SS 316	SS 316
2	Inter Connection	2" NPT (M)	1" NPT (M)
3	Header Take-Off	SS 316	SS 316
4	Take-Off Connection	½" NPT (M)	½" NPT (M)
5	Take-Off Valve	½" Ball Valve SS 316	½" Ball Valve SS 316
6	Drain	½" Ball Valve SS 316 at the lowest point	½" Ball Valve SS 316 at the lowest point

Table 10.10

Specification for CS Pipe

S.N	Property	Requirement
1	Reference	ASTM A-106 Gr. C
2	Material	Cold Drawn Seamless CS
3	Type	Seamless/ threaded ends as per ASA B2.1/ Hot dip Galvanised from Inside & outside as per IS-1239
4	Size	½" to 2" NB
5	Schedule	80/160
6	Standard Length	5 metre

Table 10.11

Specification for CS Pipe Fittings

S.N	Property	Requirement
1	Reference	ASTM A-234/ ASA B16.11
2	Type	Forged/ hot dip galvanised from inside & outside

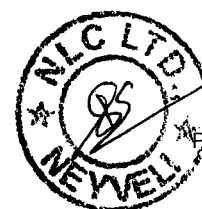
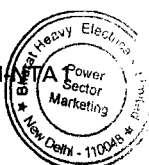


S.N	Property	Requirement
3	Size	½" to 2" (as required)
4	Rating	3000/6000/9000 lbs.
5	End Connection	Threaded as per ASA B2.1
6	Type of Fittings	Reducing Coupling, Male-Female reducer/ Straight Coupling/ Equal Tee/ Three piece Union/ Elbow/ Cap etc.

Table 10.12

Specification for CS Globe Valve

S.N	Property	Requirement
1	Reference	ASTM A-105/ASTM B62
2	Type	Globe
3	Construction	Forged body cadmium plated
4	Rating	PN 40/PN 160/ PN 320/ PN 400
5	End Connection	Screwed Female ends as per ASA B2.1
6	Material	Body- Carbon steel Stem- Hardened Steel Plug- AISI 316 SS Seat- SS Stellite
7	Size	½" to 2 " as required
8	Packing	Teflon/Grafoil as required
9	Hand wheel	CS
10	Yoke	ASTM A105
11	Design Standard	As per ANSI B16.34





12. SYSTEM CABINETS, PANELS & JUNCTION BOX

12.1 General Requirements

1. All control panels, system cabinets, local panels and local instrument enclosures, racks shall be furnished fully wired with necessary provision for convenience outlets, internal lighting, grounding, ventilation, space heating, anti-vibration pads and accessories as per IS:5039-1969 as required for completeness of the system.
2. All panels & cabinets shall be free standing type and have bottom entry for cables unless otherwise specified. The bottom of panels, cabinets, enclosures shall be sealed with bottom plate, compression cable glands and fire proof sealing material to prevent ingress of dust and propagation of fire. The Cabinets shall be designed for front & back access to components, terminals and wiring
3. The cabinets shall be provided with bottom two/three piece glanding plate which shall be removable from inside and shall be provided with sufficient no. of knockouts. The details of knockouts shall be provided during detail engineering. All knockouts shall be provided with pluggable grommets.
4. The cabinets shall be of max. 2200 mm height including base channel. The base channel shall be of 100 ISMC. All cabinets shall be of same height. Construction shall be modular..
5. System & non-system cabinets shall have "look alike" appearance.
6. All electronic system cabinets shall be designed for 50 deg C operating under maximum ambient temperature without air conditioning system in service. Further cabinets, panels shall be so designed that temperature rise due to heat load does not exceed 10 deg. C above ambient temperature under all operating conditions. Necessary louvers, fans, limited packing density, adequate spacing between instruments, devices etc. shall be provided to maintain temperature rise within permissible limits.
7. Panels, cabinets enclosures wiring shall be arranged to enable the removal of modules/instruments and devices without unduly disturbing them.
8. All panels, cabinets, enclosures interiors shall be illuminated with rapid start fluorescent strip fixtures with door actuated switches. Door switch terminals shall be shrouded. All illumination lights shall be provided with isolation switch in addition to door switch for maintenance & switching Off when not required. Illumination light shall be provided on both front & back sides if both sides are provided with equipments/instruments/terminal blocks requiring maintenance.
9. Sufficient number of power receptacles with disconnect switches shall be installed within panels, enclosure and racks.
10. The local instrument enclosures/racks shall be provided locally for mounting of electronic transmitters and switches, etc.



11. All panels, cabinets shall be properly grounded. The grounding scheme shall be as approved by the Owner.
12. Exterior steel surface shall be sand blasted, ground smooth, filed, primed, sanded and smooth enamel painted to give a good finish subject to minimum paint thickness of 65-75 microns for sheet thickness of 3 mm and 50 microns for sheet thickness of 2mm. Minimum 2 coats of primer and two sprays of final finish colour shall be applied to all surfaces.
13. The colour of the panel's interior shall be brilliant white. External colour of the panels shall be as RAL 7032 for LIE/ LIR and RAL 7035 for control room system cabinets.
14. All panels, enclosures, system cabinets, marshalling cabinets shall be provided with a minimum of 20% spare terminations and system cabinets shall be provided with spare space for 20% additional modules fully wired with connectors etc. in excess of the total requirement of the system design when the cabinets are delivered. The spare space capacity shall be distributed evenly throughout the cabinets.

12.2 System Cabinets

Table 12.1

Specifications for System Cabinets

S.N	Features	Minimum Requirements
1	Application	For housing Signal conditioning cards, input/output cards, processor cards, power supply units etc.
2	Location	Indoor
3	Type	Free standing Vertical type
4	Protection class	IP-42
5	Material & Thickness	CRCA steel/ min. 2mm for panel sides & 3mm for gland plates
6	Doors	Double door with neoprene gasket, Lockable,
7	Cable entry	Bottom with fire proof compound thickness 50 mm for sealing
8	Anti vibration pad	Required, 15mm
9	Painting	Interior- Brilliant White Exterior- RAL 7035
10	Cabinet Dimension	To be decided during detail engineering
11	Grounding	M6 earthing stud shall be provided
12	Ventilation	Fans & louvers with brass mesh required
13	Lighting	rapid start fluorescent strip fixtures with door actuated switches required
14	Lifting arrangement	Removable lifting eyebolts shall be provided

1. The racks in system cabinets shall have provision along with plug in sockets/back plane to house accommodate the spare slots/modules as specified elsewhere.



2. The system cabinets, racks in system cabinets, slots in the racks & the terminals shall have identification numbers. A stainless steel metal tag (plate) shall be fixed to the inside of the door & the layout of the racks, slots & details of the card type/service shall be inscribed on this metal tag.
3. Each cabinet shall be provided with one each 3 pin receptacles for 230 V, 1P, 50 Hz and receptacles for 24V DC.
4. One of the doors shall be provided with folder to keep the relevant engineering document of the cabinet.
5. All cabinets shall have common key for locks.
6. Door shall have concealed type of hinges with 120 degree swing.
7. Door latches shall be of the three-point type to ensure tight closing.
8. Separate Power & shield earthing bus shall be provided at the front & rear side of the cabinets. The earthing bus shall be isolated from panel body by suitable insulation material.

12.3 Marshalling Cabinets

Table 12.2

Specifications for Marshalling Cabinets

S.N	Features	Minimum Requirements
1	Application	For termination of all cables originating from field.
2	Location	Indoor
3	Type	Free standing Vertical type
4	Protection class	IP-42
5	Material & Thickness	CRCA steel/ min. 2mm for panel sides & 3mm for gland plates
6	Doors	Double door with neoprene gasket, Lockable,
7	Cable entry	Bottom with fire proof compound thickness 50 mm for sealing
8	Terminal Blocks	Rail mounted cage-clamp suitable for conductor size up to 2.5 mm ² & fused type with LED indication for power supply (24 VDC, 230 V AC, 110 V AC etc.) for instruments & equipments.
9	Anti vibration pad	Required, 15mm
10	Painting	Interior- Brilliant White Exterior- RAL 7035
11	Cabinet Dimension	To be decided during detail engineering
12	Grounding	M6 earthing stud shall be provided
13	Ventilation	Fans & louvers with brass mesh required
14	Lighting	rapid start fluorescent strip fixtures with door actuated switches required
15	Lifting arrangement	Removable lifting eyebolts shall be provided



1. Separate Marshalling cabinets for the system shall be supplied for terminating all cables originating from the field and for distributing the signals to different functional panels and cubicles.
2. The terminal blocks shall be cage clamp type. Fused terminal blocks hinged at one end to facilitate easy isolation shall be provided wherever necessary. All cabinets shall be provided with spare terminals for the spare inputs/outputs as specified elsewhere in the specification. The type of terminals for terminations from cabinets/panels shall match with the pre fabricated cables and pins supplied.
3. The terminals for field cables shall be arranged in a logical order of equipment/system wise and shall be worked out by Contractor, subject to approval by Owner / Consultant.
4. The marshalling cabinets, the terminal blocks, the terminals and the electronic hardware if any, shall have identification numbers.
5. Each cabinet shall be provided with one each 3 pin receptacles for 230 V, 1P, 50 Hz and receptacles for 24V DC.
6. One of the doors shall be provided with folder to keep the relevant engineering document of the cabinet.
7. All cabinets shall have common key for locks.
8. Door shall have concealed type of hinges with 120 degree swing.
9. Door latches shall be of the three-point type to ensure tight closing.
10. Separate Power & shield earthing bus shall be provided at the front & rear side of the cabinets. The earthing bus shall be isolated from panel body by suitable insulation material

12.4 Local Instrument Enclosure & Racks

1. Transmitters and switches, devices, etc. mounted in the field shall be suitably grouped together and mounted in local instruments enclosures in case of open areas of the plant and in local instrument racks in case of covered areas. These local instrument enclosures and racks shall be furnished as per the actual requirements finalised during detailed engineering stage. The exact grouping of instruments in a particular instrument enclosure/instrument rack shall be as finalised during detailed engineering stage subject to the Owner's approval.
2. The local instrument enclosures shall be constructed of 2 mm sheet plate and shall be of modular construction with one or more modules and two end assemblies bolted together to form an enclosure. Vibration dampeners shall be installed for supporting each enclosure. The internal layout shall be such that the impulse piping/ blow down lines are accessible from back doors of the enclosure and the transmitters etc. are accessible from front side for easy maintenance. Gaskets shall be used between all mating sections to achieve protection class of IP-65.



3. The local instrument racks shall be free standing type constructed of suitable 3 mm thick channel frame of steel and shall be provided with a canopy to protect the equipment mounted in racks from falling objects, water etc. The canopy shall not be less than 3 mm thick steel, and extended beyond the ends of the rack. Bulk heads, especially designed to provide isolation from process line vibration shall be provided. Exact fabrication details shall be as finalized during detailed engineering stage. The junction box for racks also shall conform to IP 65 protection class.
4. Provision for continuous purging arrangement is to be made for all air and flue gas applications.
5. Each transmitter enclosure housing instruments i.e. for air and flue gas applications, requiring purge air for continuous air purging shall be provided with common purge air header, air filter regulators of sufficient capacity, required pressure gauges, valves, fittings, SS tubing and individual purge meters for each purge line etc. as required.
6. As soon as the panel's fabrication is over, Owner shall inspect the panels and further work on the panels, namely assembly, wiring and assembly of components shall be carried out only after the inspection.
7. The junction box of Local Instrument Enclosure & Racks shall be provided with hinged type door, latch for locking & gland plates for cable entry. All terminals in junction box shall be of rail mounted cage clamp type suitable for conductor size up to 2.5 Sq. mm.

12.5 Local Junction Box

Table 12.3

Specifications for Junction Box

S.N	Features	Minimum Requirements
1	No. of Ways	32 (2X16) with 20% spares terminals
2	Material & Thickness	2 mm thick Stainless steel
3	Protection class	IP-65 for outdoor/ IP 55 for Indoor
4	Cable entry	Bottom
5	Mounting	Suitable for Wall/column/structures mounting
6	Terminal Blocks	Rail mounted cage-clamp type suitable for conductor size up to 2.5 mm ²
7	Grounding	M6 earthing stud shall be provided
8	Gland plate	Removable type
9	Door	Single Lockable door with gasket, able to open sideways, turnable hinge based, latch type lock without handle with common key.
10	Accessories	Tag plate, clamps, fixtures, bolts (SS), nuts (SS), Gasket (Neoprene), cable glands (SS), Lugs (Brass), Fire proof compound for sealing.

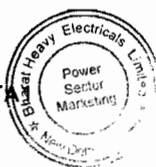


1. All JB's for outdoor application shall be provided with individual canopies to prevent ingress of water.
2. All JB' shall have provision to add 10% additional TB's.
3. The marking on terminal strips shall correspond to the terminal numbering on wiring diagrams.
4. Separate Terminal blocks shall be used for Analog & Digital Signals & also for signals with different voltage levels.
5. The terminal blocks shall be arranged with at least 100 mm clearance between two sets of terminal blocks and between terminal blocks and junction box walls.
6. Separate shield bus shall be provided with screw connection for terminating cable shields.
7. All spare cable entries shall be provided with plugs.
8. All wires in JB shall be neatly dressed & ferruled.
9. Double deck type terminal block shall not be used.

Table 12.4

Specifications for Cable Glands

S.N	Features	Minimum Requirements
1	Type	Double compression
2	Entry Thread	½" NPT
3	Material	Brass
4	Finish	Cadmium Plated
5	Protection	IP-54 or better
6	Accessories	Neoprene gasket, Locknut, Reducer etc.





S.N	Test Requirement	Standard
2	Core Concentricity	IEC 793-1-A3
3	Macro Bending	EIA/TIA-455-62A (IEC 793-1-C11)
4	Micro Bending	IEC-793-1-C3
C	Proof Test	IEC-793-1-B1
D	Strippability	IEC 793-1-B6
E	Visual Examination	EIA/TIA-455-13 (IEC 793-1-B5)

11.4 Instrumentation Cable Interconnection & Termination Philosophy

The cable interconnection philosophy to be adopted shall be such that expensive grouping of signals by large scale use of field mounted Group Junction Boxes (JBs) at strategic locations. (where large concentrations of signals are available, e.g. valves limit and torque switches, switchgear) is done and consequently cable with higher number of pairs are extensively used. The details of termination to be followed are mentioned in the following Table:

Table 11.5

Instrumentation Cable Interconnection & Termination Philosophy

S.N	Application		Type of Termination		Type of Cables
	From (A)	To (B)	End A	End B	
1.	Limit, Torque switches of valves / dampers / drives (integral junction box)	Marshalling cubicle / Marshalling cum Termination Cubicle / Local group JB	Plug-in connector	Posts mount cage clamp type	G
2.	Transmitters, E/P converters, process actuated switches mounted in LIE / LIR	Integral junction box of LIE / LIR	Plug-in connector	Cage clamp (rail mount)	F, G
3.	RTD heads	Local junction Box	Plug-in connector	Cage clamp (Rail mount) type	F
4.	Thermocouples	Junction Box	Plug in connector	Cage clamp (Rail mount) type	A, B, C*
5.	Other Field Mounted Instrument	Local JB / Group JB	Plug in connector	Screwed, Cage clamp (Rail mount) type	F (For analog signals) G (For Binary Signals)
6.	Junction Box (For	Marshalling Cubicle /	Cage clamp (Rail mount)	Screwed, Cage clamp (Rail	A, C*. These



S.N	Application		Type of Termination		Type of Cables
	From (A)	To (B)	End A	End B	
	Thermocouples for interlock and protection	Marshalling cum Termination Cabinet	type	mount) type	signals shall preferably through 6 pair cable
7.	Local junction box, Instrument Junction box of LIE / LIR / Group JB / MCC / SWGR	Group JB	Cage clamp (Rail mount) type	Cage clamp (Rail mount) type	F, G
8.	Local junction box, Instrument Junction box of LIE / LIR / Group JB / MCC / SWGR	Marshalling Cubical / Marshalling cum termination Cabinet	Cage clamp (Rail mount) type	Posts mount cage clamp type	F, G
9.	Marshalling Cubical / Termination Cabinet	Electronic system cabinet	Cage clamp post mounted type	Plug-in connector / Other System as per manufacturer's Standard	Internal Wiring

Notes:

1. Normally 10% spare cores shall be provided when the numbers of pairs of cables are more than four pairs.
2. For analog signals, individual pair shielding & overall shielding & for binary signals only overall shielding of instrumentation cables shall be provided.
3. * For high temperature applications only.
4. Instrument Cabling for instruments / equipment of specialized / proprietary Control System shall be as per manufacturer's standard.

11.4.1 Terminal Blocks

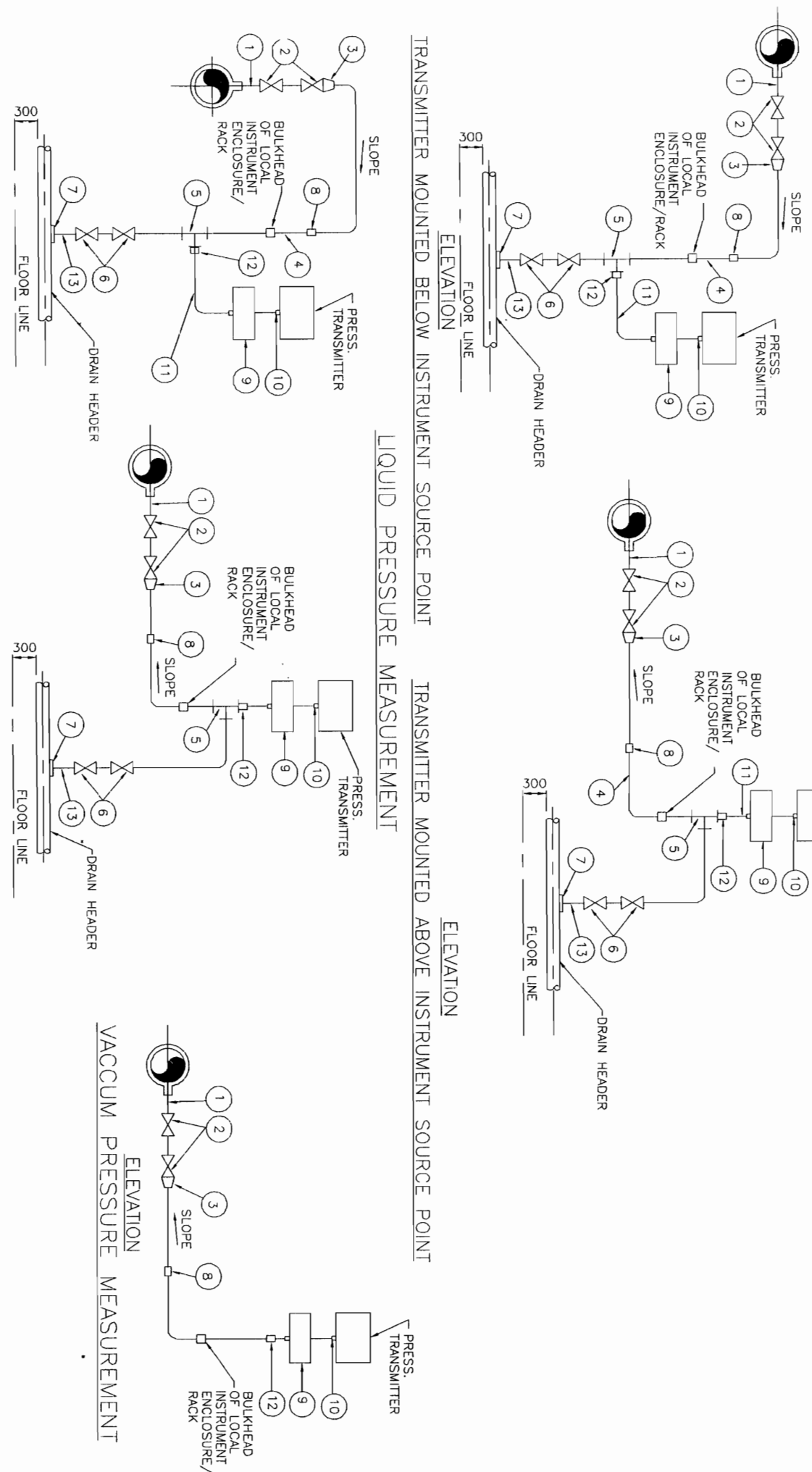
1. All terminal blocks shall be rail mounted/post mounted, cage clamp type with high quality non-flammable insulating material of melamine suitable for working temperature of 105 deg. C. The terminal blocks in field mounted junction boxes, temperature transmitters, instrument enclosures/racks, etc. shall be suitable for cage clamp connections. The terminal blocks in Control Equipment Room logic / termination / marshalling cubicles shall be suitable for the post mounted cage clamp connection at the field input end. The terminal blocks for

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" / 3/4" / 1" NPS SCH. 40/80/160/XXS/P91 NIPPLE OF MATERIAL AS THAT OF MAIN PIPE
2	3/4" / 1" SW GLOBE VALVE
3	3/4" / 1" TO 1/2" REDUCING INSERT
4	1/2" NPS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SCH. 80/160 SW x 1/2" CS/AS COUPLER
8	1/2" VALVE MANIFOLD
9	2/3 VALVE MANIFOLD
10	SUITABLE ADAPTER
11	SS TUBE
12	1/2" PIPE x 1/2" PIPE UNION
13	1/2" NPS SCH. 80/160 SW x 1/2" NPT (M) CS/AS NIPPLE

NOTES:-

- FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.

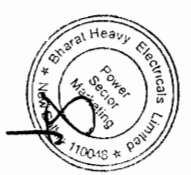


TRANSMITTER MOUNTED BELOW INSTRUMENT SOURCE POINT
ELEVATION
STEAM PRESSURE MEASUREMENT

TRANSMITTER MOUNTED ABOVE INSTRUMENT SOURCE POINT
ELEVATION
LIQUID PRESSURE MEASUREMENT

VACUUM PRESSURE MEASUREMENT
ELEVATION

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REV. NO.	DATE	BY	CHKD	DEI	DEI	DESCRIPTION
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NEVELL LIGHTTE CORPORATION LTD, NEVELL, TAMILNADU

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO. : PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

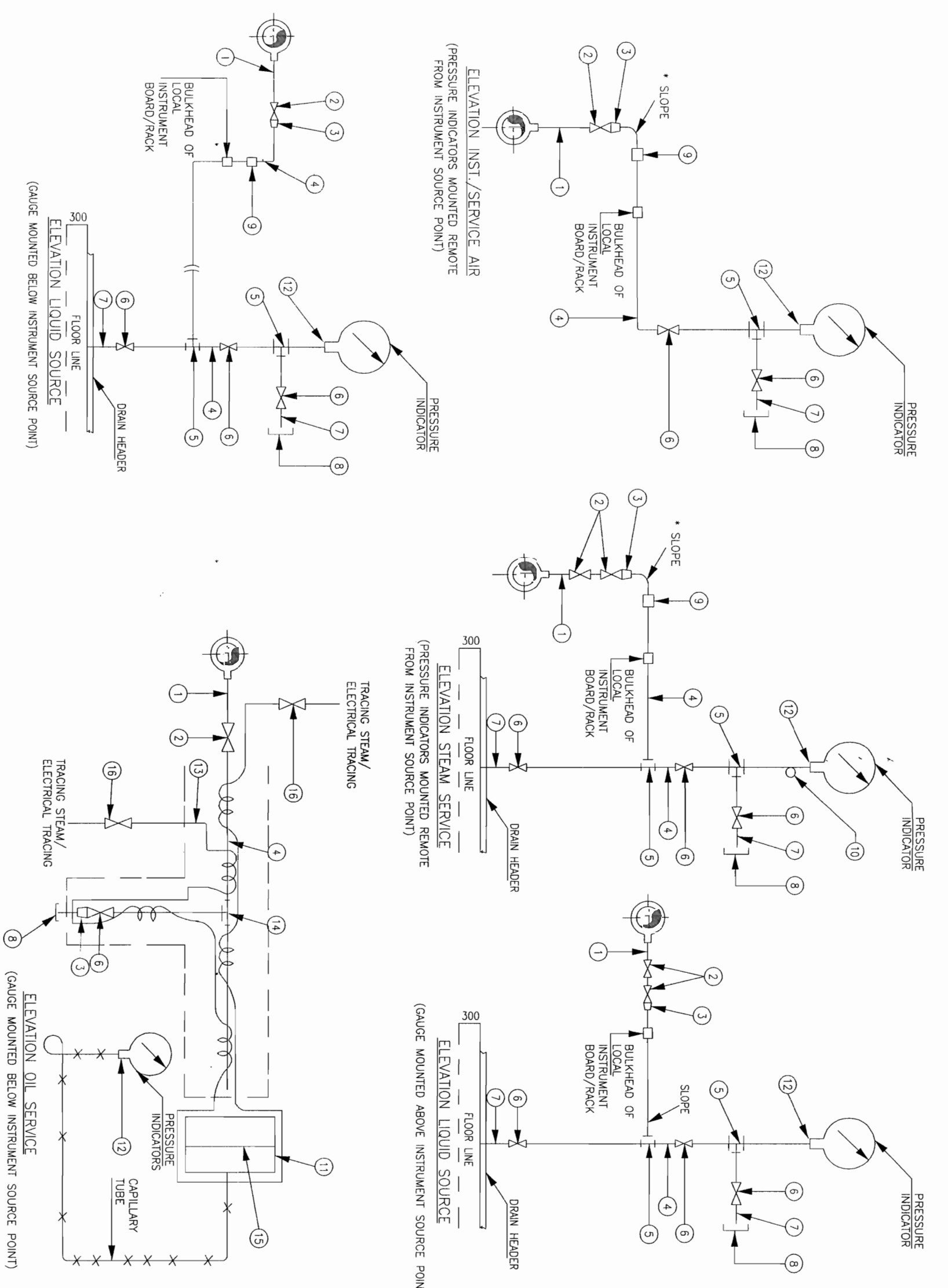
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DRAWING NO LI-GE011019-G-00172-703

SHEET 00 1 OF 1

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- NOTES:-
1. THE MATERIAL SPECIFICATION AND SCHEDULE NO. OF IMPULSE PIPE AND NIPPLE AS LISTED HEREIN SHALL BE AS PER TECHNICAL SPECIFICATIONS.
 2. THE MATERIAL SPECIFICATION AND RATING OF FITTINGS AS LISTED SHALL BE AS PER SPECIFICATION. WELDED /THREADED FITTING SHALL CONFIRM TO ANSI-8.16-11
 3. INSTRUMENT VALVES BODY STEM MATERIAL AND PRESSURE CLASS SHALL BE AS PER TECHNICAL SPECIFICATIONS.
 4. FOR BOILER AIR/FLUE GAS SERVICES SOURCE CONNECTIONS IMPULSE PIPING AND ALL FITTING SHALL BE OF 3/4" NB SIZE.
 5. GAUGES SHALL NOT BE MOUNTED ON THE PIPE. IT WILL BE MOUNTED ON CHANNEL, FRAME OR RACK.
 6. *SLOPE APPROX 40MM/METRE.

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" 3/4" 1" NPS SCH 40/80/160/XXS/P91 (AS PER PROCESS REQUIREMENT) NIPPLE OF MATERIAL SAME AS THAT OF MAIN PIPE
2	1/2" 3/4" 1" SW GLOBE VALVE/GATE VALVE
3	3/4" 1" x 1/2" SW REDUCING INSERT
4	1/2" 3/4" SW GLOBE VALVE
5	1/2" 3/4" SW EQUAL TEE
6	1/2" 3/4" SW GLOBE VALVE
7	1/2" 3/4" NPS SW X 1/2" 3/4" NPT (M) CARBON/ALLOY STEEL NIPPLE
8	1/2" 3/4" NPT (F) CS CAP
9	1/2" 3/4" PIPE UNION
10	6" SS SYMPHON
11	1/2" BLIND 300lbs RF ANSI FLANGE DRILLED AND TAPED FOR 1" NPT PIPE
12	SUITABLE ADAPTER
13	1/4" CHROME MOLY STEEL TUBE
14	1" 3/4" SW EQUAL TEE
15	DAPHRAGM (WATER ELEMENT)
16	ISOLATION VALVE 316 SS. 1/4" SW

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NEVELL LIGHTITE CORPORATION LTD. NEVELL, TAMILNADU

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

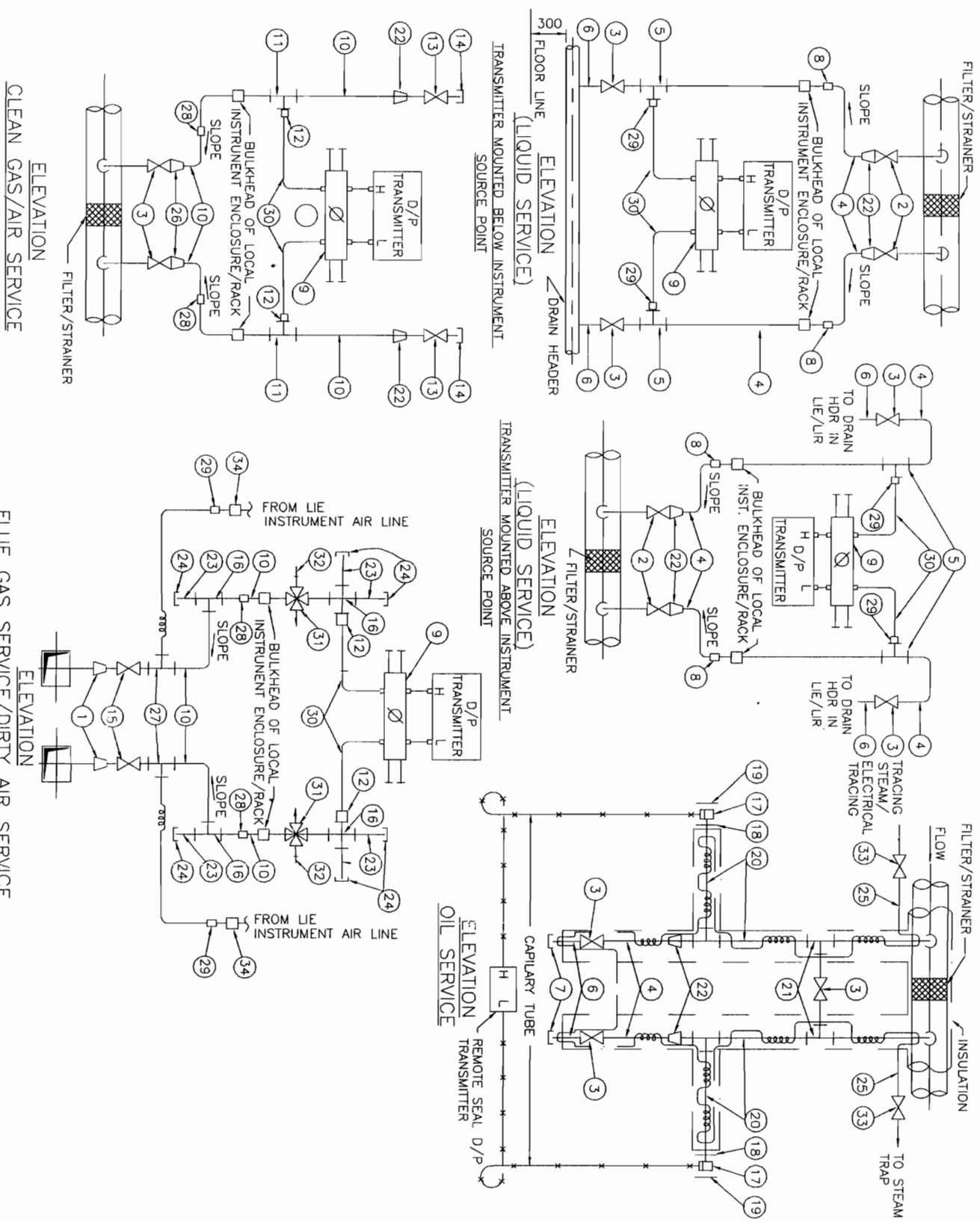
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 DATE : 16-DEC-13
 CHECKED BY : SKM
 DATE : 16-DEC-13
 APPROVED BY : AV
 DATE : 16-DEC-13
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LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	42x2 TO 3/4" SW REDUCING AGENT
2	3/4" SW GLOBE VALVE
3	1/2" SW GLOBE VALVE FOR LIQUID APPLICATION & 3/4" / 1" IN GAS / AIR APPLICATION
4	1/2" NPS 40/80/160 (AS PER PROCESS REQUIREMENT) CARBON / ALLOY STEEL PIPE
5	1/2" SW EQUAL TEE
6	1/2" NPS SW x 1/2" NPT(M) CS NIPPLE
7	1/2" NPT (F) CS CAP
8	1/2" PIPE x 1/2" PIPE UNION
9	5 VALVE MANIFOLD
10	3/4" SCH 80 CARBON / ALLOY STEEL PIPE
11	3/4" / 1/2" SW EQUAL TEE
12	3/4" x 1/2" TUBE UNION
13	1/2" SCREWED GLOBE VALVE
14	1/2" NPT (M) PLUG
15	3/4" SW GATE VALVE
16	3/4" SW EQUAL CROSS
17	WATER ELEMENT FOR USE WITH 3" ANSI R.F. VALVE
18	3" BLIND 300lbs R.F. WELD NECK FLANGE DRILLED FOR 1" SCH. 40/80 PIPE
19	3/4" BLIND FLANGE
20	1" NPS SCH. 40/80 (AS PER PROCESS REQUIREMENT) CS PIPE
21	1" SW EQUAL TEE
22	3/4" x 1/2" SW REDUCING INSERT
23	3/4" SW x 3/4" NPT (M) CS/AS NIPPLE
24	3/4" NPT (F) CS/AS CAP
25	1/4" NPS ALLOY STEEL PIPE
26	1" x 3/4" REDUCING AGENT
27	3/4" SW x 1/2" PSW BRANCH TEE
28	3/4" PIPE UNION
29	1/2" CLAMP UNION (THREADED) SUITABLE FOR FLEXIBLE CONNECTION OF NYLON REINFORCED PVC TUBE
30	SS TUBE
31	3/4" SW 4 WAY VALVE
32	QUICK DISCONNECT FITTINGS
33	1/4" SW ISOLATION VALVE 316SS
34	1/2" x 1/2" SS PIPE UNION



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NEVELL LIGNITE CORPORATION LTD. NEVELL, TAMILNADU



LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO : PROJECT :
NAME : 2 X 500 MW NEVELL NEW THERMAL
POWER PROJECT
DATE : 16-DEC-13

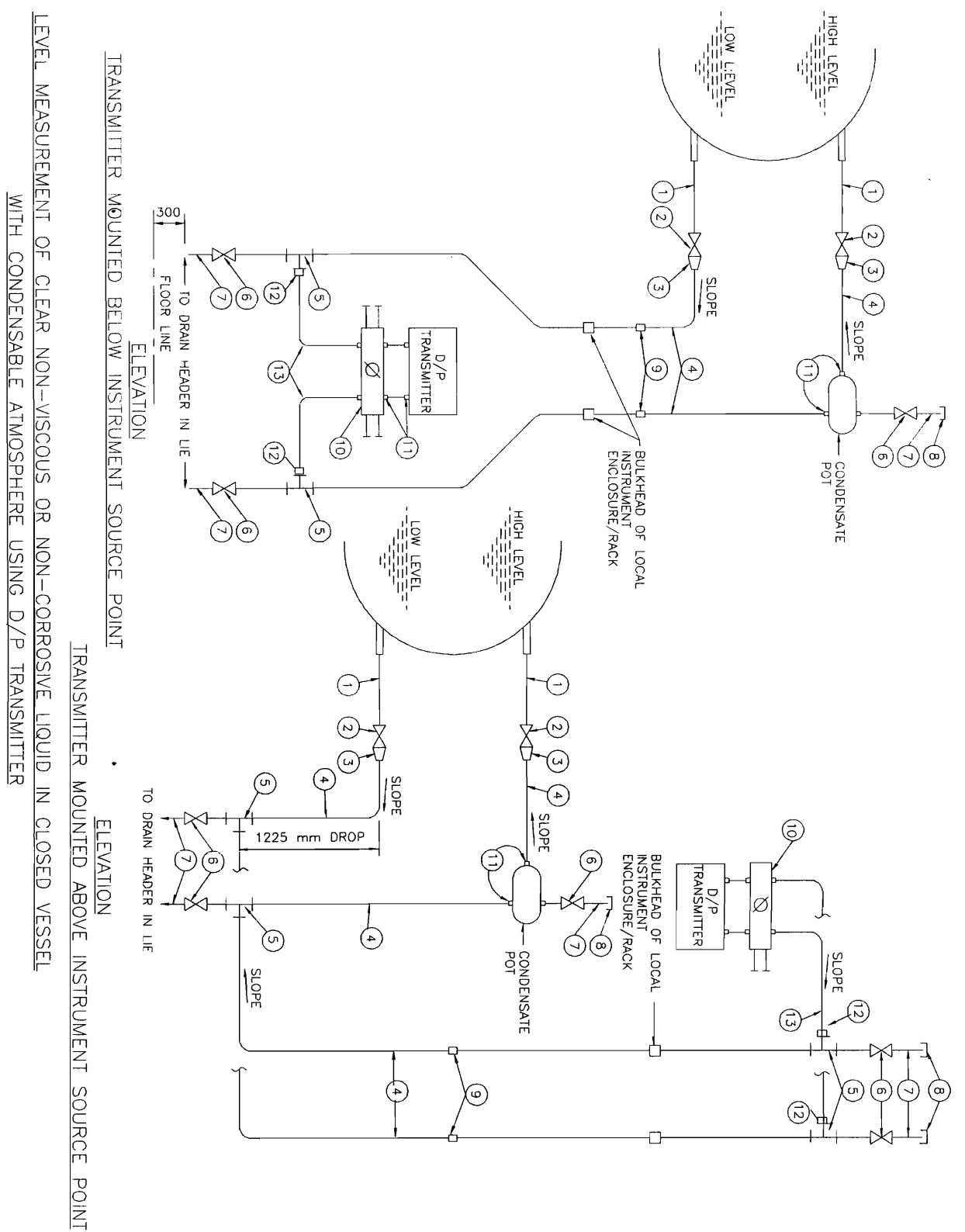
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DESIGNED BY : NHR
CHECKED BY : SKM
APPROVED BY : AW

DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM
DIFF. PRESS. MEASUREMENT (LIQUID/OIL/AIR/GAS SERVICE)

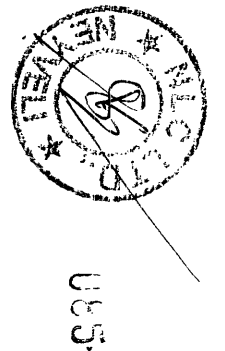
SHEET NO : 00 OF 1
SCALE : 1:1

LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	1/2" 3/4" 1" NPS SCH 40/80/160/XXS/P91(AS PER PROCESS REQUIREMENT) CARBON/ALLOY STEEL PIPE
2	1" SW GLOBE VALVE
3	3/4"/1" TO 1/2" REDUCING INSERT
4	1/2" NPS SCH.80/160/XXS(AS PER PROCESS REQ.)CS/AS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SW X 1/2" NPT(M) CS/AS NIPPLE
8	1/2" NPT (F) CS CAP
9	1/2" PIPE UNION
10	5-VALVE MANIFOLD
11	SUITABLE ADAPTER
12	1/2" PIPE X 1/2" TUBE UNION
13	S.S. TUBE



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REV. NO.	DATE	BY	CHKD.	DESCRIPTION
00	16.12.13	SM		
		SM		
		SM		

NEVELL LIGHTING CORPORATION LTD. NEVELL, TAMILNADU

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

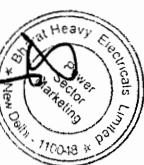
CONTRACT NO. :
 PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT
 PREPARED BY : PS DATE : 16-DEC-13
 DESIGNED BY : NHR DATE : 16-DEC-13
 CHECKED BY : SKM DATE : 16-DEC-13
 APPROVED BY : AV DATE : 16-DEC-13
 SHEET SIZE : A3
 DRAWING NO. : LI-GE0111019-G-00172-708
 SCALE : NTS
 SHEET : 00 OF 28

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LIST OF MATERIALS

ITEM NO	DESCRIPTION
1	3/4" / 1" NPS 40/80 CARBON STEEL PIPE
2	3/4" SW GLOBE VALVE
3	3/4" / 1/2" SW REDUCING INSERT
4	1/2" NPS SCH 40/80 CS PIPE
5	1/2" SW EQUAL TEE
6	1/2" SW GLOBE VALVE
7	1/2" NPS SW X 1/2" NPT(M) CS NIPPLE
8	1/2" NPT (F) CS CAP
9	3/4" TO 4" EXPANDER
10	3/4" BUTT WELDED GATE VALVE
11	4" ANSI 300LBS RF WELDED NECK FLANGE
12	4" ANSI MATCHING FLANGE WITH FLUSH DIAGRAM OF LEVEL TRANSMITTER
13	SS TUBE
14	3-VALVE MANIFOLD
15	1/2" PIPE X 1/2" TUBE UNION

NOTES:-
1. FOR VACUUM APPLICATION OTHER PORT OF TRANSMITTER SHALL BE KEPT OPEN TO ATMOSPHERE.



085

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REV	DATE	BY	CHKD	DESCRIPTION
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		DATE	DEI	
		CHECKED		

NEVELLI LIGNITE CORPORATION LTD, NEVELLI, TAMILNADU



LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

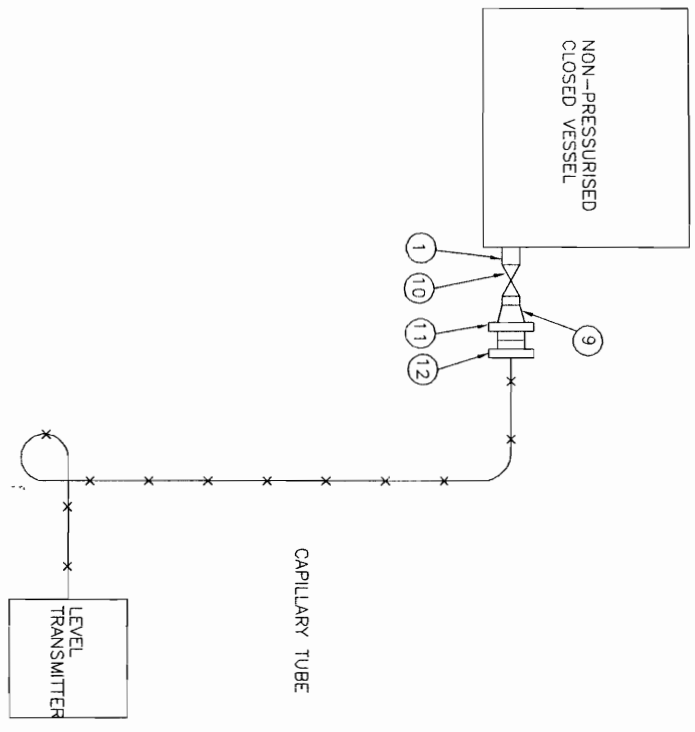
CONTRACT NO. : PROJECT :
2 X 500 MW NEVELLI NEW THERMAL
POWER PROJECT

DESIGNED BY : PS 16-DEC-13
DRAWING TITLE : INSTRUMENT INSTALLATION DIAGRAM
(LEVEL MEASUREMENT- CLOSED/OPEN VESSEL)
CHECKED BY : SMW 16-DEC-13
APPROVED BY : AV 16-DEC-13

SHEET NO. : A3 DRAWING NO. : LI-GE011019-0-00172-709
SCALE : NTS REV. : 00 SHEET : 1 OF 1

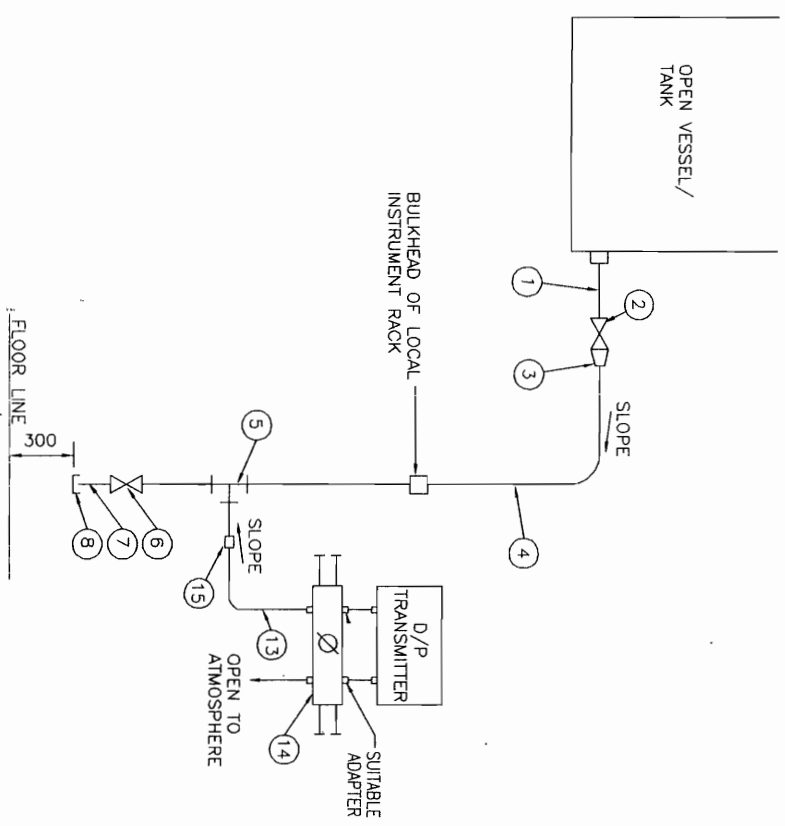
LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID
IN CLOSED VESSEL USING FLUSH DIAPHRAGM/WAFER TYPE
LEVEL TRANSMITTER WITH REMOTE SEAL

ELEVATION



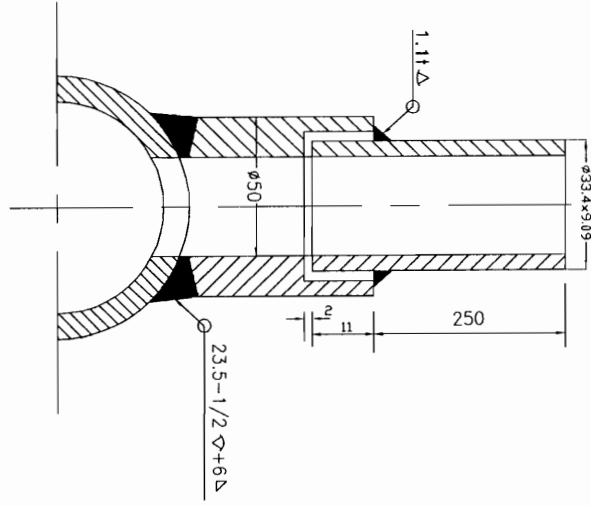
LEVEL MEASUREMENT OF CLEAN LIQUID IN AN OPEN VESSEL
USING D/P TRANSMITTER

ELEVATION

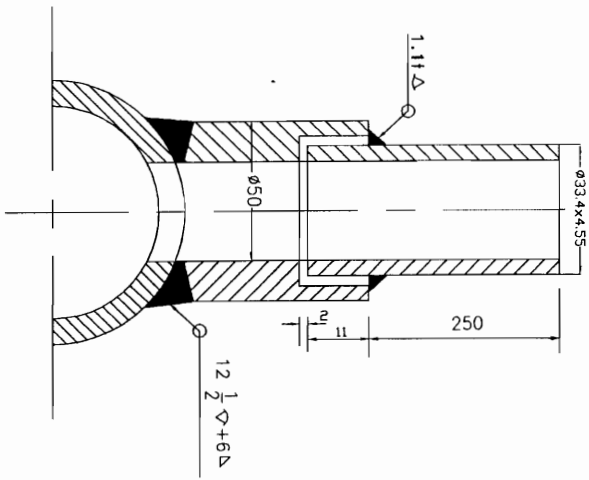


PRESSURE MEASUREMENT

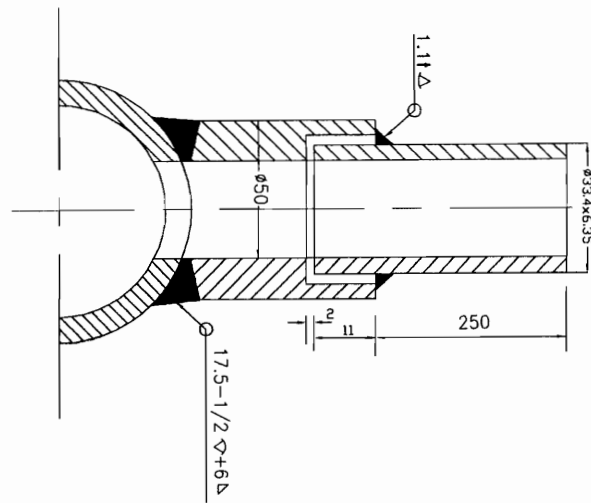
(SYSTEM PR. > 40kg/Sq cm CL 9000)



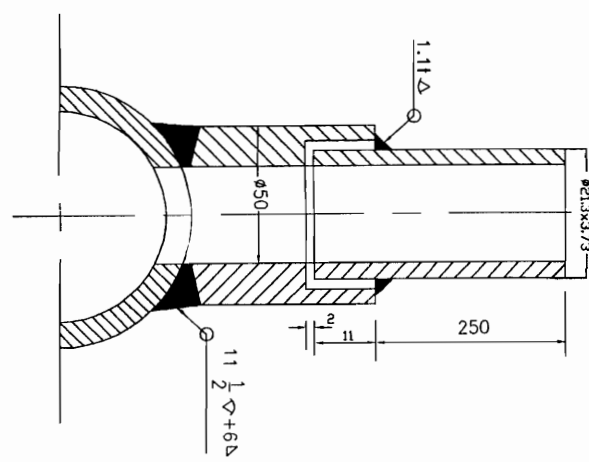
(SYSTEM PR. < 40kg/Sq cm NB 25 CL 3000)



(SYSTEM PR. > 40kg/Sq cm CL 6000)

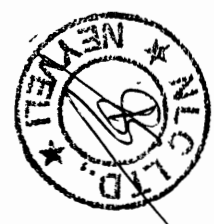


(SYSTEM PR. < 40kg/Sq cm NB 15 CL 3000)



- NOTES:-
1. MATERIAL OF THE BOSS AND NIPPLE BE THE SAME AS PIPE INTO WHICH IT IS WELDED AND CONFORM TO ANSI B 16.11.
 2. THE LENGTH OF THE NIPPLE SHOULD BE 250mm
 3. THE OTHER END OF THE NIPPLE SHALL BE SOCKETWELDED WITH 1" GLOBE VALVE OF MATERIAL AS PER ANSI B16.1.
 4. TWO ISOLATED VALVES ARE TO BE USED FOR PRESSURE => 62kg/cm² & TEMP => 425°C
 5. EDGE HOLE MUST BE CLEAN AND SQUARE OR ROUNDED SLIGHTLY (1/54 RADIUS) FREE FROM BURRS, WIRE EDGES OR OTHER IRREGULARITIES.
 6. ORIENTATION OF TAP WILL VARY WITH TYPE OF PROCESS FLUID AND NATURE OF RUN OF THE PIPE.
 7. ACTIVITIES TO BE COMPLETED AT THE SHOP WELD THE COUPLING(OR BOSS) ON THE PIPE AND DRILL PRESSURE CONNECTION HOLE (SAME AS I D OF NIPPLE) IN THE PIPE IN ALIGNMENT WITH HOLE IN THE COUPLING.
 8. ALL DIMENSIONS ARE IN mm UNLESS OTHERWISE STATED.

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NO.	REV.	DATE	BY	CHKD	APPD	DESCRIPTION
00	18.12.13					SKM

NEVELL LIGHTITE CORPORATION LTD, NEVELL, TAMILNADU



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CONSULTING ENGINEERS, GURGAON, INDIA

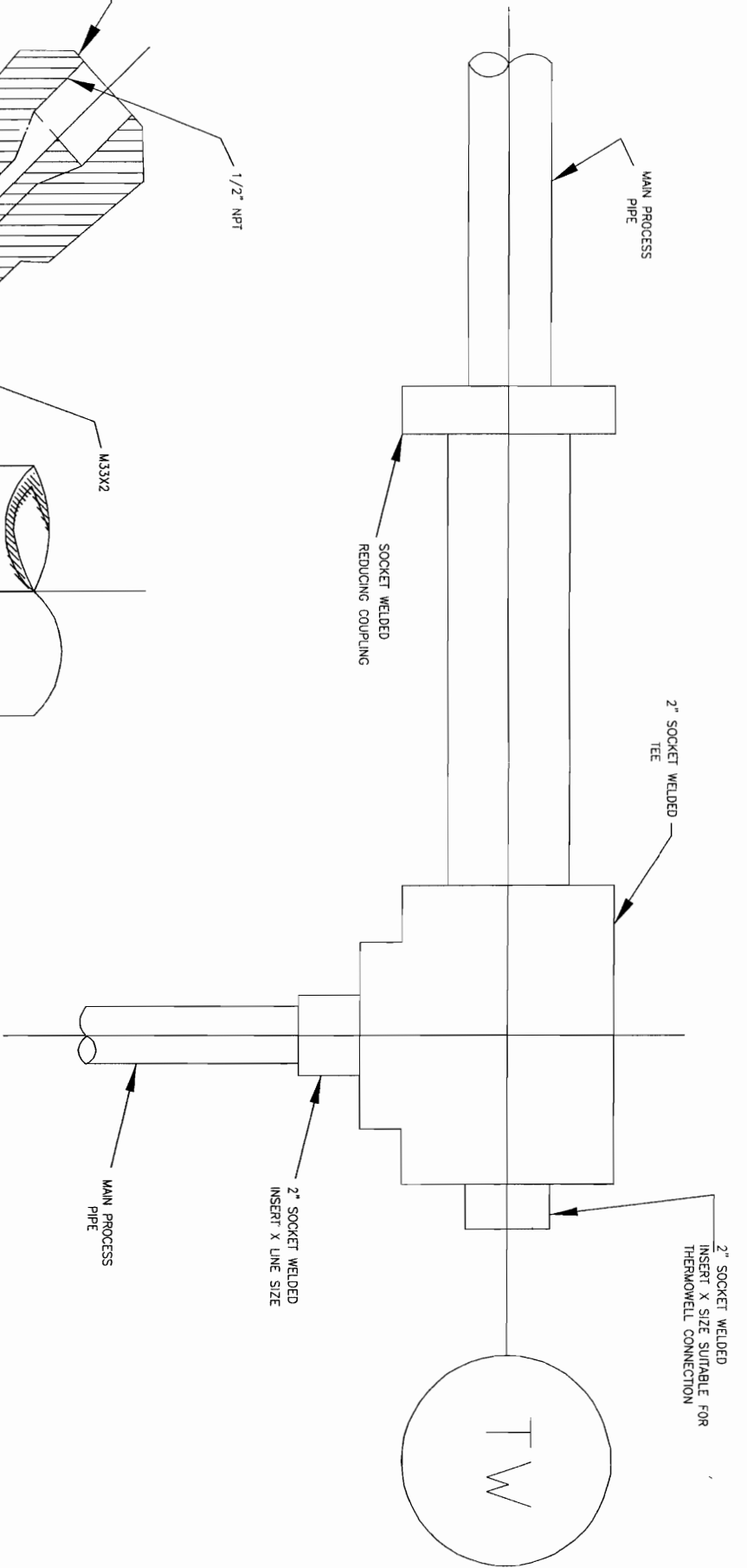
CONTRACT NO :
PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

DESIGNED BY : NHR 16-DEC-13
CHECKED BY : SKM 16-DEC-13
APPROVED BY : ANV 16-DEC-13

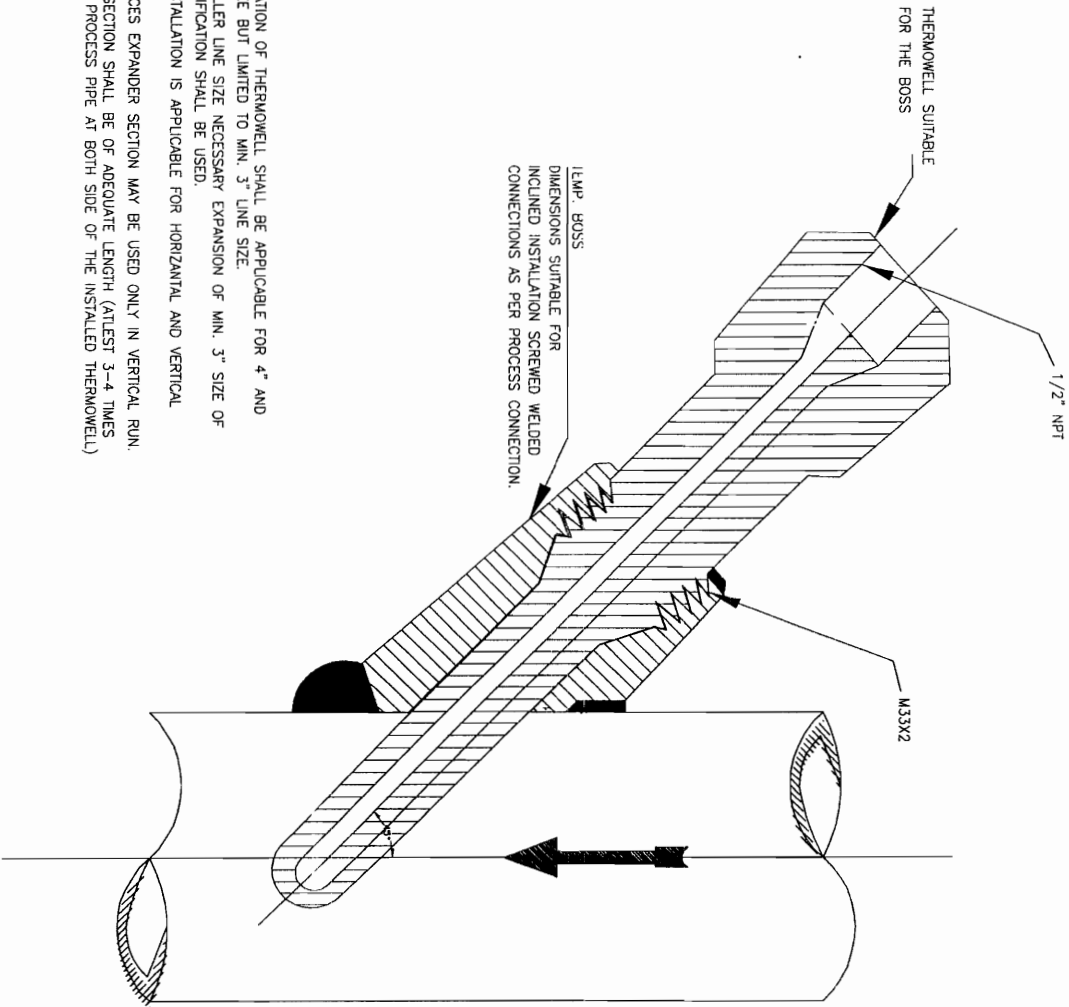
DRAWING NO : LI-GC011019-0-00172-710
SCALE :
SHEET NO : 00 OF 1

Production mark: DM, 1/4 - 1 - E
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TEMP. MEASUREMENT



ELEVATION LIQUID SOURCE



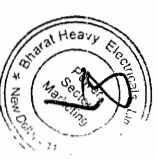
NOTES:-

1. THIS TYPE OF THERMOWELL INSTALLATION IS SUITABLE FOR PROCESS PIPE OF 2" NPS AND SMALLER.
2. FOR STEAM SERVICE THIS TYPE OF THERMOWELL INSTALLATION GORBEND MAY BE USED ONLY IN VERTICAL PLANE.
3. THE LENGTH OF THE LARGER PIPE SECTION SHALL BE MINIMUM 150 mm (IT MUST BE GREATER THAN THERMOWELL LENGTH)

NOTES:-

1. INCLINED INSTALLATION OF THERMOWELL SHALL BE APPLICABLE FOR 4" AND SMALLER LINE SIZE BUT LIMITED TO MIN. 3" LINE SIZE.
2. FOR 2" AND SMALLER LINE SIZE NECESSARY EXPANSION OF MIN. 3" SIZE OF MAIN PIPING SPECIFICATION SHALL BE USED.
3. THIS TYPE OF INSTALLATION IS APPLICABLE FOR HORIZONTAL AND VERTICAL PIPE SECTION.
4. FOR STEAM SERVICES EXPANDER SECTION MAY BE USED ONLY IN VERTICAL RUN.
5. THE EXPANDER SECTION SHALL BE OF ADEQUATE LENGTH (ATLEAST 3-4 TIMES DIA OF THE MAIN PROCESS PIPE AT BOTH SIDE OF THE INSTALLED THERMOWELL).

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REV. No.	DATE	DESCRIPTION
00	16.12.13	SM
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	CHECKED BY	SM
	APPROVED BY	AV
	CHECKED	DEC 03
	CHECKED	DEC 03

NEVELL LIGNITE CORPORATION LTD, NEVELL, TAMILNADU

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

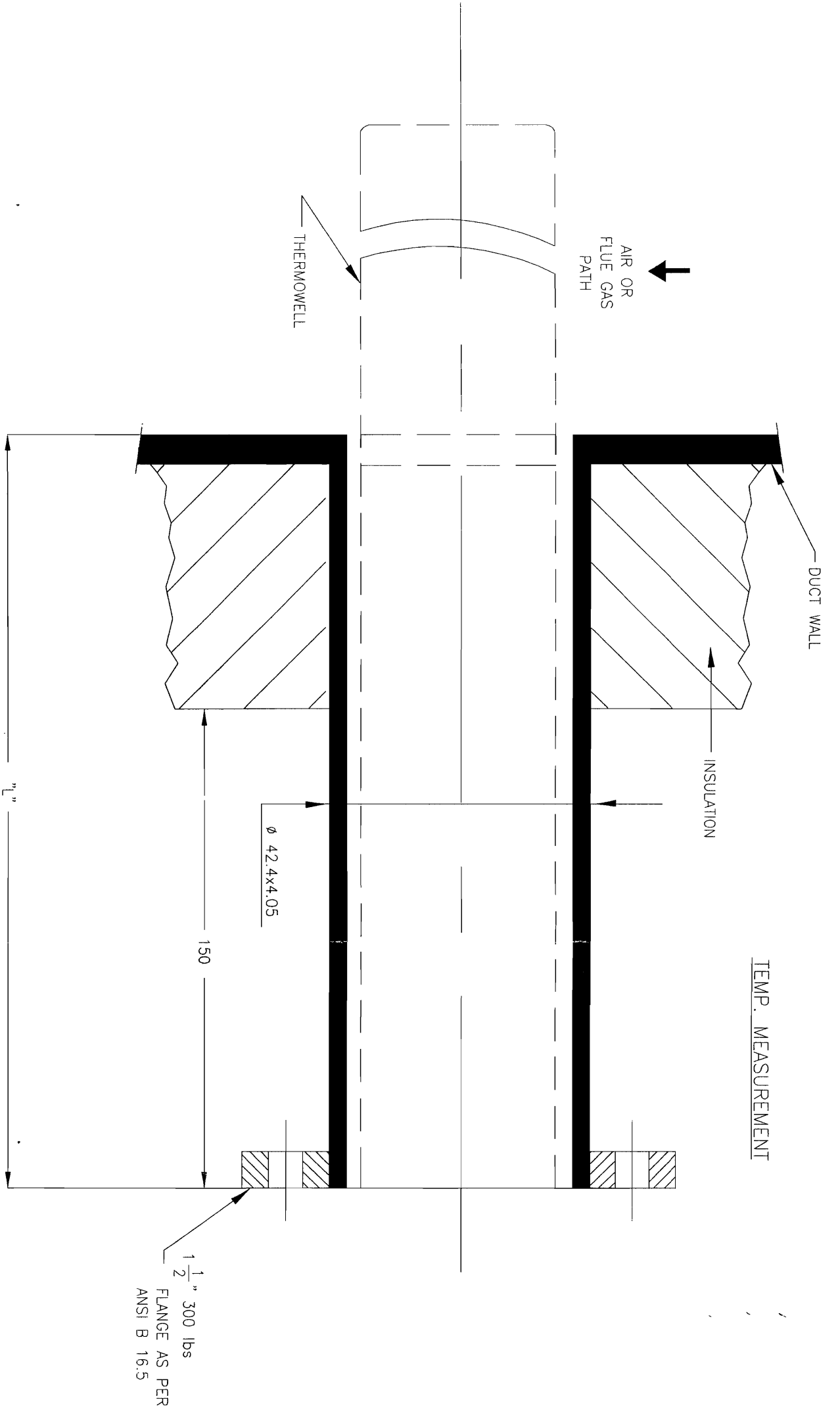
PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MEASUREMENT

DRAWING NO : LI-GE0E11019-G-00172-712

SCALE : NIS

PROTECTION MARK: DN 34 - 1 - E



TEMP. MEASUREMENT

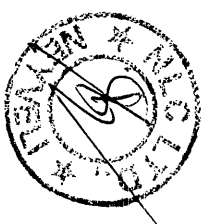
- NOTES:-
1. THIS TYPE OF THERMOWELL CONNECTION SHALL BE PROVIDED FOR TEMPERATURE MEASUREMENT IN AIR AND FLUE GAS DUCT
 2. MATERIAL OF THERMOWELL SHALL BE OF 316SS.
 3. EXTERNAL CONNECTION SHALL BE OF SLIP ON FLANGED TYPE AND THERMOWELL DESIGN SHALL BE AS PER ASME PTC-19.3
 4. CONTRACTOR TO SUPPLY AND INSTALL THE COUNTER FLANGED AND THERMOWELL (ALONG WITH TEMP. ELEMENT)
 5. ALL DIMENSIONS ARE INDICATIVE ONLY

1 1/2" 300 lbs
ANSI B 16.5

Ø 42.4x4.05

150

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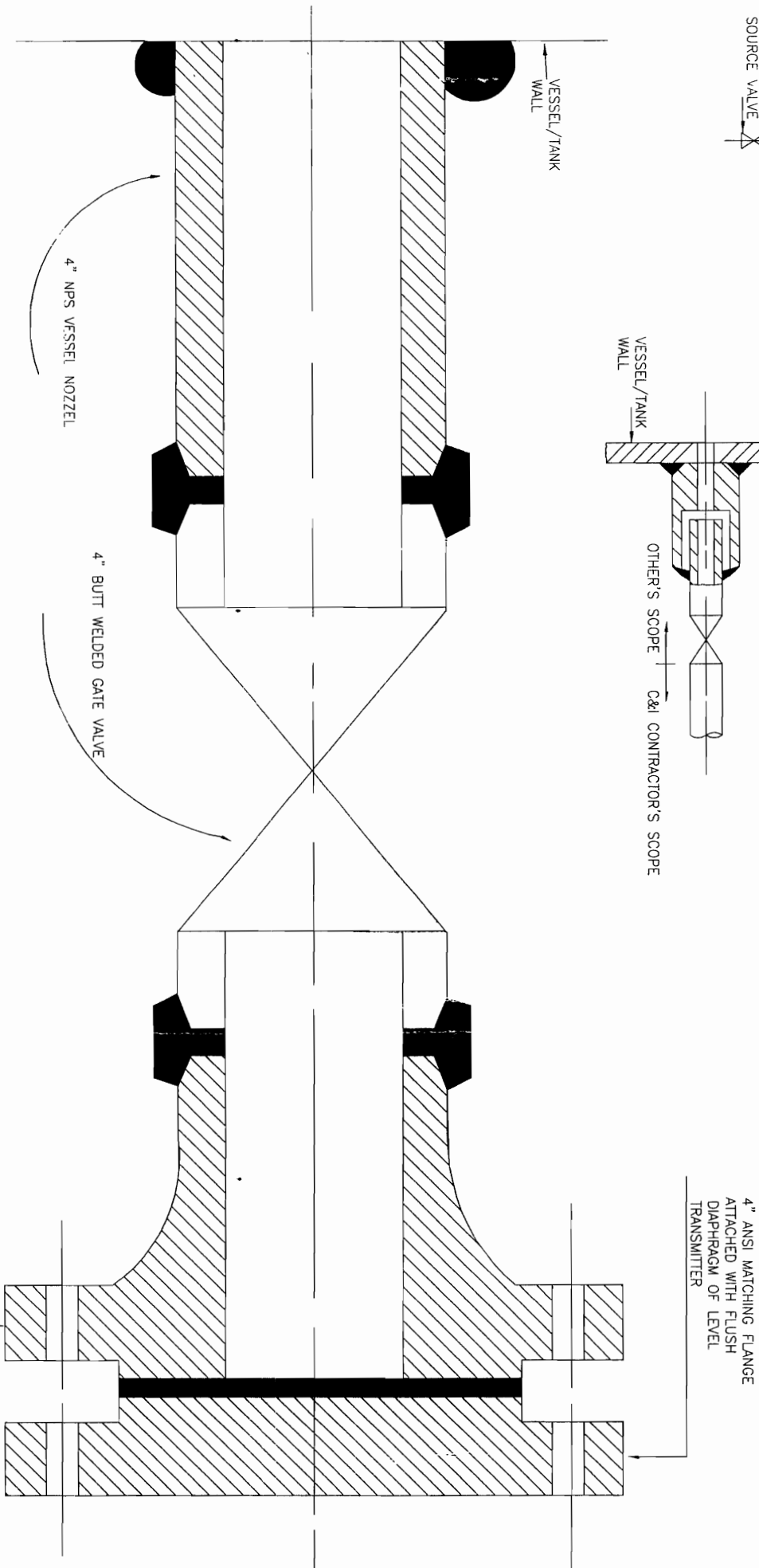
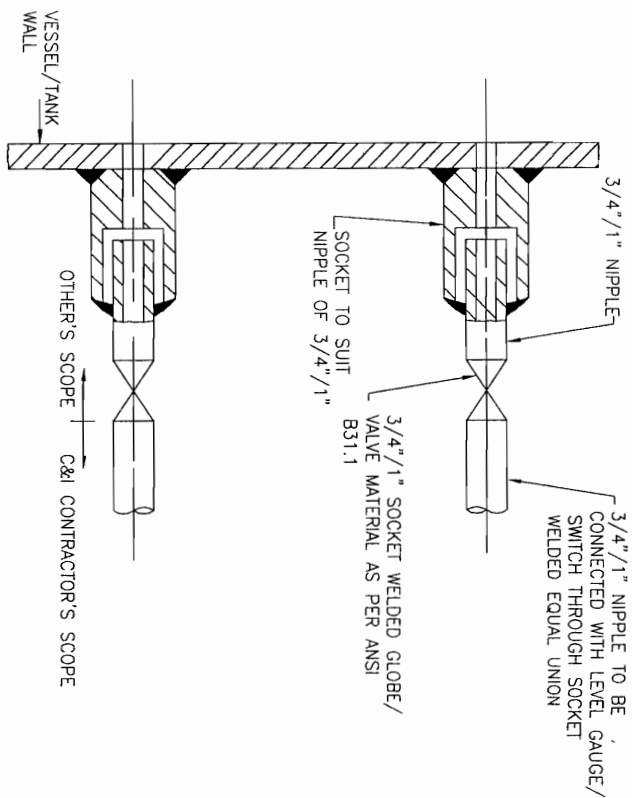
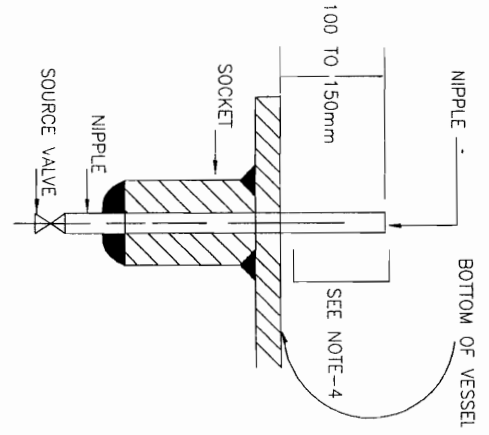
LAHMEYER INTERNATIONAL (INDIA) PVT. LTD.
CONSULTING ENGINEERS, GURGAON, INDIA

CONTRACT NO. :	PROJECT :
PREPARED BY : PS	2 X 500 MW NEVELLY NEW THERMAL POWER PROJECT
DATE : 16-DEC-13	
DESIGNED BY : MHR	DRAWING TITLE :
DATE : 16-DEC-13	INSTRUMENT SOURCE CONNECTION DETAILS - TEMP. MEASUREMENT
CHECKED BY : SKM	
DATE : 16-DEC-13	
APPROVED BY : AMV	
DATE : 16-DEC-13	
SHEET SIZE : A3	DRAWING NO. : LI-GCOE1019-6-00172-713
SCALE : NTS	
PRODUCTION MARK : DIN 34 - 1 - E	REV. SHEET
	00 1 OF 1

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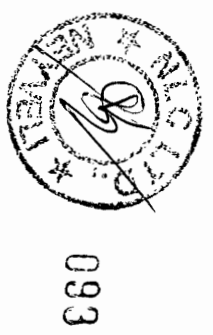
LEVEL MEASUREMENT

- NOTES:-
1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR LEVEL GAUGE AND EXTERNAL GAGE TYPE FLOAT OR DISPLACER OPERATED LEVEL SWITCH.
 2. FOR GAUGES 3/4" NIPPLE ALONG WITH 3/4" SW SOURCE VALVE AND FOR SWITCHES 1" NIPPLE ALONG WITH 1" SW SOURCE VALVE SHALL BE PROVIDED AS PROCESS CONNECTION.
 3. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECTED TO INTERFACE AND TURBULANCE FROM INLETS AND OUTLETS.
 4. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100mm TO 150mm ABOVE THE BOTTOM OF THE VESSEL.



- NOTES:-
1. THIS TYPE OF PROCESS CONNECTION SHALL BE PROVIDED FOR TANK LEVEL MEASUREMENT OF VISCOUS OR CORROSIVE LIQUID USING FLASH DIAPHRAGM/WATER TYPE LEVEL TRANSMITTER.
 2. WELDING OF MATCHING FLANGE TO GATE VALVE SHALL BE DONE BY CONTRACTOR.

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REV. No.	DATE	CHKD	DEE	DEI	DESCRIPTION
00	16.12.13	PS	SM		

NEVELL LIGHTITE CORPORATION LTD, NEVELL, TAMILNADU

LAHMEYER INTERNATIONAL (INDIA) PVT. LTD. CONSULTING ENGINEERS, GURGAON, INDIA

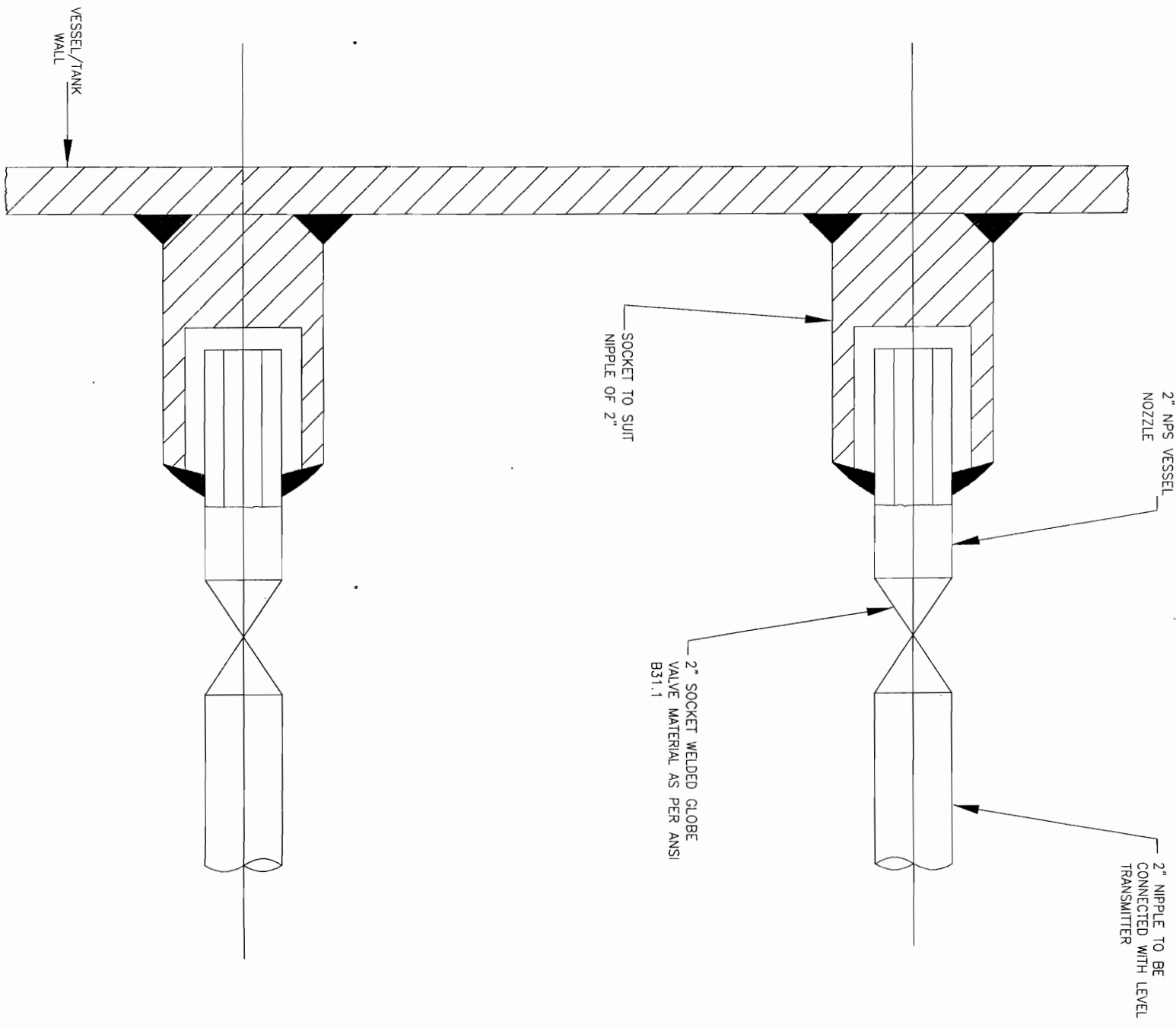
CONTRACT NO. : PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT

DRAWING NO. : LI-GE011019-G-00172-716

SHEET NO. : 00 OF 1

LEVEL MEASUREMENT



- NOTES:-
1. THIS TYPE OF PROCESS CONNECTION SHALL BE USED FOR DISPLACER TYPE LEVEL TRANSMITTER.
 2. SOURCE CONNECTION ON VESSEL SHOULD NOT BE LOCATED AT PLACES SUBJECT TO INTERFACE
 3. IF LOWER CONNECTION IS TAKEN FROM BOTTOM OF THE VESSEL THEN THE NIPPLE MUST BE 100mm TO 150mm ABOVE THE BOTTOM OF THE VESSEL.

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REV.	DATE	BY	CHKD	DEI	DESCRIPTION
00	16.12.13	SMW			

LAHMEYER INTERNATIONAL
CONSULTING ENGINEERS, GURGAON, INDIA

NEVELL LTD.
NEVELL LIGNITE CORPORATION LTD, NEVELL, TAMILNADU

CONTRACT NO. :
PROJECT : 2 X 500 MW NEVELL NEW THERMAL POWER PROJECT

DRAWING TITLE : INSTRUMENT SOURCE CONNECTION DETAILS - LEVEL MEASUREMENT

SHEET NO. : 00 OF 1

SCALE : NIS



Contractor quality assurance personnel for these shop and site tests shall be identified in advance and shall be acceptable to the Owner. The approval of the Owner/Consultant or passing of such inspection of tests shall not, however, prejudice the right of the Owner/consultant to reject the equipment if it does not comply with the specifications when erected or fails to give complete satisfaction in service.

2. The Contractor shall furnish details of shop and site tests proposed to be conducted by him at various stages to meet the specification requirements for each type of instrument/system along with his proposal. Contractor shall also furnish details of his proposed shop and site quality assurance organization for this contract.
3. Contractor shall prepare a detailed shop and site 'Quality Assurance Program' to meet the requirements of these specifications for Owner's/consultant's approval. This document shall also contain the formats for reports and maintenance of test records specification of test equipment to be used for site tests.
4. All equipment and systems furnished under this specification shall be subjected to shop & site tests in accordance with the Quality Assurance Program approved by the Owner/consultant and shall be adequate to ensure full compliance with these specification, all applicable codes & standards and detailed engineering drawings and documents approved by the Owner/consultant.
5. The Contractor shall provide all required test equipment and simulation devices for performing all shop and site tests. All tests equipment shall be of reputed make, required accuracy class and shall be recently calibrated. The record of calibration of test equipment shall be made available to the Owner/consultant on demand.

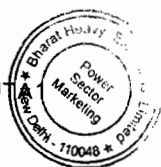
14.2.1 Test & Inspection for Instruments

After Manufacturing, all instruments shall be tested and calibrated at Factory. Contractor shall be responsible in obtaining test certificates related to calibration of all the Instruments and submit for Owner/Consultants approval. Contractor shall allow dispatch of these instruments only after passing applicable Factory Acceptance test and approved by Owner/consultant. The details of the tests to be carried out for the different instruments / field equipments/ Systems shall be as indicated in the Table-14.1 and any other tests as required by the Standards and Codes.

Table 14.1

Test for Instruments

S.N	Instruments/Equipments	Test to be conducted
1	Pressure indicators	<ul style="list-style-type: none"> • Calibration test • Hydro test (1.5 times max. Pr.)
2	Pressure switches	<ul style="list-style-type: none"> • Calibration test • Hydro test • Contact rating test





S.N	Instruments/Equipments	Test to be conducted
		<ul style="list-style-type: none"> • Accuracy test • Repeatability Test • Hysteresis test • Differential test
3	Pressure Transmitters	<ul style="list-style-type: none"> • Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test.
4	Differential Pressure Indicators	<ul style="list-style-type: none"> • Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test.
5	Differential Pressure Switches	<ul style="list-style-type: none"> • Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test
6	Differential Pressure Transmitters	<ul style="list-style-type: none"> • Calibration test • Hydro test • Leak test • Over range test • Accuracy test • Repeatability test.
7	Thermometers	<ul style="list-style-type: none"> • Calibration test • Material test • Accuracy test • Bore concentricity • Hydrostatic test for TW (1.5 times max. pr.).
8	Temperature switch	<ul style="list-style-type: none"> • Calibration test • Material test • Accuracy test • Bore concentricity • Hydrostatic test for TW (1.5 times max.pr.) • Contact rating test
9	Resistance temperature detector assembly	<ul style="list-style-type: none"> • Calibration • Material test • Accuracy test • Bore concentricity test • Insulation test (<500 M ohms at 500 V, DC) as per ISA • Hydro test for TW. • Accuracy test
10	Thermocouple assembly	<ul style="list-style-type: none"> • Calibration • Material test • Insulation test (<500 at 500 V, DC) as per ISA • Hydro static test (1.5 times max. pr.)



S.N	Instruments/Equipments	Test to be conducted
		<ul style="list-style-type: none"> Bore concentricity Accuracy test
11	Temperature transmitters	<ul style="list-style-type: none"> Calibration test Accuracy test Ambient temperature error test
12	Thermowells	<ul style="list-style-type: none"> Material test Bore concentricity : $\pm 1.5\%$ of wall thick Hydrostatic test for TW (1.5 times max.pr)
13	Interposing relay	<ul style="list-style-type: none"> Functional test Temperature rise test High voltage test Limits of operation test Insulation test Contact rating test
14	Level gauges	<ul style="list-style-type: none"> Hydrostatic test Material test Seat leakage test Ball check test
15	Level switches	<ul style="list-style-type: none"> Material test Contact rating test Hydro test Calibration test
16	Level Switch (Probe)	<ul style="list-style-type: none"> Material test Contact rating test Hydro test Calibration test
17	Flow switch	<ul style="list-style-type: none"> Material test Hydro test (1.5 time max. pr) Functional test
18	Flow glasses	<ul style="list-style-type: none"> Material test Hydro test (1.5 time max. pr) Functional test
19	Variable area flow metres	<ul style="list-style-type: none"> Calibration test Material test Hydrostatic test (1.5 time max.pr)
20	Flow element	<ul style="list-style-type: none"> 100% Radiography test Hydro test / Calibration test IBR certificate
21	Control valves	<ul style="list-style-type: none"> IBR certificate Form III C Hydrostatic test : IBR/MSS-SP-61/ANSI B 16.34 Seat leakage test : As per ANSI B 16-104 CV test : As per ISA procedure Magnetic particle test : As per ANSI B 16.34 Special class (applicable for pr. > 70 bar & tem < 4000C Liquid penetration test : As per ANSI B 16.34 Special class (applicable for pr > 70 bar & temp < 4000C Calibration Hysteresis test
22	Position Transmitters	<ul style="list-style-type: none"> Calibration



S.N	Instruments/Equipments	Test to be conducted
		<ul style="list-style-type: none"> • Hysteresis • Accuracy test
23	I/P Converters	<ul style="list-style-type: none"> • Calibration test • Accuracy Test
24	Solenoid Valves	<ul style="list-style-type: none"> • Hydro test • Seat leakage test • CV test • Coil insulation test
25	Air Filter Regulators	<ul style="list-style-type: none"> • Calibration test • Accuracy test
26	Junction Boxes	<ul style="list-style-type: none"> • Test for degree of protection • Material test
27	Transmitter Racks/ Enclosures/Local Panels/Marshalling Cabinets/System Cabinet	<ul style="list-style-type: none"> • Hydro test • Air leak test for tubing, Piping & fittings Verification of degree of protection • Test for enclosure type • Type tests & routine tests as per relevant Indian standards. • Electrical tests as detailed under "Wiring, Terminations & Accessories"
28	Wiring Termination and Accessories	
a	Routine test	<ul style="list-style-type: none"> • Conductor resistance test (*) • High voltage test (*) • Impulse dielectric test • Insulation test • Humidity test • Temperature rise tests on power circuits • Short time current tests on power circuits.
b	Type test	<ul style="list-style-type: none"> • Annealing test (*) • Test for insulation and sheath (*) • Flame retardance test – (a) Oxygen index, (b) Flammability • Test for acid gas generation • Test for water absorption (*) • Wet dielectric test.
		Note (*) – As per IS-1554
29	Test for terminal blocks	<ul style="list-style-type: none"> • Test for moulding for flame resistant • Non-hygroscopic and Decarbonised • Insulation test between terminals • Insulation between terminal block and frame

14.2.2 Test & Inspection for SG Integral Control system

Tests for SG integral control system shall include:-

1. Factory Acceptance Test (FAT):



- There has been no change in the components from the offered equipment & tested equipment.
 - The test has been carried out as per the latest standards along with amendments as on the date of contract signing.
- In case the approved equipment is different from the one on which the type test had been conducted earlier on any of the above grounds, then the tests have to be repeated and the cost of such tests shall be borne by the Contractor within the quoted price and no extra cost shall be payable by the Owner on this account
4. As mentioned against certain items, the test certificates for some of the items shall be reviewed and approved by the Contractor or his authorized representative and the balance have to be approved by the Owner/consultant.
 5. The schedule of conduction of type tests/ submission of reports shall be submitted and finalized during detail engineering.
 6. For the type tests to be conducted, Contractor shall submit detailed test procedure for approval by Owner/consultant. This shall clearly specify test setup, instruments to be used, procedure, acceptance norms (wherever applicable), recording of different parameters, interval of recording precautions to be taken etc. for the tests to be carried out.
 7. All applicable requirements of latest revised edition of I.S.A. Recommended practice MC-55.1 - 1982/ANSI MC 8.1-1975 regarding hardware testing of Digital process computers shall be fully met.

Table 14.2

Type Test Requirement

S. N	Item	Test Requirement	Standard	Test To Be Specifically Conducted	Approval Req. on Test Certificate	Remarks
1	Transducers	As per standard	IEC-688, IS12784	No	Yes	
2	Thermocouple	Degree of protection test	IS-1247	No	No	
3	RTD	As per standard	IEC-751	No	No	
4	Electronic transmitter	As per standard	BS-6447 / IEC-770	No	Yes	
5	E/P converter	As per standard	Mfr. Standard	No	No	
6	Pressure gauge	Degree of Protection test Temp interference	IS-2147 IS-3624	No No	No No	

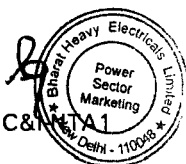


S. N	Item	Test Requirement	Standard	Test To Be Specifically Conducted	Approval Req. on Test Certificate	Remarks
		test				
7	Temperature gauge	Degree of protection test	IS-2147	No	No	
8	Pressure & DP switch	Degree of Protection test As per standard	IS-2147 BS 6134	No No	No No	
9	Level switch	Degree of protection test	IS-2147	No	No	
10	Conductivity level switch	Degree of protection test	IS-2147	No	No	
11	Control valves	CV Test	ISA 75.02	Yes	No	
12	Flow Nozzles & Orifice plate	Calibration	ASME PTC , BS1042	Yes	No	
13	SG control System a) I/O modules b) Other modules c) CLCS Systems	SIL-3(for Boiler Protection System) CMRR & NMRR verification CMRR & NMRR Verification Model test	As per standard Mfr standard Mfr standard Approved procedure	Yes Yes Yes Yes	Yes Yes Yes Yes	
14	LIE / LIR / Junction Box	Degree of protection test	IS-2147	No	No	
15	Flue gas O2	Degree of protection test	IS-2147	No	Yes	





S. N	Item	Test Requirement	Standard	Test To Be Specifically Conducted	Approval Req. on Test Certificate	Remarks
	Analys er					
16	Flue gas CO Analys er	Degree of protection test	IS-2147	No	Yes	





**CHECK LIST FOR
PRESSURE / DIFFERENTIAL PRESSURE GAUGE
(MECHANICAL AUXILIARY PACKAGES)**

SPECIFICATION NO.: PE-TS-394-145-I054
VOLUME
SECTION
REV. NO. 00 DATE: 27.09.2013
SHEET 13 OF 19


SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				P	W	V	
1.0	CHECK FOR		APPROVED TECHINCAL REQUIREMENT/ DATA SHEET				MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
	1.1 DIAL SIZE	100%		M	C	C	
	1.2 MODEL NO/TAG NO	100%		M	C	C	
	1.3 RANGE/SCALE	100%		M	C	C	
	1.4 END CONNECTION	100%		M	C	C	
	1.5 SWITCH CONTACT RATING & NOS	100%		M	C	C	
2.0	CALIBRATION						
	2.1 ACCURACY	100%		M	C	B	
	2.2 REPEATABILITY (FOR SWITCH)	100%		M	C	B	
	2.3 SET POINT ADJUSTMENT FOR SWITCH	100%		M	C	C	
3.0	OVER PRESSURE & LEAK TEST	100%		M	C	C	
4.0	OPERATION OF PR. RELEIF DEVICE	ONE PER TYPE		M	C	C	
5.0	REVIEW OF T.C. FOR MATERIAL OF--						
	5.1 SENSOR	FOR LOT	-	-	B		
	5.2 MOVEMENT		-	-	B		
	5.3 PROCESS CONNECTION		-	-	B		
	5.4 HOUSING		-	-	B		
6.0	REVIEW OF T.C. FOR DEGREE OF PROTECTION	TYPE TEST	-	-	B		
7.0	REVIEW OF T.C. FOR CONTACT RATING OF SWITCH	ONE PER TYPE	-	-	B		
8.0	ACCESSORIES AS APPLICABLE	100%	M	C	C		

LEGEND:

M: MANUFACTURER/ SUB CONTRACTOR, C: CONTRACTOR/ NOMINATED INSP AGENCY, B: BHEL. P: PERFORM, W: WITNESS, V: VERIFICATION.

NOTE:

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.

	CHECK LIST FOR PRESSURE / DIFFERENTIAL PRESSURE TRANSMITTER (Mechanical Auxiliary Packages)	SPECIFICATION NO.:	
		VOLUME	
		SECTION	
		REV. NO.	DATE:
		SHEET 1 OF 1	
Data Sheet No.: PE-CL-999-145-1026-0			

SL NO	TESTS/CHECKS	QUANTM OF CHECK	REFERENCE DOC. ACCEPTANCE NORMS	AGENCY			REMARKS
				M	C	B	
1.0	CHECKS FOR VISULA, MODEL TAG NO.	SEE NOTE-1 BELOW	APPROVED TECHINCAL REQUIREMENT/ DATA SHEET	P	W	V	MFR TO CARRY OUT ROUTINE TEST ON 100%. WHEN MATERIAL CORELATION ARE NOT AVAILABLE MFR'S COMPLIANCE TO BE PROVIDED
2.0	PROCESS CONNECTION	-do-		P	W	V	
3.0	ACCURACY	-do-		P	W	V	
4.0	REPEATEABILITY	-do-		P	W	V	
5.0	HYSTERISIS	-do-		P	W	V	
6.0	EFFECT OF TEMP VARIATION ON ACCURACY	-do-		P	W	V	
7.0	SPAN /ZERO ADJUSTMENT	ONE/TYPE		P	W	V	
8.0	EFFECT OF SUPPLY VOLTAGE VARIATION	ONE/TYPE		P	W	V	
9.0	HIGH PRESSURE TEST	SEE NOTE-1 BELOW		P	W	V	
10.0	BURN IN TEST	ONE/TYPE		P	W	V	
11.0	DEGREE OF PROTECTION	ONE/TYPE		P	W	V	

LEGEND:

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NOTE:

- QUANTUM OF CHECK SHALL BE AS BELOW
100 % - BY MANUFACTURER
RANDOM FOR EACH TYPE – BY BHEL & CUSTOMER
- MANUFACTURER TO MAINTAIN CALIBRATED INSTRUMENT HAVING BETTER ACCURACY THAN THE ITEM UNDER TEST. INSPECTING ENGINEER SHALL CHECK THE SAME.
- IN CASE OF IMPORTED ITEMS CONTRACTORS SHALL REVIEW TC's AND NOT INSPECT.

CONTRACTOR TO PROVIDE COMPLIANCE CERTIFICATE FOR TESTS/CHECKS VERIFIED BY CONTRACTOR AND SUBMIT THE SAME ALONGWITH TEST CERTIFICATES TO BE VERIFIED BY BHEL.



STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-I031	
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 16.05.2007
SHEET	1 OF 3

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	
1.0	Raw Material/ Component Sensing Element, Casing, Contact, Process Connection	1. Chem. Composition	MA	Chemical Analysis	1 sample from each lot	BHEL Spec. / Approved data sheet	Relevant material standard	Test Report	3/2	---	2,1	Relevant compliance certificate to be verified.
		2. Make, Marking, Damage and Cracks	MA	Visual	100%	BHEL spec. / manufacturer standard	BHEL spec. / manufacturer standard	Log Book	2	---	---	
		3. Leakage (Element Conn.)	MA	Pressure Test	100%	Manufacturer standard	No Leak	Log Book	2	---	---	
	Micro Switch	1. No. and type of contacts	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Log Book	3/2	---	2,1	
		2. Continuity	CR	Electrical	100%	Manufacturer standard	To have continuity	Log Book	3/2	---	2,1	
2.0	Final Inspection											
2.1	Assembly	1. Marking: Range, Model, Tag No. Sl.No.	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	---	10% to be witnessed by BHEL
		2. Correct assembly, workmanship and finish	MA	Visual	100%	Manufacturer standard	Manufacturer standard	Log Book	2	1	---	- do -

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 2 - Vendor 3 - Sub-vendor
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STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-I031	
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 16.05.2007
SHEET	2 OF 3

SI. 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	
2.2	Routine Test	3. Connection	MA	Visual & Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	---	10% to be witnessed by BHEL
		4. Scale Marking	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	---	- do -
		5. Cleanliness	MA	Visual	100%	Manufacturer standard	Free from scratches dirt etc.	Log Book	2	1	---	- do -
		6. Overall Dimension	MA	Measurement	100%	BHEL Spec. / Approved drg.	BHEL Spec. / Approved drg.	Inspection Report	2	1	---	- do -
		1. Overload	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		2. Repeatability	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		3. Set point adjustment	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		4. Differential	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -

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STANDARD QUALITY PLAN FOR PRESS AND DIFF PRESS SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-I031	
VOLUME	IIB
SECTION	D
REV. NO.	01 DATE: 16.05.2007
SHEET	3 OF 3

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. Contact Rating	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	---	1	Manufacturer compliance certificate to be verified.
		6. Insulation Resistance & HV	CR	Electrical	100%	Relevant standard	Relevant standard	Test Report	2	1	1	10% to be witnessed by BHEL
		7. Calibration Test	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
		8. Accuracy Test	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1	1	- do -
2.3	Type Test	1. Weatherproofness	CR	Measurement	1 sample / design	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	3/2	---	1	Vendor to furnish test report for verification
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	

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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	* Category	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	IS:1079 IS:513	IS:1079 IS:513	Test Certificate	3	---	2	
		2. Bend Test	CR	Mech. test	Sample	IS:1079 IS:513	IS:1079 IS:513	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	IS:2062	IS:2062	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%	IS:2062	IS:2062	Log Book	2	---	1	
3.0	Cables / Wires	1. Visual / Surface defects	MA	Visual	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		2. IR and HV	MA	Electrical	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	

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1 - BHEL
 2 - Vendor
 3 - Sub-vendor



**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	2 OF 7

SI. 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 IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	Log Book	2	---	---	
		4. Type / Routine Test Certificates	MA	Verification	100%	BHEL Spec. and IS:1554 or IS:694	BHEL Spec. and IS:1554 or IS:694	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	Sample 100% Sample+ 100% 100% 100% 100%	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	BHEL Spec. and BOM Relevant IS Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue Relevant Indian Std & Catalogue	Log Book Log Book Log Book Log Book Log Book Log Book Log Book	2 2 2 2 2 2 2	--- --- --- --- --- --- ---	--- --- --- --- --- --- ---	+ for relay & contactors only @ for all components except relays & contactors. 1

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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	3 OF 7

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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**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	4 OF 7

SI. 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	
9.0	Pre-treatment and Painting	1. Pretreatment Process	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		2. Process parameters like bath temp. concentration etc.	MA	Measurement	Periodic	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		3. Dipping / Removal Time	MA	Measurement	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		4. Surface quality after every dip	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		5. Primer after phosphating	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		6. Putty Application & Rubbing after primer	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		7. Paint first coat	MA	Visual, Thickness	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		8. Putty Application and Rubbing after first coat of paint	MA	Visual	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	
		9. Paint second coat	MA	Visual, Thickness, Scratch test Colour adhesion	100%	Factory Standard & IS: 6005	Factory Standard & IS: 6005	Log Book	2	---	1	

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 MI - Minor characteristics V - Agency Verifying the Test. 3 - Sub-vendor



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	5 OF 7

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	
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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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	6 OF 7

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. 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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**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	7 OF 7

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 IS-13947 Part-1, IS-2148.	BHEL approved spec., drg relevant IS-13947 Part-1, IS-2148.	Type Test Certificate	3	---	1	
14	ROUTINE TEST	IR before & after HV Test	CR	Electrical	100%	BHEL approved spec., drg., BOM & relevant IS.	BHEL approved spec., drg., BOM & relevant IS.	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 Calibratio	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 IS.	BHEL approved spec/drg & relevant IS.	Inspection Report	2	1	1	

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 MA - Major characteristics
 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



STANDARD QUALITY PLAN FOR LEVEL SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-I033	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	1 OF 3

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	
1.0	Raw Material/ Component											
1.1	Non Wetted Parts	Physical, Chemical properties	MA	Physical, Chemical Analysis	1/ Cast	BHEL Spec/ Approved drg. / data sheet	Relevant material standard	Test Report	3/2	---	2,1*	*Relevant compliance certificate to be verified.
1.2	Float Assembly & Wetted Parts	Physical for float only & chemical properties for all wetted parts including float assembly	MA	Physical, Chemical Analysis	1/Batch	AISI:316 / BHEL spec. / drg. / Approved data sheet	AISI:316 / BHEL spec. / drg. / Approved data sheet / Relevant material std.	Test Certificate	3/2	---	2,1*	
1.3	Chamber	Dimensions & leak tightness	MA	Measurement, visual, hyd. test	100%	BHEL Spec/ Approved drg. / data sheet	BHEL Spec/ Approved drg. / data sheet	Internal inspection report	3/2	2	1	
1.4	Float	Leak tightness	MA	Hyd. test	100%	BHEL Spec/ Approved drg. / data sheet	No leakage	Internal inspection report	3/2	2	1	
1.5	Switch	1.. Make, type and rating	MA	Visual	100%	BHEL / Mfr. spec.	BHEL / Mfr. spec.	Internal inspection report	3/2	---	2,1	
		2. Contact Continuity	CR	Electrical	100%	BHEL / Mfr. spec.	BHEL / Mfr. spec.	To have continuity	3/2	---	2,1	
2.0	Final Inspection											
2.1	Assembly	1. Marking: Range, Model, Tag No. Sl.No.	MA	Visual	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	1	---	

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 2 - Vendor 3 - Sub-vendor
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STANDARD QUALITY PLAN FOR LEVEL SWITCHES

QUALITY PLAN NO.: PE-QP-999-145-I033	
VOLUME	IIB
SECTION	D
REV. NO.	00
DATE:	15.03.99
SHEET	3 OF 3

SI. 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	
2.3	Type Test	4. Differential	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Test Report	2	1❖	1	Manufacturer compliance certificate to be verified.
		5. Contact Rating	CR	Measurement	100%	BHEL Spec. / Approved data sheet	BHEL Spec. / Approved data sheet	Inspection Report	2	---	1	
		6. Insulation Resistance & HV	CR	Electrical	100%	Manufacturer standard	Manufacturer standard	Test Report	2	1❖	1	
		1. Weatherproofness	CR	Measurement	1 sample / design	BHEL Spec. / Approved data sheet	IS : 2147 / NEMA-4	Test Report	3/2	---	1	
3.0	Packing	Soundness of packing	MA	Visual	100%	BHEL Spec.	BHEL Spec.	Log Book	3/2	2	---	

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 2 - Vendor 3 - Sub-vendor
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PEM :: C&I

STANDARD QUALITY PLAN FOR RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL

QUALITY PLAN NO.: PE-QP-999-145-I025	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	21.03.2012
SHEET	1 OF 2

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	
1.0	Raw Material / Component											
1.1	Resistance sheath	Material composition	CR	Chemical testing	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲	▲ Relevant compliance certificate to be verified.
1.2	Protective Sheath	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲	
1.3	Terminal Head	Material composition	MA	Chemical testing		Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1 ▲	
1.4	Thermowell⊕	1. Chemical properties	CR	Chemical composition	One Sample from each lot	Approved drg. / data sheet	Relevant material std.	Test Certificate	3,2	---	2,1	
		2. Dimensions (wall thickness concentricity of bore, OD & length)	MA	Measurement	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection report	2	1♦	1	♦ BHEL to witness 25% Samples
		3. Threading	MA	Thread matching	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	2	2,1♦	1	
		4. Leak Test (Hyd. test at 1.5 times design press)	CR	Visual	100%	Approved drg., BHEL Spec.	Approved drg., BHEL Spec.	Inspection Report	3,2	1**	2/1	⊕ IBR certificate wherever specified to be verified. **10% of total quantity with minimum of 2 random piece/type & size

LEGEND: * CR - Critical characteristics § P - Agency Performing the Test. 1 - BHEL
 MA - Major characteristics W - Agency Witnessing the Test. 2 - Vendor
 MI - Minor characteristics; Mfd std - Manufacturers' standard V - Agency Verifying the Test. 3 - Sub-vendor



**STANDARD QUALITY PLAN
FOR
RESISTANCE TEMPERATURE DETECTOR WITH THERMOWELL**

QUALITY PLAN NO.: PE-QP-999-145-I025	
VOLUME	IIB
SECTION	D
REV. NO.	01
DATE:	21.03.2012
SHEET	2 OF 2

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			
2.0	Final Inspection													
2.1	RTD Assembly	1. Workmanship 2. Marking 3. Dimensions	MA MA MA	Visual Visual Measurement	100% 100% 100%	Approved drg. / data sheet	Approved drg. / data sheet	Inspection Report	2	----	1▲			
											2		----	1▲
											2		----	1▲
2.2	Routine Tests	1. Calibration (Resis Vs. Temp.) 2. Insulation Resistance 3. Thermal Response time	CR MA CR	Measurement Electrical Measurement	100% 100% One Sample from each type	IS:2848 IS:2848 IS:2848	IS:2848 IS:2848 IS:2848	Test Report Test Report Test Certificate	2 2 2	2 1 1	1 --- ---			
2.3	Type Test	Enclosure protection test	CR	Verification	Each type	Approved drg. / data sheet	Approved drg. / data sheet	Test Certificate	3/2	----	1*		*Type Test Certificate (not more than 5 year old) to be verified	
3.0	Packing	Soundness of packing	MA	Visual	100%	Mfd std.	Mfd std.	Inspection Report	3/2	2	---		Visual	

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STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	1 OF 7

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	

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
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



STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	2 OF 7

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. 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
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RT- Radiographic Test
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[§] P - Agency Performing the Test.
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STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	3 OF 7

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	
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



STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: **PE-QP-999-145-I 006**

VOLUME IIB

SECTION D

REV. NO. 06 DATE: 05.09.2013

SHEET 4 OF 7

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.

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STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	5 OF 7

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	

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RT- Radiographic Test
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STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)

QUALITY PLAN NO.: PE-QP-999-145-I 006	
VOLUME	IIB
SECTION	D
REV. NO.	06
DATE:	05.09.2013
SHEET	6 OF 7

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. Hysterisis	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. Hysterisis	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


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 PEM :: C&I	STANDARD QUALITY PLAN FOR CONTROL VALVE (PNEUMATIC)							QUALITY PLAN NO.: PE-QP-999-145-I 006				
								VOLUME	IIB			
								SECTION	D			
								REV. NO.	06	DATE: 05.09.2013		
								SHEET	7	OF 7		
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 MA - Major characteristics MI - Minor characteristics	RT- Radiographic Test UT – Ultrasonic Test	PT – Dye penetrant Test MT- Magnetic Test	^{\$} 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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TITLE
**STANDARD TECHNICAL SPECIFICATION FOR
FO SYSTEM**

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

VOLUME III

SECTION

REV 00

DATE : 10.08.2014

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

VOL-III

(TECHNICAL SCHEDULES)



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

DEVIATION SHEET (COST OF WITHDRAWAL)



PROJECT:- 2x500MW NNTPP, NEYVELI

PACKAGE:- FUEL OIL UNLOADING AND STORAGE SYSTEM

TENDER ENQUIRY REFERENCE:-

NAME OF VENDOR:-

SL NO	VOULME/ SECTION	PAGE NO.	CLAUSE NO.	TECHNICAL SPECIFICATION/ TENDER DOCUMENT	COMPLETE DESCRIPTION OF DEVIATION	COST OF WITHDRAWAL OF DEVIATION	REFERENCE OF PRICE SCHEDULE ON WHICH COST OF WITHDRAWAL OF DEVIATION IS APPLICABLE	NATURE OF COST OF WITHDRAWAL OF DEVIATION (POSITIVE/ NEGATIVE)	REASON FOR QUOTING DEVIATION
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TECHNICAL DEVIATIONS

COMMERCIAL DEVIATIONS

PARTICULARS OF BIDDERS/ AUTHORISED REPRESENTATIVE

NAME	DESIGNATIONS	SIGN & DATE

NOTES:

- 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.
- For directly dispatchable items, cost of withdrawal of deviation will be applicable on the basic price including taxes, duties & freight.
- All the bidders have to list out all their Technical & Commercial Deviations (if any) in detail in the above format.
- Any deviation not mentioned above and shown separately or found hidden in offer, will not be taken cognizance of.
- 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.
- Bidder shall furnish price copy of above format along with price bid.
- The final decision of acceptance/ rejection of the deviations quoted by the bidder shall be at discretion of the Purchaser.
- Bidders to note that any deviation (technical/commercial) not listed in above and asked after Part-I opening shall not be considered.
- 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.
- Any deviation mentioned in priced copy of this format, but not mentioned in the un-priced copy, shall not be accepted.
- 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.
- 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.
- In case nature of cost of withdrawal (positive/negative) is not specified it shall be assumed as positive.
- In case of discrepancy in the nature of impact (positive/ negative), positive will be considered for evaluation and negative for ordering.



TITLE:

**TECHNICAL SPECIFICATION
2X500MW NNTPP, NEYVELI
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPEC. NO.: PE-TS-400-166-A001

VOLUME: III

SECTION:

REV. NO. 0 DATE

SHEET 1 OF 2

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', if applicable, 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 shall be within the contracted price with no extra implications to BHEL after award of the contract.
- d) All drawings/ data-sheets/ calculations etc. submitted along with the offer shall be considered for reference only, same shall be subject to BHEL/ CUSTOMER approval in the event of order.
- 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 as applicable, 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. This clause will apply in case during site 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.



TITLE:
**TECHNICAL SPECIFICATION
2X500MW NNTPP, NEYVELI
COMPLIANCE CUM CONFIRMATION
CERTIFICATE**

SPEC. NO.: PE-TS-400-166-A001

VOLUME: III

SECTION:

REV. NO. 0 DATE

SHEET 2 OF 2

- 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.

SIGNATURE: _____

NAME : _____

DESIGNATION: _____

COMPANY: _____

DATE: _____

COMPANY SEAL

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

(DRAWINGS)



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

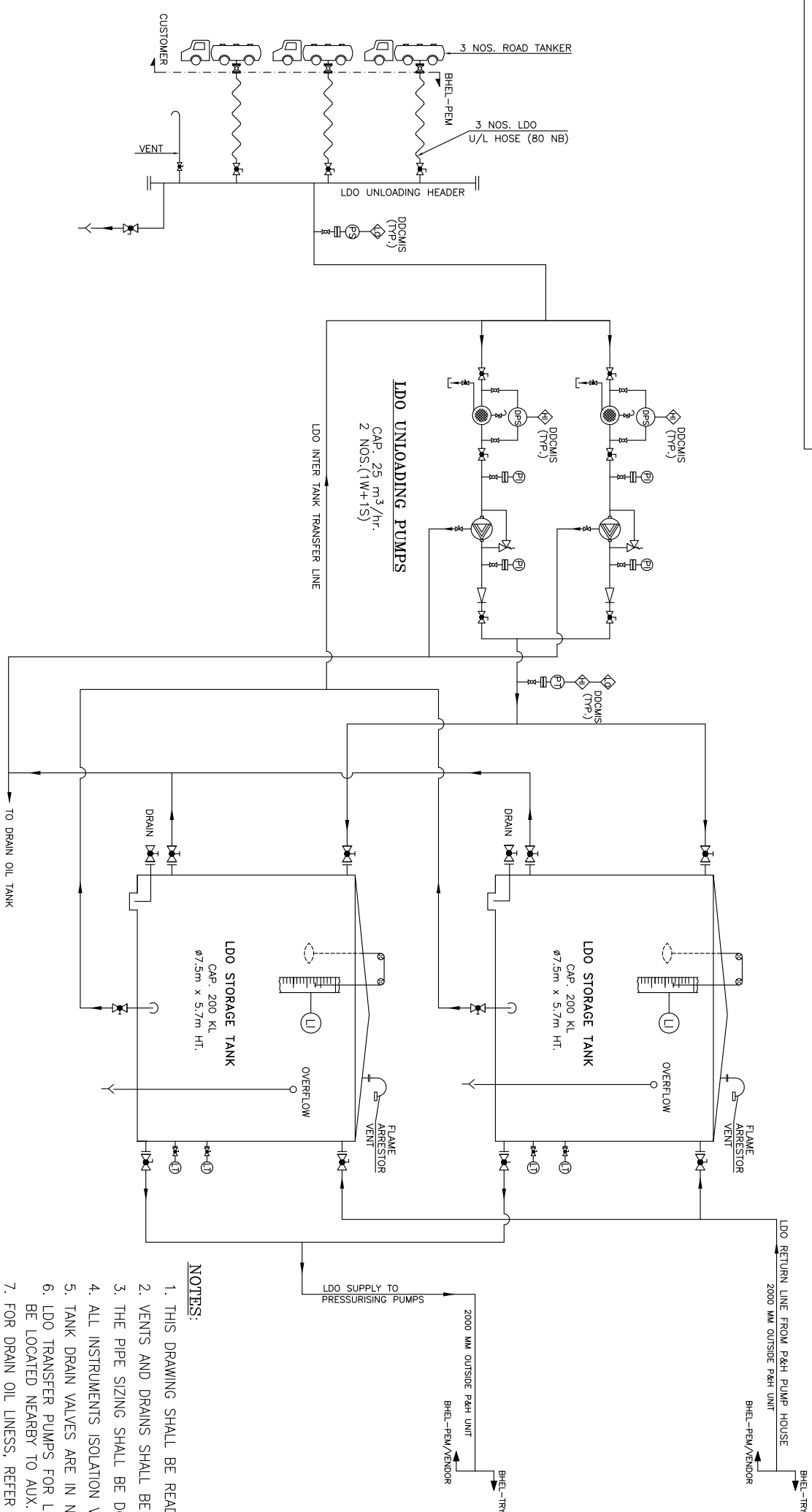
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it must not be used directly or indirectly in any way detrimental to the interest of the company.

DRAWING NO. PE-DG-400

PRODUCED BY AN AUTODESK EDUCATIONAL PRODUCT

FIRST ANGLE PROJECTION

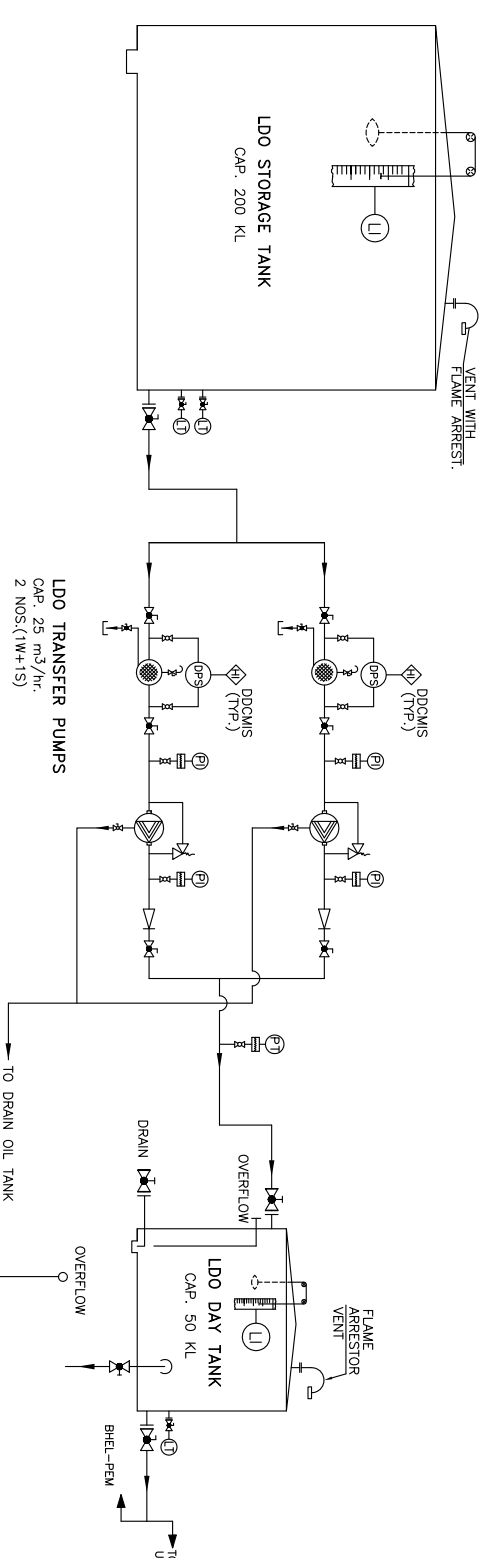
ALL DIMENSIONS ARE IN MM



- NOTES:**
1. THIS DRAWING SHALL BE READ IN CONJUNCTION WITH OTHER TENDER DRGS & TECH SPECS.
 2. VENTS AND DRAINS SHALL BE PROVIDED AT THE HIGHEST AND LOWEST POINTS RESPECTIVELY.
 3. THE PIPE SIZING SHALL BE DONE DURING DETAIL ENGINEERING.
 4. ALL INSTRUMENTS ISOLATION VALVES SHALL BE GLOBE VALVE.
 5. TANK DRAIN VALVES ARE IN NORMALLY CLOSE CONDITION.
 6. LDO TRANSFER PUMPS FOR LDO DAY TANK SHALL BE LOCATED INSIDE U/L P/H AND DAY TANK SHALL BE LOCATED NEARBY TO AUX. BOILER. PIPING AFTER DAY TANK SHALL BE DONE BY BHEL-PC/TRY.
 7. FOR DRAIN OIL LINESS, REFER P & ID NO. PE-DG-400-166-A101.

LEGEND	
DIAMETER SYMBOL	DESCRIPTION
PI	PRESSURE INDICATOR
PT	PRESSURE TRANSMITTER
DP	DIFFERENTIAL PRESSURE SWITCH
LI	LEVEL TRANSMITTER
LI	LEVEL INDICATOR
SI	SIMPLEX STRAINER
GI	GATE VALVE
RV	RELIEF VALVE
NRV	NON RETURN VALVE
HOSE	HOSE
LD	LOCAL DRAIN
DI	SIGNAL TO DCS(LO OR HI)

FLOW DIAGRAM FOR LDO DAY TANK SYSTEM



JDB NO.	400
STATUS	CONTRACT
DISTRIBUTION	
NO. OF	ALTD
REV.	DATE
	CHD
	APPD

CUSTOMER		NEVELL LIGNITE CORPORATION LIMITED (NLC LTD)	
CONSULTANT		M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD	
PACKAGE: STEAM GENERATOR AND AUXILIARIES (NTAI)			
NEVELL NEW THERMAL POWER PROJECT (NNTPP) 2X500 MW LIGNITE FIRED UNITS AT NEVELL			
BHARAT HEAVY ELECTRICALS LTD BOILER PLANT UNIT TRUCHIRAPALLI-620014			
DRPT	NAME	SIGN	DATE
DOB	PK	Sd/-	01.05.14
DNSN	PK	Sd/-	01.05.14
CHD	SS	Sd/-	01.05.14
APPD	PK	Sd/-	01.05.14

TITLE PROCESS & INSTRUMENTATION DIAGRAM FOR LDO SYSTEM			
DRPT	SCALE	DRPT	SCALE
SIGN		SIGN	
DATE		DATE	
DRAWING No.		PE-DG-400-166-A102	
SHEET 01 OF 01		REV 00	
FORMAT SIZE A3			

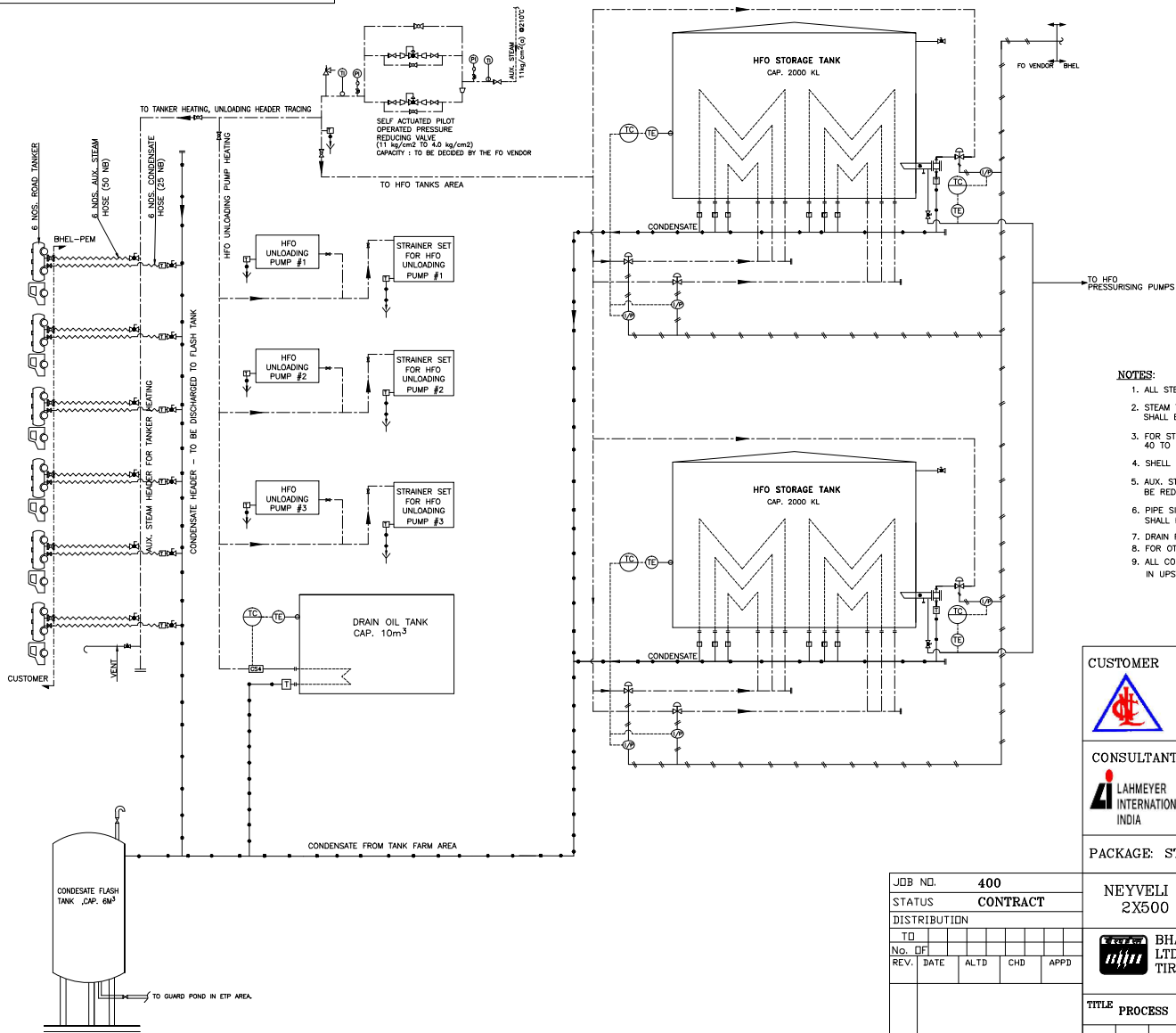
FIRST ANGLE PROJECTION

ALL DIMENSIONS ARE IN MM

DRAWING NO. PE-DG-400-166-A103

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FILE NAME : 100_M026R0



LEGEND	
SYMBOL	DESCRIPTION
TC	TEMPERATURE CONTROLLER
TE	TEMPERATURE ELEMENT
TS	STEAM TRAP
PLUG	PLUG / BALL VALVE
GV	GATE VALVE
PCV	PNEUMATICALLY OPERATED CONTROL VALVE
HOSE	HOSE
CH	COIL HEATER
LD	LOCAL DRAIN
ES	ELECTRICAL SIGNAL
CL	CONDENSATE LINE
IAL	INSTRUMENT AIR LINE
ASL	AUX. STEAM LINE
IC	1/P CONVERTER

NOTES:

1. ALL STEAM/CONDENSATE LINES SHALL BE INSULATED.
2. STEAM TRAPS FOR SUCTION HEATER & FLOOR COIL HEATER OF STORAGE TANKS SHALL BE OF IS TYPE. ALL OTHER STEAM TRAPS SHALL BE OF TD TYPE.
3. FOR STEAM LINES & TRACER LINES, TRAPS SHALL BE PROVIDED AT EVERY 40 TO 45 MTR.
4. SHELL SURFACE OF F.O. STORAGE TANKS & ENTIRE DRAIN OIL TANK ARE INSULATED.
5. AUX. STEAM WILL BE SUPPLIED TO AT 11KG/SQ. CM (g) & 210 °C. FURTHER IT SHALL BE REDUCED TO 4KG/SQ. CM (g) OR AS PER SYSTEM REQUIREMENT.
6. PIPE SIZES FOR ALL STEAM LINES, TRACER LINES, CONTROL STATIONS, CONDENSATE LINES ETC. SHALL BE PROVIDED AS PER APPROVED CALCULATION.
7. DRAIN FROM FLASH TANK SHALL BE DISCHARGED TO GUARD POND IN ETP AREA.
8. FOR OTHER DETAILS, REFER P & ID FOR HFO SYSTEM, PE-DG-400-166-A101.
9. ALL CONTROL VALVES SHALL BE PROVIDED WITH ISOLATION VALVES AND WITH A DRAIN VALVE IN UPSTREAM AND DOWNSTREAM.

 CUSTOMER	NEYVELI LIGNITE CORPORATION LIMITED (NLCL LTD)
 CONSULTANT	M/s LAHMEYER INTERNATIONAL (INDIA) PVT LTD

PACKAGE: STEAM GENERATOR AND AUXILIARIES (NTA1)

JOB NO.	400	NEYVELI NEW THERMAL POWER PROJECT (NNTPP) 2X500 MW LIGNITE FIRED UNITS AT NEYVELI
STATUS	CONTRACT	
DISTRIBUTION		
TO		
No. OF		
REV.	DATE	ALTD CHD APPD

 BHARAT HEAVY ELECTRICALS LTD BOILER PLANT UNIT TIRUCHIRAPALLI-620014	DEPT. CODE	NAME	SIGN	DATE
	DRN	PK	Sd/-	01.05.14
	DRSN	PK	Sd/-	01.05.14
	CHD	SR	Sd/-	01.05.14
	APPD	PK	Sd/-	01.05.14

TITLE			
PROCESS & INSTRUMENTATION DIAGRAM FOR STEAM & CONDENSATE SYSTEM			
DEPT.	SCALE	DRAWING No.	
SIGN		PE-DG-400-166-A103	
DATE		SHEET	01 OF 01
		REV	00

FORMAT SIZE A3

2X500MW LIGNITE FIRED UNITS AT NEYVELI

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

(UNPRICED PRICE SCHEDULE)



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

SCHEDULE-1									
2 X 500 MW NNTPP, NEYVELI- FUEL OIL UNLOADING & STORAGE SYSTEM									
SUGGESTIVE PRICE FORMAT (MAIN PRICE)									
S.No	Details of Works or Equipment/System	Qty (Nos)	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	10=4+5+6+7+8+9
1.0	<u>Lumpsum prices</u>								
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-400-166-A001 .	LOT						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/demonstration 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-400-166-A001 .	LOT	NA						
1.3.0	Total (1.1.0 +1.2.0)								
	Notes:								
a)	<i>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 tehcnical specification.</i>								
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)	In case, total (FOR site supply price) indicated at S.N.1.1.0 above does not match with the total of item wise break-up of S.N.1.4 of SCHEDULE-2 , the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.								
e)	Bidder shall furnish the price of all items as indicated in the price SCHEDULE 1,2 & 3 . Bidder's offer shall liable to be rejected in case bidder does not furnish the same. For SCHEDULE-2 , pls refer next page.								
f)	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										
2 X 500 MW NNTPP, NEYVELI- FUEL OIL UNLOADING & STORAGE SYSTEM										
SUGGESTIVE PRICE FORMAT (SUPPLY BREA-UP)										
S.No	Details of Works or Equipment/System	Unit Ex-works price	Unit	Qty (Nos)	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)	Items price %age w.r.t total supply price
1	2	3	4	5	6	7	8	9	10=6+7+8+9	
1.4	<u>Break - up of Total (for site supply price) given at S.N 1.1.0 of SCHEDULE-1</u>									
1.4.1	Lump sum price for HFO Tanks (cap. 2000 cum) with all accessories including steel plates, structural steel, pipe nozzles, fittings, flanges etc.		Nos	2						28 - 32
1.4.2	Lump sum price for LDO Tanks (cap. 200 cum) with all accessories including steel plates, structural steel, pipe nozzles, fittings, flanges etc.		Nos	2						3 - 4
1.4.3	Lump sum price for Drain oil tank (cap. 10 cum) with all accessories including steel plates, structural steel, pipe nozzles, fittings, flanges etc.		Nos	1						1 - 1.5
1.4.4	Lump sum price for Condensate flash tank (cap. 6 cum) with all accessories including steel plates, structural steel, pipe nozzles, fittings, flanges etc.		Nos	1						1 - 1.5
1.4.5	Lump sum price for LDO day tank (cap. 50 cum) with all accessories including steel plates, structural steel, pipe nozzles, fittings, flanges etc.		Nos	1						2 -2.5
1.4.6	Lump sum price for HFO & LDO flexible metalic/ neoprene unloading hoses with all accessories		Nos	9						less than 1
1.4.7	Lump sum price for Steam & condensate hoses with all accessories		Nos	12						

1.4.8	Lump sum price for HFO & LDO Pipe & Fittings (excluding insulation & cladding)									
1.4.8.1	CS PIPE & FITTINGS : 15 NB		LOT	1						20 - 25
1.4.8.2	CS PIPE & FITTINGS : 25 NB		LOT	1						
1.4.8.3	CS PIPE & FITTINGS : 40 NB		LOT	1						
1.4.8.4	CS PIPE & FITTINGS : 50 NB		LOT	1						
1.4.8.5	CS PIPE & FITTINGS : 80 NB		LOT	1						
1.4.8.6	CS PIPE & FITTINGS : 100 NB		LOT	1						
1.4.8.7	CS PIPE & FITTINGS : 150 NB		LOT	1						
1.4.8.8	CS PIPE & FITTINGS : 200 NB		LOT	1						
1.4.8.9	CS PIPE & FITTINGS : 250 NB		LOT	1						
1.4.8.10	Any other items required		LOT	1						
1.4.9	Lump sum price for Steam & Condensate Pipe & Fittings									
1.4.9.1	CS PIPE & FITTINGS : 15 NB		LOT	1						10 - 15
1.4.9.2	CS PIPE & FITTINGS : 25 NB		LOT	1						
1.4.9.3	CS PIPE & FITTINGS : 40 NB		LOT	1						
1.4.9.4	CS PIPE & FITTINGS : 50 NB		LOT	1						
1.4.9.5	CS PIPE & FITTINGS : 80 NB		LOT	1						
1.4.9.6	CS PIPE & FITTINGS : 100 NB		LOT	1						
1.4.9.7	CS PIPE & FITTINGS : 150 NB		LOT	1						
1.4.9.8	CS PIPE & FITTINGS : 200 NB		LOT	1						
1.4.9.9	Any other items required		LOT	1						
1.4.10	Lump sum price for Air, oily water & others types of pipes & fittings Fittings		LOT	1						less than 1

1.4.11	Lump sum price for Valves (Ball / Plug / Gate / check / Globe / others) in HFO & LDO line									
1.4.11.1	Size-15 NB		LOT	1						6 - 8
1.4.11.2	Size-25 NB		LOT	1						
1.4.11.3	Size-40 NB		LOT	1						
1.4.11.4	Size-50 NB		LOT	1						
1.4.11.5	Size-80 NB		LOT	1						
1.4.11.6	Size-100 NB		LOT	1						
1.4.11.7	Size-150 NB		LOT	1						
1.4.11.8	Size-200 NB		LOT	1						
1.4.11.9	Size-250 NB		LOT	1						
1.4.11.10	Size-300 NB		LOT	1						
1.4.11.11	Any other size		LOT	1						
1.4.12	Lump sum price for Valves (Gate / check / Globe / others) in steam & condensate line									
1.4.12.1	Size-15 NB		LOT	1						4 - 5
1.4.12.2	Size-20 NB		LOT	1						
1.4.12.3	Size-25 NB		LOT	1						
1.4.12.4	Size-40 NB		LOT	1						
1.4.12.5	Size-50 NB		LOT	1						
1.4.12.6	Size-80 NB		LOT	1						
1.4.12.7	Size-100 NB		LOT	1						
1.4.12.8	Size-150 NB		LOT	1						
1.4.12.9	Size-200 NB		LOT	1						
1.4.12.10	Any other size		LOT	1						
1.4.13	Lump sum price for Valves in Water line		LOT	1						less than 1.5
1.4.14	Lump sum price for Valves in Air line		LOT	1						less than 2
1.4.15	Lump sum price for Steam Trap		LOT	1						less than 2
1.4.16	Lump sum price for HFO unloading Pumps (cap. 25 cum/hr)		Nos	3						less than 2
1.4.17	Lump sum price for HFO unloading Pump motors		Nos	3						
1.4.18	Lump sum price for HFO unloading Pump Strainers		Nos	3						

1.4.37	Total price for special tools & tackles for maintenance		LOT	1						less than 1
1.4.38	Total price for startup and commissioning.		LOT	1						less than 1
1.4.39	Total price for Mandatory spares as per SCHEDULE-3		LOT	1						less than 1
	Total of 1.4 (sum of 1.4.1 to 1.4.39)									

Notes:

- a) Total (for site supply price) of mandatory spares indicated at **S.N.1.4.39 above** shall match with the total of item wise break-up of **S.N.1.5 of SCHEDULE-3**.
- b) In case, total (for site supply price) indicated at **S.N.1.4.39 above** does not match with the total of item wise break-up of **S.N.1.5 of SCHEDULE-3**, the highest price so calculated shall be considered for evaluation but in case of order, the same shall be placed at the lowest price.
- c) Items price %age w.r.t total FOR SITE supply price is indicated under last column of **each row from 1.4.1 to 1.4.39**. Bidder to strictly fill the prices of each item under column no.10 as per indicated percentage only.

SCHEDULE-3									
2 X 500 MW NNTPP, NEYVELI- FUEL OIL UNLOADING & STORAGE SYSTEM									
SUGGESTIVE PRICE FORMAT (MANDATORY SPARES)									
S.No	Details of Works or Equipment/System	Unit Ex-works price	Unit	Qty (Nos)	Total ex-works Price	ED	CST /VAT	FREIGHT	TOTAL (For site price)
1	2	3	4	5	6	7	8	9	10=6+7+8+9
1.5	<u>Break - up of Total (for site supply price) given at S.N 1.4.39 of SCHEDULE-2</u>								
1.5.1	HFO pump suction filter-Gasket		sets*	3					
1.5.2	HFO u/l Pump								
1.5.2.1	Rotor assembly complete (cartridge)		Nos	2					
1.5.2.2	Bearings		sets	2					
1.5.2.3	Relief valve spring		Nos of each type	2					
1.5.2.4	Coupling inserts		Nos	2					
1.5.2.5	Motor of each type		Nos	1					
	Total (sum of 1.5.1 +1.5.2.1 to 1.5.2.5)								

Notes:

- a) * - One (1) set means total numbers as required for one complete replacement for one equipment.